HABITAT CONSERVATION PLAN for the NORTHERN SPOTTED OWL

ON TIMBERLANDS OWNED BY THE MURRAY PACIFIC CORPORATION LEWIS COUNTY, WASHINGTON

HABITAT CONSERVATION PLAN

for the

NORTHERN SPOTTED OWL

(*Strix occidentalis caurina*)

ON TIMBERLANDS OWNED BY

THE MURRAY PACIFIC CORPORATION

LEWIS COUNTY, WASHINGTON

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Purpose

For one hundred years, Murray Pacific Corporation proposes to commit 54,610 acres in the Mineral Block of Lewis County, Washington to the requirements of a Habitat Conservation Plan in support of an incidental take permit for the northern spotted owl. The permit will be issued by the U.S. Fish and Wildlife Service (USFWS) under the provisions of the Endangered Species Act.

Current Property Status and Plan Objectives

There is currently insufficient habitat to support breeding on this second growth forest due to historical logging practices typical of the region. Notwithstanding its present condition, the ownership can be managed in the future so as to develop and sustain dispersal habitat in an ideal location, while allowing Murray to continue as a viable enterprise.

The Mineral Block was found to be "of particular importance for contributions from non-federal lands," in the federal Draft Recovery Plan. For the next century, the forestry management practices of Murray will include the development and maintenance of dispersal habitat, an important element of spotted owl recovery identified by the Recovery Team. According to the federal Draft Recovery Plan, dispersal habitat is a significant objective in this geographic area. This HCP, throughout its life, will cause the restoration and maintenance of dispersal habitat and likely enhance recovery of the species.

Dispersal habitat is particularly desirable at this location in the Mineral Block. The Murray ownership is centrally located between three Designated Conservation Areas established by the federal Recovery Team. Under the requirements of the plan, this private ownership will be dedicated and managed so as to provide protection for spotted owls as they move across the property to established breeding areas on these adjacent federal lands.

Although three owls have been detected on the property in the past, and a fourth may be present, spotted owl reproduction has not been found in any of the biological surveys conducted over three consecutive years. Any "taking" under the incidental permit will be negligible because what possible habitat remains occurs only in small, isolated stands where reproduction is unlikely. Within 1.8 miles of the two owl activity centers found on the property, there now exists from 19 to 32 percent suitable habitat where 40 percent is considered to be the minimum for reproduction. In addition, one of the two activity centers lies in the middle of the Murray ownership, distant from any suitable habitat on federal land that could link it to future owl populations.

Mitigation

In contrast to the present situation, and in mitigation of any possible adverse effects from an incidental take, timber management under this HCP will provide much needed connectivity among the three Designated Conservation Areas, thereby promoting viable nesting owl populations in those Designated Conservation Areas both during and after recovery. Without dedication of this property to dispersal habitat, juvenile owls would be required to cover distances of 11 to 19 miles to reach the Designated Conservation Areas. Previous studies have determined that dispersal across a barren landscape for a distance of 12 miles substantially diminishes the likelihood of survival. By virtue of its location, the Murray property subject to this HCP will facilitate maintenance of the known breeding populations through juvenile dispersal until the Designated Conservation Areas can reach their target habitat and population levels, and thereafter.

Among the factors involved in mitigation and in promoting the growth and maintenance of the dispersal habitat are the following changes in timber management practices by Murray (Table ES-1). The size and timing of harvests will at all times conform to detailed HCP requirements for improving dispersal habitat. The size and location of harvest areas and the timing of harvests will avoid the creation of large areas of very young forest where dispersal would be unsafe. Significant gaps between protected areas will be reduced and eventually eliminated. Reforestation and other silvicultural activities will be accelerated, seeking to reduce the time during which dispersal is risky across young second growth stands. Structural

Table ES-1. Measures to be implemented for spotted owls under the Murray HCP.

- Known spotted owl activity centers and other areas likely to support nesting will be monitored annually and nests will be protected from disturbance (i.e., road building or timber harvest) from 1 March through 30 September in years of active reproduction;
- A minimum of 1,222 acres of the ownership will be permanently protected from future harvest and retained as mature forest habitat as shown in Figure 2-2 (State Forest Practices Rules and Regulations do not require full protection of these areas);
- No more than 20 percent (10,000) acres of the commercial timberland on the ownership will be clearcut harvested in any 10-year period and no more than 5 percent (2,500 acres) will be harvested in any 1 year (actual harvest rates may be considerably less in many years);
- Clearcut harvest size will range from 5 acres to 120 acres and average 40 acres over any 10-year period;
- A minimum of two residual live trees from the dominant or codominant size classes and three snags will be retained for every acre of clearcut harvest (as required by State Forest Practices Rules and Regulations);
- A minimum of two logs measuring at least 12 inches in diameter and 20 feet in length will be left for each acre of clearcut harvest (as required by State Forest Practices Rules and Regulations);
- All clearcut sites will be replanted with native coniferous seedlings within 2 years of harvest (consistent with standard forest practices in the region);
- Precommercial thinning will be conducted on approximately 5,000 acres currently in need of stocking control, and any future stands with similarly high densities of trees, to accelerate stand development and individual tree size to facilitate owl use;
- Fertilization will be tested as a means of accelerating stand development at the seedling/sapling stage, and up to 1,000 acres will be fertilized annually during the life of the HCP if results are positive;
- Pruning will be tested as a means of accelerating the development of dispersal habitat by pruning 1,000 acres between 1993 and 1998 and monitoring results;
- Total acreages of dispersal habitat and gap on the ownership will improve as shown in Figure 2-6 by 2043, and will remain at approximately those levels through 2093;
- The Dispersal Landscape Index (DLI) for the ownership will increase to 7.47 by 2043 as shown in Figure 2-10, and remain at or above that level through 2093;
- All areas of the ownership greater than 1/2 mile from a stand of dispersal habitat (i.e., areas with DHVs of 1 or 0) will be eliminated by 2043 and
- The total area of the ownership lying 1/4 to 1/2 mile from the nearest stand of dispersal habitat (i.e., areas with a DHV of 3) will be reduced to 1,000 acres or less by 2043.

components of the forest which support owl prey will be retained during harvest activities. Progress toward development of dispersal habitat across the ownership will be monitored at regular intervals. The ability of Murray to respond to market forces in its industry will be restricted by the timing and harvest levels dictated in the HCP and the attendant costs will be substantial.

Should management for dispersal habitat as proposed in the HCP not occur, and should Murray continue normal operations under the current regime of "owl circles," the consequences for the species will be significantly less desirable. Owls will have little chance of survival as they attempt dispersal across broad spaces of unprotected landscape seeking to reach suitable breeding areas. The slight protection from predation now available and the marginal forage in such areas will soon be gone. Under the current operating regime and without this HCP, any remaining but marginally suitable habitat in the limited amount of late successional forest outside existing owl circles will disappear in about ten years.

In contrast, to have 54,610 acres of continually managed dispersal habitat located between the immediately adjacent Designated Conservation Areas and, more broadly, between the Olympic and Cascade mountain ranges, and to have this habitat assured for the next 100 years, will contribute to recovery of the species and is a vastly more desirable approach.

Dispersal Habitat

Dispersal habitat for spotted owls will be provided by managing the number of trees, tree size, rotation periods and spacing of the forest stands so as to provide roosting and foraging habitat. A thorough review of the scientific literature shows that managed timberlands will provide roosting and foraging habitat when stands have a minimum of 130 coniferous trees per acre with a minimum diameter at breast height (dbh) of 10 inches and a minimum canopy closure of 70 percent. The size and spacing of stands is also important, so an average stand size of 40 acres and a maximum distance between stands of 1/4 mile will be maintained. The total area of dispersal stands will increase steadily to 42 percent of the ownership (23,233 acres) by 2043 and range between 38 percent and 42 percent of the ownership from 2043 to 2093. Murray will also maintain important habitat features like snags and logs to support the prey of the spotted owl.

Thomas Model

Murray's dispersal habitat model is similar to one developed in the Thomas Report and adopted in the Draft Recovery Plan. The Thomas model, referred to as "50-11-40," prescribes the percentage of the landscape that should be suitable for roosting and foraging (50%), the minimum average dbh of dispersal stands (11 inches) and the minimum canopy closure of dispersal stands (40%). The Thomas model is based on a stand condition known to meet or exceed the minimum requirements of adult spotted owls in Oregon and on the average percentage of habitat expected to be present on federal lands. The Thomas model did not focus on the specific requirements of dispersing owls.

Murray Pacific Model

The Murray model avoids the use of average dbh when describing dispersal habitat because average dbh tells little about the range and distribution of tree sizes in a stand. By stating tree size in the form of a minimum number (130 per acre) at a minimum size (10 inches dbh), the Murray model ensures that an adequate component of large dominant trees will be present. This same component of trees is not guaranteed in stands having an average dbh of 11 inches. The objectives of the Murray model and the Thomas model are the same; the Murray model is simply more specific.

Model Comparisons

The Murray model states a minimum canopy closure of 70 percent. A second growth stand with less than 70 percent canopy closure would not likely be suitable for spotted owls. Under 40 percent canopy closure, foraging is inhibited because dominant tree limbs reach nearly to the ground and the understory vegetation is too dense. The Thomas Committee chose 40 percent as a general value to be used across the full range of the spotted owl, including drier forests in eastern Washington and the Klamath Province. It is not an appropriate minimum for western Washington.

The Thomas Committee chose 50 percent as the landscape value, a value which was believed to be available on managed federal lands, and allowed for spacing between stands of up to 1.5 miles or more. The Murray model directly addresses the critical components of stand size and spacing, and indirectly derives its landscape value. This is a more logical and defensible approach. The Murray model will result in a landscape value of 38 to 42 percent compared to the Thomas model value of 50 percent. This difference is negligible (approximately 3,310 acres), particularly when given the significant improvement in stand spacing.

Fifty-Year Projections

The HCP sets forth computer projections for the development and maintenance of dispersal habitat, and provides cost estimates, for the first 50 years of operation under the plan. This time period was selected as being reasonably credible for the forestry and economic projections involved, without engaging in undue speculation. The dispersal habitat objective of the HCP should be achieved across the entire landscape in 30 years after issuance of the permit; thereafter the dispersal habitat will continue to improve and will be maintained for the remaining life of the 100-year term. Monitoring for verification and validation of the computer projections will continue for the duration of the HCP and the permit.

Marbled Murrelets

Marbled murrelets have been detected by their calls on the Murray ownership, but none have been seen and none are known to be occupying Murray lands. This HCP and permit do not deal with marbled murrelets. Murray is now and will continue to survey and take other appropriate steps necessary to avoid take of marbled murrelets, if any occupy the property. The current plan and permit must be amended, or a new HCP and incidental take permit obtained, if murrelets are found occupying the property and if implementing this HCP for the spotted owl risks a "taking" of murrelets.

Unforeseen Circumstances

The HCP provides for comprehensive, periodic reports and regular review by the USFWS, anticipating refinements and revisions. Amendments in response to calamities or unforeseen events can be made with the agreement of the USFWS and Murray in accordance with the original objective of the plan and applicable regulations.

Costs and Funding

To implement the silvicultural activities anticipated in the HCP, it will require an estimated $6,462,500 over the first 50 years. Administration costs due to the HCP for the first 50 years, including the cost of creating the plan, will be approximately $10,000,000. The opportunity cost of implementing the plan cannot be estimated with reasonable accuracy at this time; the opportunity cost of the plan will be very significant. While these costs are necessarily estimates, they are based on operating factors affecting Murray and on standard ranges for the industry; the estimates have been studied and found workable by the management of Murray, a company with 82 years of successful experience growing and harvesting trees.

Funding for these activities will be derived from ongoing timber operations by Murray in accordance with the HCP and from no other source. Murray projects that net annual earnings above and beyond the costs for timber operations will be approximately $4,000,000.00. The program is "fail safe" with respect to the HCP costs involved, because the property itself will be encumbered by the requirements of the HCP as a covenant running with the land. Should Murray fail, the trees will continue to grow and provide dispersal habitat. Should another owner acquire the property, the same HCP and permit requirements will continue in effect as to that owner.

OVERVIEW

OVERVIEW

Murray Pacific Corporation (Murray) is applying for a permit from the U.S. Fish and Wildlife Service (USFWS) for the incidental take of northern spotted owls (*Strix occidentalis caurina*) on its 54,610-acre ownership in the Mineral Block in eastern Lewis County, Washington. The proposed permit will allow incidental take resulting from the harvest of timber within the home ranges of spotted owls. To minimize and mitigate the impacts of this habitat modification, Murray will initiate a three-part Habitat Conservation Plan (HCP).

In the following pages, the regulatory background and major components of Murray's HCP are reviewed. The product of consultation with state, federal and consulting biologists, the HCP consists of the following measures: a) seasonal protection of future active nest sites in known territories, b) maintenance of current habitat reserves (RMZs, etc.) and c) management of commercial forestlands to develop and maintain spotted owl dispersal habitat. These components, particularly the development and maintenance of dispersal habitat, will meet or complement the management goals for the area established by the Interagency Scientific Committee to Address the Conservation of the Northern Spotted Owl (ISC) and the recovery goals identified by the federal Spotted Owl Recovery Team.

Regulatory Background

The Federal Endangered Species Act of 1973 (ESA), as amended, created for the purpose of preserving threatened and endangered plants and animals, prohibits the "taking" of listed wildlife species. Taking is defined as any action that would cause the harassment, harming, pursuit, hunting, shooting, wounding, killing, entrapment, capture or collection of a listed species. Encompassed within this definition is the destruction or alteration of habitat essential to the basic behavioral or survival functions of a species. Exceptions to the take prohibition can be made under Section 10(a)(1)(B) of the ESA, which provides for applications for an "incidental take" permit. Approval of such a permit depends on the satisfaction of the following conditions: a) the proposed taking will be incidental to otherwise legal activity, b) the applicant will minimize and mitigate the impacts of taking to the maximum extent practicable, c) the applicant insures adequate funding for mitigation, monitoring and minimization measures, d) the taking is found to not appreciably reduce the likelihood of survival and recovery of the species and e) any other measures considered necessary or appropriate by the Secretary of the Interior.

The northern spotted owl was listed as threatened throughout its range in 1990. To formulate a strategy for the management of the species, an interagency scientific committee comprised of representatives from government agencies, the forest products industry and wildlife groups was established. The interagency plan, presented in 1990, was based largely on the management of spotted owl habitat on federal lands in geographic units known as Habitat Conservation Areas (HCAs). The plan recommends that lands between HCAs be managed to facilitate the successful dispersal of juvenile spotted owls between HCAs; this is the principal objective of this Habitat Conservation Plan.

In 1992, a federal Recovery Team for the northern spotted owl expanded on this strategy in its Draft Recovery Plan. Although the team identified a variety of threats to the spotted owl, declining habitat due to timber harvest was the only severe threat identified in the Cascade mountain range of western Washington, the area in which the Murray ownership is located. The team recommended that suitable resident habitat be preserved where feasible on non-federal lands in the Mineral Block in order to increase the reproductive capacity of nearby HCAs, and that interconnecting lands be managed to provide dispersal habitat between HCAs.

Description of the Plan Area

The Murray ownership is a mosaic of coniferous forest of varying ages located approximately 10 miles southwest of Mount Rainier National Park, in an area known as the Mineral Block. Because timber production represents the primary land use of non-federal lands in the area, nearly all of the ownership has been partially or completely harvested at least once. Approximately 4,678 acres of suitable spotted owl habitat (i.e., late successional or mature coniferous forest) currently exist in small stands sporadically located on Murray lands, comprising 8.6 percent of the ownership. According to 1991 and 1992 surveys, this habitat is occupied by three resident spotted owls and possibly by a fourth. The ownership, including the 4,678 acres of suitable habitat, contains a total of 11,412 acres (20.9 percent) of dispersal habitat suitable for foraging and roosting by juvenile owls.

In addition to the spotted owl, some 24 animal species listed as threatened, endangered or sensitive by state or federal agencies possibly could occur on the Murray ownership. Many of these species are extremely rare and unlikely to be present. Others, particularly birds found in mature and late successional forests, could exist on Murray lands. Among these are the marbled murrelet, the northern goshawk, the pileated woodpecker and Vaux's swift. Fifteen state-listed sensitive plant species also possibly could occur on the Murray ownership, although none have been observed.

The Habitat Conservation Plan

Approximately 42 percent of Murray's merchantable timber is within owl circles (i.e., within a radius of 1.8 miles of the activity centers of resident owls) and considered to be suitable habitat, even though none of the circles contains enough habitat to support reproduction. Additional harvest of suitable habitat in these circles would reduce the acreage of habitat even further below the minimum considered necessary to support spotted owls. Deferring harvest to protect owls, however, would significantly reduce if not eliminate Murray's operating income for the next 10 to 20 years; this is not a viable economic option for the company and would accomplish little for the owl. Murray explored the option of temporarily deferring the harvest of some of the suitable habitat to minimize the impacts to owls, but this alternative is financially unsound. In response to the dual concerns of spotted owls and economic survival, Murray has prepared this HCP in accordance with the permit requirements of the Endangered Species Act, 16 U.S.C. § 1539(a)(2). The HCP provides a framework for continued successful management of private commercial forestland, and thereby provides the resources and the techniques needed to complement recovery efforts and to help assure survival of the northern spotted owl.

This HCP is designed to minimize and mitigate the effects of the any incidental take. It consists of three main components. First, Murray will provide seasonal protection of any future spotted owl nest sites that may be found on its ownership. Although no such sites currently exist, Murray will continue monitoring stands on its ownership having the greatest potential for nesting and will implement protective measures around any active nests that are found. No harvest or alteration of suitable habitat will occur within 1/4 mile of an active nest site until after September 30 of the year any nest is active. Second, 1,222 acres of habitat reserves will be designated in accordance with Washington Forest Practices Rules and Regulations and protected from all future timber harvest (rather than subjected to partial harvest as allowed under the regulations). Third, the most important element of the HCP, management of the commercial timberlands throughout the Murray ownership will be directed to developing dispersal habitat for juvenile spotted owls. As a result, total dispersal habitat will more than double from an existing 11,412 acres to an estimated 23,233 acres (42 percent of the total area) by the year 2043 and average 23,000 acres from 2043 to 2093. At the same time, the wide gaps now present between stands of dispersal habitat (any areas more than 1/4 mile from dispersal stands) will be decreased from 26,556 acres to 8,720 acres. Dispersal habitat will be provided by continually managing the commercial forest stands in such a way that each stand will provide suitable roosting and foraging habitat for dispersing spotted owls for a portion of its rotation period (i.e., the period between the planting and harvesting of a stand). Silvicultural tools such as precommercial thinning, fertilization and pruning will be used where technically feasible in an effort to accelerate the development of dispersal habitat. Overall conditions for dispersal will improve steadily over the first 30 years of the HCP and will be sustained thereafter for the duration of the plan and permit. The accelerated rate of improvement, however, will be limited by natural rates of tree growth and stand development; it is not a fast process despite any human efforts. Management for dispersal habitat will complement an important recovery goal identified by the ISC and the Recovery Team, both of which concluded that the dispersal of juvenile spotted owls between HCAs is essential to the survival and recovery of the species.

Murray will manage its timberlands under the HCP and permit for 100 years (until the year 2093). Habitat conditions, spotted owl populations and other species of concern will be monitored for the life of the program. Validation of the HCP also will occur at specified intervals, through the monitoring of structural characteristics and prey populations. Reports on the progress of the HCP will be submitted to the USFWS at specified intervals, and amendments to the HCP will be made consistent with the Implementation Agreement.

Funding will come from revenues generated by the harvest and sale of commercial timber from the ownership in accordance with the requirements of the HCP. The greatest cost associated with the plan will be the opportunity costs like deferring harvests beyond their economic rotation age in order to create the desired distribution of habitats and like foregoing the ability to respond to market fluctuations due to the harvest levels dictated by the HCP requirements. These costs are expected to be significant throughout the life of the HCP and permit.

Effects of the Plan on Plants and Wildlife

Under the HCP and permit, Murray expects to resume timber harvest within the owl circles in 1993, rendering them insufficient to support resident spotted owls by 2003. Over time, harvest will continue until all commercial timber within the circles is eventually harvested and replanted with seedlings. The USFWS has indicated that, in the worst possible case, this harvesting may constitute a "take" of the three owls now on the ownership, as well as a possible "take" of other adults and their offspring on adjacent lands. The actual take, if any, is expected to be limited to the three owls on the ownership. To mitigate this possible effect, the entire commercial forest will be managed to create a landscape conducive to dispersal by juvenile spotted owls. Over the first 30 years of the HCP, the total area of dispersal stands will increase and the gaps between dispersal stands will decrease. These trends will signify an overall improvement in conditions conducive to juvenile spotted owl dispersal. These improvements will then be maintained for yet another 70 years.

The primary effect of the HCP on other wildlife species will be a change in the types and distribution of habitats on the Murray ownership over the next 100 years. The ownership will experience a decrease in the amount of seedling, large sawtimber, late successional, mixed and hardwood forest. Total areas of wetland, brush and rock habitat will remain the same. Those species of concern associated with aquatic, riparian and wetland habitats will be little affected by the HCP, since these habitats are protected by existing state and federal law and will be treated no differently under the HCP. Species associated with particular successional stages of coniferous forest will be affected by the change in the distribution of habitats. Some species, such as the pileated woodpecker, Vaux's swift and goshawk, reach highest densities in the remnant stands of mature and late successional forest which will be harvested under the HCP. While the total number of these birds would be lower under the HCP, none of these species is expected to be extirpated from the ownership. No taking of the marbled murrelet, which is known to occur in the vicinity of the Murray ownership, will not be allowed by this HCP. Approximately 1,039 acres of potential marbled murrelet habitat have been mapped by Murray and surveys will be conducted in the potential habitat prior to harvest to avoid the risk of any take.

Alternatives to the Proposed HCP

Two main alternative actions have been identified. Both alternatives involve curtailment of harvest in the owl circles for so long as owls occupy them. Long term occupancy is not likely given the condition of the habitat. Under the first alternative, consistent with now-rescinded USFWS guidelines, all existing suitable spotted owl habitat within 1.8 miles of each owl activity center would be protected until the circle is abandoned. The total area of dispersal habitat under this alternative would be 16,978 acres by 2043 compared to the 23,233 acres which will be generated under the HCP. Under the second alternative, 500 acres of suitable habitat within 0.5 mile of each activity center would be protected; this alternative is consistent with the memorandum issued on August 24, 1992 by the Assistant Secretary of the Interior for Fish, Wildlife and Parks. The total area of dispersal habitat under this alternative would be 15,310 acres by 2043 compared to the 23,233 acres which will be generated under the HCP. Neither of these alternatives was selected by Murray. The alternatives unnecessarily restrict harvest of 750 to 2,430 acres of commercial timber, and do nothing to assure the continued presence of owls on the ownership because of the small amount of suitable habitat currently available. Neither alternative is considered sound long-term management for either the owls or the commercial timber operations. The HCP and the alternatives are compared in Table 3-1 on Page 3-9 of this HCP.

Review of Criteria for Issuance of a Permit for Incidental Taking

The Endangered Species Act lists five criteria that must be met, after public comment, before the Secretary of the Interior may issue a permit for a taking incidental to otherwise lawful activities. Those criteria are listed and briefly discussed below.

Any taking will be incidental: The Murray ownership currently supports three known resident spotted owls, and possibly a fourth. Additional owls also exist on adjacent lands. The timber harvest proposed by Murray under this HCP will remove habitat available to those owls, and, in the opinion of the USFWS, may lead to a taking of the owls. All timber harvests proposed by Murray will comply with local, state and federal laws and regulations governing the management of forestlands, and as such, will constitute "lawful activities" contemplated in the ESA. If any taking occurs, it will be incidental to the otherwise lawful activity of harvesting timber and will not be the purpose or intent of harvesting the timber.

The HCP will, to the maximum extent practicable, minimize and mitigate the impacts of taking: The Murray HCP includes detailed prescriptive measures to minimize and mitigate the impact of any incidental taking. Any adverse impact will be minimized and mitigated by protecting any active nests during the breeding season, maintaining up to 1,222 acres of permanent roosting and foraging habitat, and managing the entire forest in a manner that promotes and maintains a landscape conducive to dispersal by juvenile spotted owls.

The applicant will ensure that adequate funding will be provided for the HCP: The cost of implementing the HCP must be absorbed as part of Murray's continued commercial operations and funded by the harvest and sale of timber. No additional or independent source of funding is relied upon but profits will be reduced to successfully implement the HCP. The principal costs which have been identified and projected for the first 50 years are silvicultural activities estimated at $6,462,500 and administration costs estimated at $10,000,000. In addition, opportunity costs will be substantial and will be caused by the inability of Murray or any successor to deviate from the restrictions imposed on harvest by the HCP. No responsible estimate of opportunity costs can be made at this time. At present, the company's "best guess" at the opportunity cost of this HCP ranges to more than $26,000,000 during the first 50 years of the HCP.

Funding to meet these costs is assured. Murray projects that net annual earnings above and beyond the costs for timber operations will be approximately $4,000,000.00. Not only does Murray Pacific have a long and successful history in the business, but the value of the land and forest stands as security for performance of the HCP obligations. If Murray Pacific should default on its obligations or fail as a company, the trees will continue to grow and the property will remain subject to the HCP as a covenant running with the land.

The taking will not appreciably reduce the likelihood of the survival and recovery of the northern spotted owl in the wild: This HCP basically deals with 54,610 acres of second growth forest in which three spotted owls live but do not breed; the plan seeks to support the continued viability of Murray Pacific Corporation as a private commercial timber company so that the resources are available and committed to timber management activities designed to help assure the long time survival of the northern spotted owl. The USFWS must find, after consultation, opportunity for public comment, and response, that the proposed take will not jeopardize the survival and recovery of the spotted owl as a species in the wild. By design, the HCP is consistent with the Conservation Strategy for the Northern Spotted Owl prepared by the ISC and with the Draft Recovery Plan for the Northern Spotted Owl prepared by the federal Recovery Team. Both the Conservation Strategy and the Recovery Plan identify the need for dispersal habitat in the Mineral Block. By creating and maintaining dispersal habitat across the Murray ownership, the use for which the property is best suited by both geography and condition, the HCP can help connect resident spotted owl populations on adjoining federal lands and, from a wider perspective, in the Cascade Mountains and Olympic Peninsula and contribute to the overall recovery of the species. The harvest of suitable habitat in two non-reproductive owl circles in the short-term will be more than offset by the long term commitment of the entire property to dispersal habitat, which is considered by the ISC and the Recovery Team to be a priority for the area.

The applicant will meet other measures required by the Secretary of the Interior as necessary or appropriate for the plan: In addition to the HCP, the USFWS as agent for the Secretary of the Interior, and Murray will execute an Implementation Agreement. No other measures have been identified as necessary or appropriate for issuance of the permit.

1.0 BACKGROUND INFORMATION

1.1 INTRODUCTION

The Murray Pacific Corporation (Murray) owns approximately 54,610 acres of primarily second-growth forestland in an area of eastern Lewis County known as the Mineral Block (Figure 1-1). The ownership has been managed for commercial timber production since 1913, and all but 4,505 acres have been clearcut harvested at least once. The entire ownership lies within the geographic range of the northern spotted owl (*Strix occidentalis caurina*), a species listed as threatened under the Federal Endangered Species Act of 1973, as amended (ESA). Less than 9 percent of the ownership supports suitable habitat for resident spotted owls, but recent surveys have identified the presence of one pair and one resident single spotted owl within the ownership and an additional four resident owl activity centers on adjacent lands. According to studies conducted elsewhere in the western Washington Cascades (Allen et al. 1989, Hays et al. 1989), the median home range size for spotted owl pairs is 6,657 acres and within a home range the median amount of old-growth and mature forest is 3,281 acres (the minimum is 1,715 acres). Within 1.8 miles of each of the two activity centers on Murray ownership (where 1.8 miles approximates the radius of a 6,657-acre circle) the total amounts of suitable spotted owl habitat are 1,206 acres (for the pair) and 1,991 acres (for the resident single). Assuming the acreage values reported by Allen et al. (1989) and Hays et al. (1989) to represent the minimum habitat requirements of territorial spotted owls, the two home ranges on Murray ownership are at or below the threshold of suitability. Similar conditions exist for the other owls within 1.8 miles of the Murray ownership. Continued harvest in the vicinities of the activity centers could potentially lead to abandonment by the owls, which would be considered by the U.S. Fish and Wildlife Service (USFWS) to be a "taking" under the ESA. Cessation of timber harvest, on the other hand, would have a serious impact on Murray. The company holds approximately 2,500 acres of merchantable timber that is suitable spotted owl habitat within 1.8 miles of activity centers, representing approximately 42 percent of their timber that is merchantable at this time. Deferral of all timber harvest in the vicinities of the owl activity centers would significantly reduce operating revenues for the company over the next 10 to 20 years and is not economically feasible. Murray explored the option of temporarily deferring harvest of some of the suitable habitat, but rejected this as financially unsound given the myriad other environmental constraints facing the company.

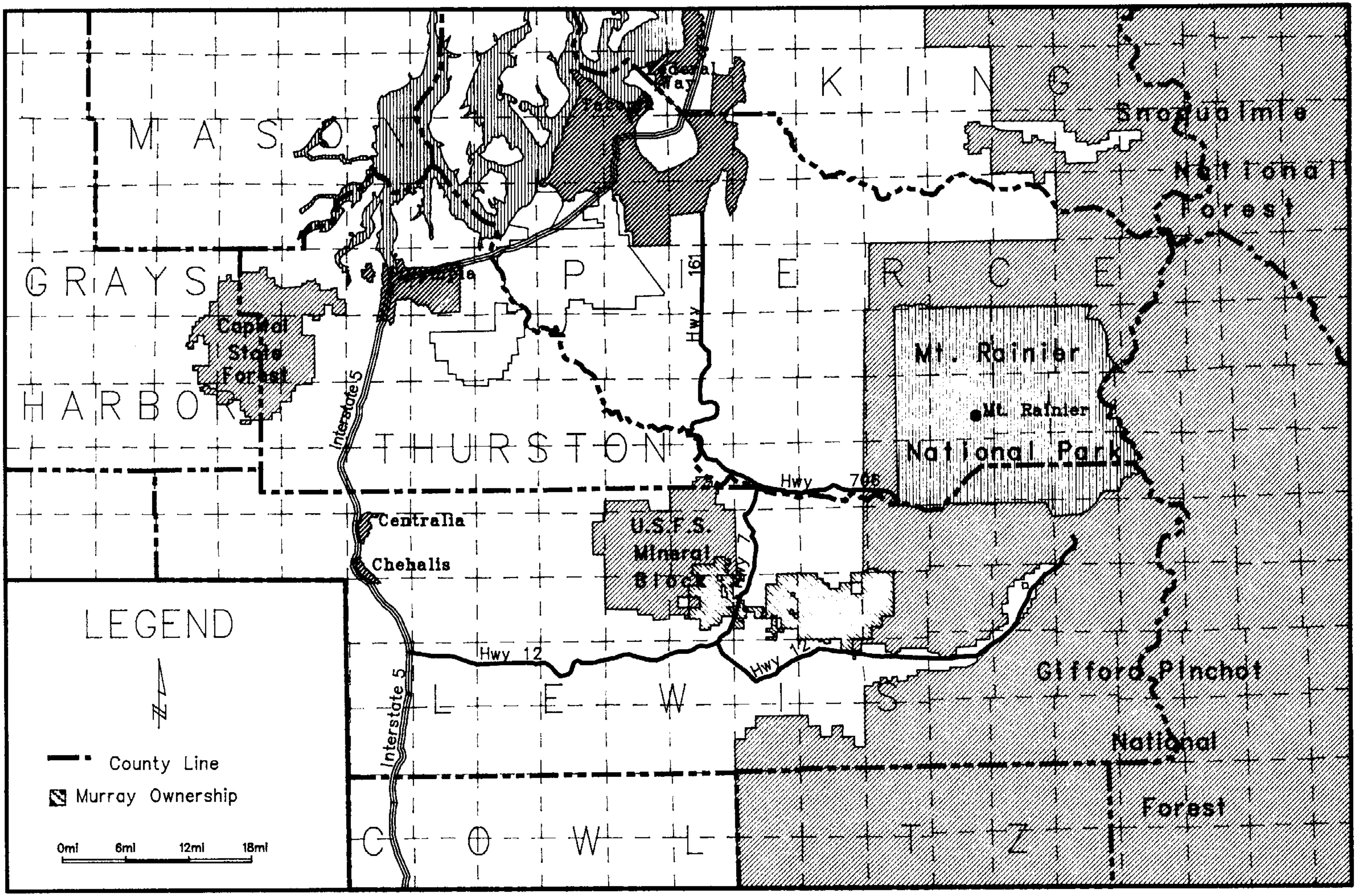

Figure 1-1. Location of the Murray Pacific ownership in the Mineral Block

In response to the dual concerns of timber management and spotted owl protection, Murray has prepared a Habitat Conservation Plan (HCP) in accordance with Section 10(a)(1)(B) of the ESA. Under provisions of the ESA, the Secretary of the Interior (through the USFWS) may issue a permit for the taking of a threatened or endangered species if: a) the taking is incidental to an otherwise legal activity, b) the applicant for the permit prepares an HCP that minimizes and mitigates the impacts of the taking to the maximum extent practicable, c) the applicant ensures adequate funding for the plan, d) the applicant provides any other measures required by the Secretary (i.e., an Implementation Agreement) and e) the USFWS finds that the taking will not appreciably reduce the likelihood of survival and recovery of the species in the wild. The intent of the Murray HCP is to provide a framework for the continued economical management of the Murray ownership as commercial forestland in a manner which helps assure survival of the northern spotted owl and compliments recovery efforts. Upon acceptance of the plan and verification that the above-listed criteria are met, the USFWS will issue to Murray a permit for incidental take which will allow Murray to resume harvest within the spotted owl home ranges on its ownership. To minimize and mitigate the impacts of the incidental taking, Murray will manage its forestlands in the Mineral Block under the provisions of the HCP for 100 years (until 2093).

Murray initiated the preparation of the HCP by contacting the Olympia Field Office of the USFWS and assembling a team of experts to assist with preparation of the plan. The HCP team was composed of representatives of Murray, the USFWS, the Washington Department of Wildlife (WDW), the Washington Department of Natural Resources (DNR) and consulting biologists. The team met on several occasions to clarify the objectives of the HCP, identify management options to be incorporated into the HCP and provide substantive guidance for the biological and economic aspects of the plan. The team also consulted with various experts on spotted owl biology and silviculture throughout preparation of the HCP to ensure the viability of the final plan.

The following document is the final product of the team's efforts, incorporating comments by the USFWS and WDW. As presented, this HCP addresses only the lands owned by Murray in the Mineral Block. It is intended to be consistent with the stated management objectives of adjacent landowners, particularly the DNR and the U. S. Forest Service (USFS), but it does not make recommendations for the management of those adjacent lands. The success of this HCP does not depend on adjacent lands, but adjacent lands could be managed under similar HCPs in the future, if so desired, and thereby extend the benefits of this HCP. Nevertheless, the size and contiguous nature of the Murray ownership allow for successful management for spotted owls without consideration of adjacent ownerships.

This HCP is organized into six sections. The remainder of Section 1.0 is a review of the status of other wildlife potentially on the ownership and a summarization of the laws and regulations relevant to the preparation of an HCP. Section 2.0 is the substance of the HCP; it is a review of the biology of spotted owls and their habitat and a presentation of the specific measures prescribed by Murray to manage for spotted owls. Monitoring and funding of the HCP also are addressed in Section 2.0, as are the effects of the HCP on spotted owls and other wildlife. Section 3.0 is a description of the two principal alternatives to the HCP. Section 4.0 is a review of USFWS criteria for issuance of a permit for incidental take and Section 5.0 is a list of literature cited in this document. The members of the HCP team are identified in Section 6.0.

1.2 DESCRIPTION OF THE PLAN AREA

1.2.1 Location

The Murray ownership is located north of U.S. Highway 12 in eastern Lewis County, Washington (Figure 1-1). It lies in the western Cascade foothills, approximately 10 miles southwest of Mount Rainier National Park. The ownership is divided into two portions that are separated by State Route 7, north of the town of Morton. The area can be reached by travelling 32 miles east from Interstate 5 along U.S. Highway 12 to Morton. Both portions of the ownership can then be accessed from State Route 7, approximately 4 miles north of Morton. The HCP area encompasses Murray timberlands in seven townships (T12N,R6E; T13N,R4E; T13N,R5E; T13N,R6E; T13N,R7E; T14N,R4E and T14N,R7E).

1.2.2 Geology and Hydrology

The Murray ownership falls within the Southwestern Washington Physiographic Province (Franklin and Dyrness 1984). The area is characterized by tall, steep ridges of volcanic origin, ranging in elevation from approximately 1,000 to 5,380 feet above sea level. Soils on these ridges are typically composed of deep deposits of volcanic ash.

The ownership receives approximately 60 to 120 inches of precipitation annually, occurring mostly in winter. Water flows from the ownership into two major river drainages; to the north into the Nisqually River and to the south into the Cowlitz River.

1.2.3 Vegetation

The Murray ownership falls within both the *Tsuga heterophylla* and the *Abies amabilis* Forest Zones (Franklin and Dyrness 1984). The *Tsuga heterophylla* Zone lies between sea level and 3,000 feet in elevation and is dominated by western hemlock (*Tsuga heterophylla*), Douglas-fir (*Pseudotsuga menziesii*) and western red cedar (*Thuja plicata*). The *Abies amabilis* zone occurs above 3,000 feet in elevation, where growing conditions are cooler and a greater proportion of the annual precipitation comes as snow. Dominant tree species include Pacific silver fir (*Abies amabilis*), noble fir (*Abies procera*), Douglas-fir, western hemlock, western red cedar and western white pine (*Pinus monticola*). Natural stands in these forest zones eventually develop what have been called "old-growth" characteristics. These include dominant trees in excess of 3 feet in diameter at breast height (dbh) and 200 feet in height, multiple ages and size classes of trees ranging from large dominants to seedlings, large standing dead trees (snags) and heavy accumulations of logs on the forest floor (Franklin et al. 1981). Such stands can reach several hundred years of age, subject only to infrequent but catastrophic disturbances such as fire or windthrow. Under commercial timber management, old-growth stands are harvested, typically by clearcutting, and converted to plantations of one or more early successional species that are then cultivated and harvested at intervals of 40 to 60 years.

The Murray ownership is currently a mosaic of coniferous forest stands of varying ages (Figure 1-2). Approximately 1,286 acres are classified as old-growth (stand ages of 250 years +), but only 581 acres have never been entered for logging and retain all or most of the old-growth characteristics described by Franklin et al. (1981). The remaining 705 acres of old-growth were logged up to 80 years ago, but only had up to 50 percent of the dominant overstory removed. Roughly 3,219 acres are natural stands that have never been harvested but regenerated after natural disturbance (probably fire) between 80 and 120 years ago and have not yet developed the size and structure typically considered old-growth, and 48,582 acres (90 percent of the ownership) have been partially or completely harvested at least once in the past 80 years. The remaining 1,523 acres of the ownership are non-forested (e.g., road, rock, creek, etc.).

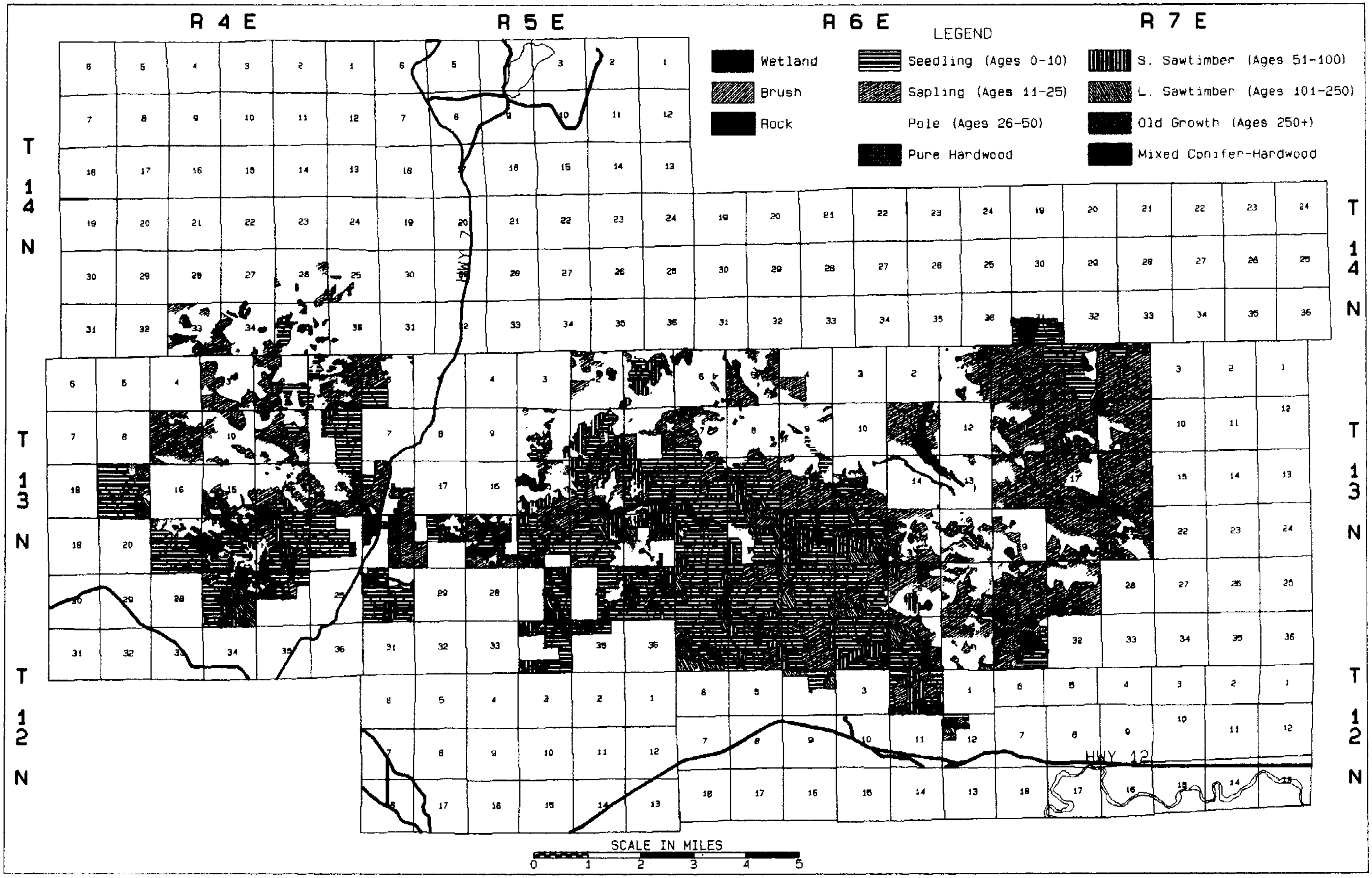

Figure 1-2. Distribution of wildlife habitats on Murray Pacific lands in 1993.

1.2.4 Land Ownership and Land Use

The Murray Pacific ownership lies in a fairly contiguous block, bordered on the east and west by federal lands administered by the USFS (Figure 1-3). State lands administered by the DNR lie within and adjacent to Murray lands, and a number of commercial and non-commercial private timberlands border Murray on the north and south. The predominant land use on non-federal lands in the Mineral Block is commercial timber production. Federal lands are managed for multiple uses, but timber harvest has traditionally been the most significant use with respect to effects on wildlife habitat. Federal land management in the Mineral Block is currently in a state of flux pending management recommendations contained in the Conservation Strategy for the Northern Spotted Owl prepared by the Interagency Scientific Committee to Address the Conservation of the Northern Spotted Owl (ISC). Under recommendations of the ISC (Thomas et al. 1990), much of the federal land to the east and west of the Murray ownership would be managed as Habitat Conservation Areas (HCAs) for the spotted owl. Activities that adversely effect spotted owls or their habitat in an HCA would be allowed only when predetermined thresholds for population size and habitat quantity are met within the HCA. Harvesting of suitable spotted owl habitat (i.e., mature and old-growth coniferous forest) is expected to be significantly reduced in HCAs due to the overall shortage of habitat at the current time. Specific recommendations for the HCAs near the Murray ownership are discussed in Section 2.1.1 of this HCP and in the ISC report (Thomas et al. 1990).

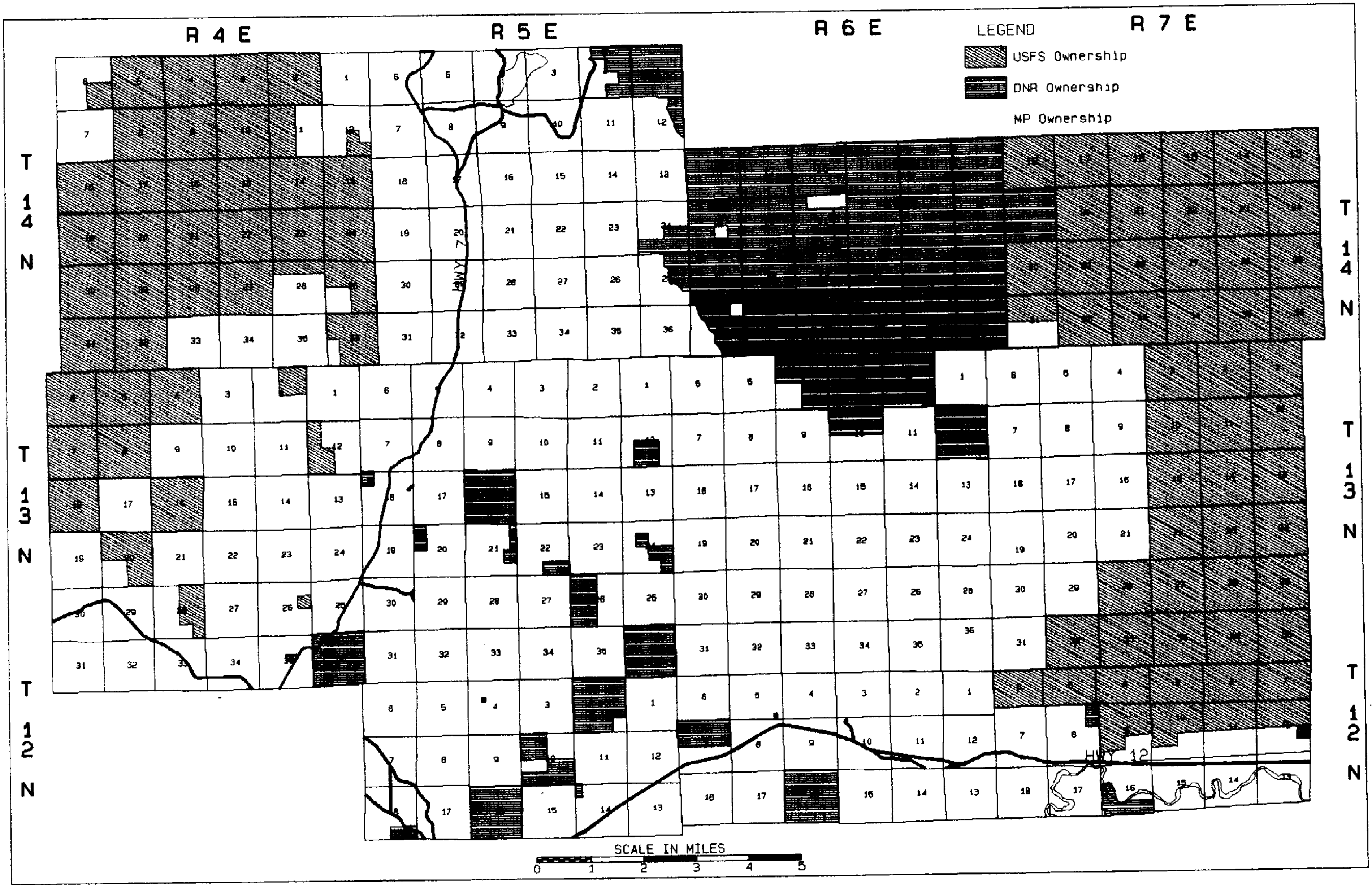

Figure 1-3. Murray Pacific ownership in the Mineral Block.

1.3 CURRENT STATUS OF THE NORTHERN SPOTTED OWL

1.3.1 Regional Status

The Federal Recovery Team for the Northern Spotted Owl (Recovery Team) estimated the minimum population of the owl, based on surveys conducted through 1991, to include 3,500 known pairs in Washington, Oregon and California (Lujan et al. 1992). The total population of owls is undoubtedly higher than 3,500 pairs, because not all portions of the species' range have been surveyed and not all segments of the population were detected in the surveys that were conducted. An accurate estimate of the total population size is not available.

The Recovery Team divided the range of the northern spotted owl into 11 physiographic provinces based on geographic patterns in the distribution of natural vegetation. These are modifications of the provinces described by Franklin and Dyrness (1984). The Mineral Block lies within the Western Washington Cascades Province, at the boundary between this province and the Western Washington Lowlands (Figure 1-4). The Recovery Team identified approximately 200 known activity centers of pairs or resident singles in the Western Washington Cascades Province, most of which occur south of Mount Rainier in the portion of the province which includes the Mineral Block. The WDW reports 17 known activity centers of pairs and seven activity centers of single spotted owls on private, state and federal lands in the Mineral Block (Hays, pers. comm. 1992). The number of known activity centers in the Mineral Block is probably a good estimate of the total number of territorial owls because of the intensive nature of surveys conducted over the past 3 years. It does not account accurately for non-territorial owls that do not respond consistently to surveyors' calls, making estimates of total population numbers somewhat conservative.

The Recovery Team analyzed trends in populations and habitat within each of the physiographic provinces inhabited by the owl and identified what it believed to be significant threats to the recovery of the owl in each province. Low population size, declining population, limited availability of habitat, patchy distribution of habitat and isolation of habitat were all listed as moderate threats to the spotted owl in the

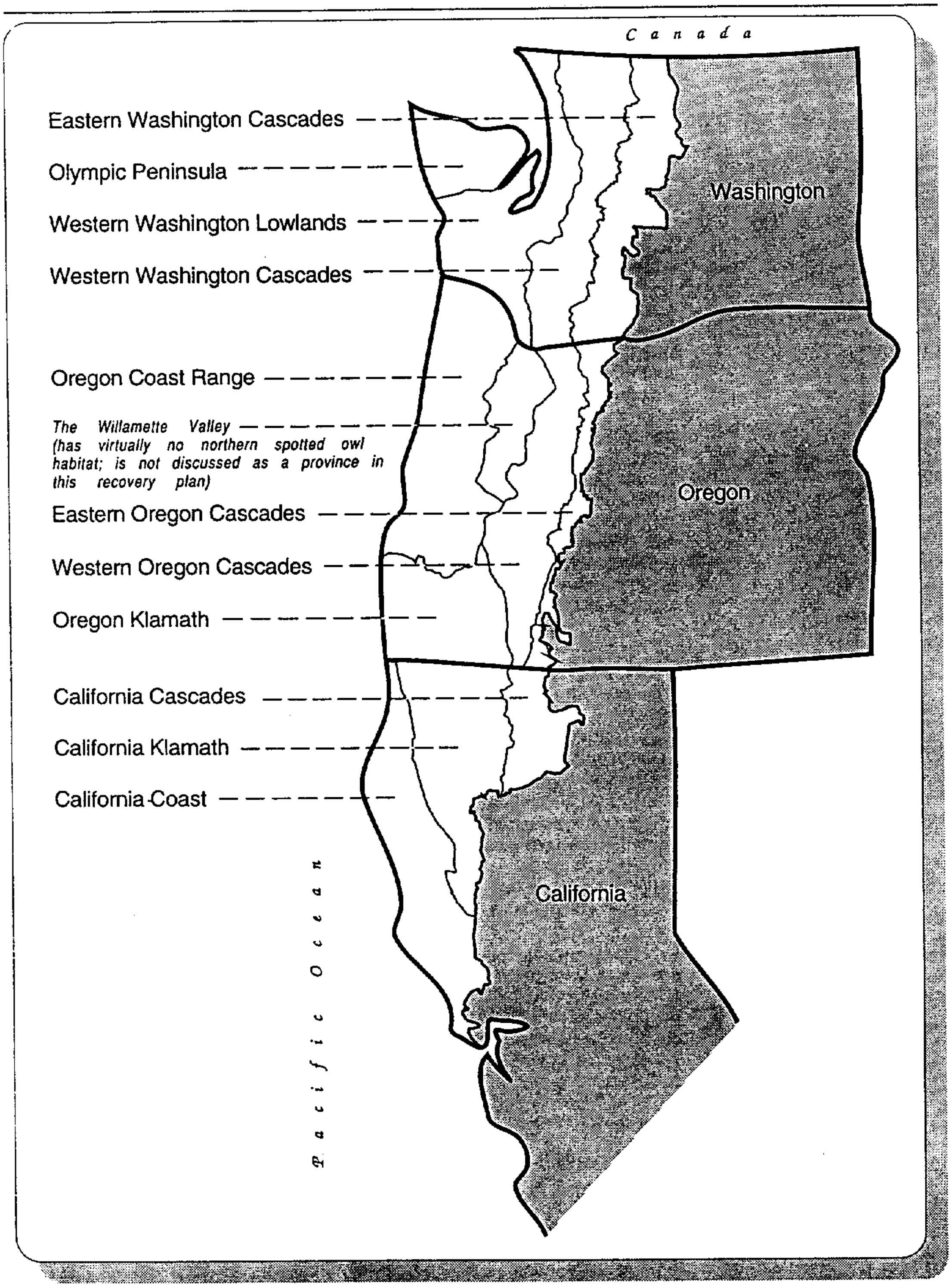

Figure 1-4. Provinces within the range of the northern spotted owl in the United States (From Lujan et al. 1992).

Western Washington Cascades Province (Lujan et al. 1992). Declining habitat due to timber harvest was considered the only severe threat in the province. The Mineral Block was specifically identified as an area where the availability of habitat and isolation of habitat are concerns. The Mineral Block is considered important as a geographic link between owl populations in the Western Washington Cascades and the Olympic Peninsula Provinces, and both the availability of habitat within the Mineral Block and the connectivity of the Mineral Block with the remainder of the Cascades are important to the future movement of owls between the provinces (Lujan et al. 1992).

1.3.2 Status Within the Plan Area

The Murray ownership currently contains approximately 4,678 acres of suitable spotted owl habitat (Figure 1-5). Habitat suitability was determined through field verification of aerial photographs and inventory information contained in Murray's Geographic Information System (GIS). Suitable habitat was classified as Type A, B or C (Table 1-1) according to the definitions of Stearns (1991). In general, Type A habitat is classic old-growth forest (Franklin et al. 1981), Type B is mature forest that has resulted from natural disturbance 100 to 200 years ago and Type C is young forest that contains some of the structural features important to spotted owls and provides habitat for at least two of the three principal activities of resident owls (roosting, foraging and nesting). Suitable habitat within the Murray ownership is primarily Type C (2,992 acres), with lesser amounts of Type A (1,167 acres) and Type B (519 acres).

Spotted owl surveys were conducted in the Murray ownership in 1991 and 1992. The 1991 surveys covered all "potential" habitat on the ownership. Potential habitat was defined as any habitat likely to contain territorial owls during the surveys, and included habitat defined as suitable by Stearns (1991) as well as forest habitat not usually considered capable of supporting resident spotted owls.

Surveys conducted in 1990 on other ownerships in the Mineral Block (Beak 1990), as well as elsewhere in the northwest have shown that spotted owls use young second-growth forest that does not meet the traditional definition of suitable habitat (i.e., old-growth coniferous forest). These findings led to the inclusion by Stearns (1991) of Type C Habitat, but the definition of potential habitat used for the Murray

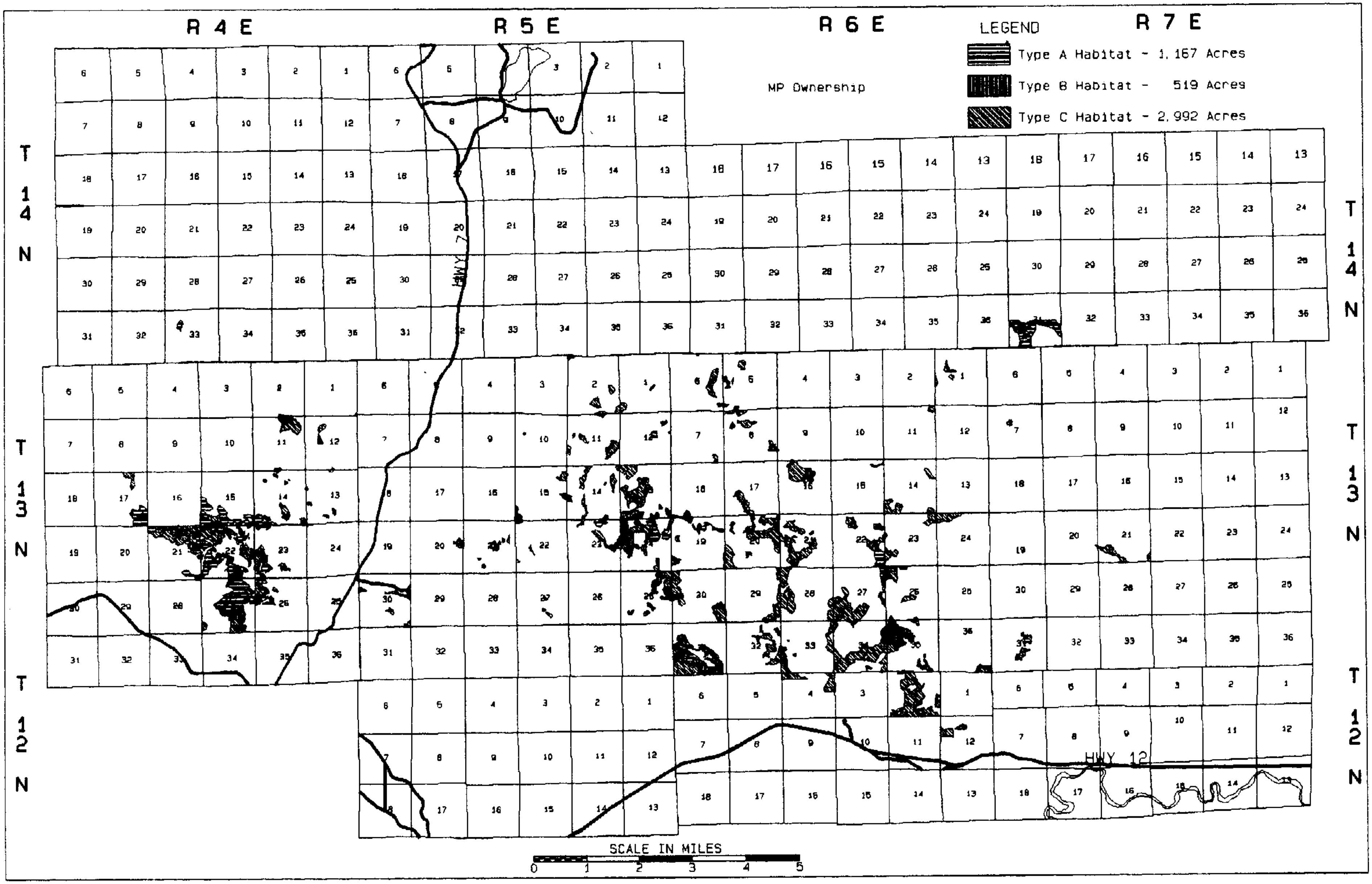

Figure 1-5. Suitable spotted owl habitat on Murray Pacific lands in the Mineral Block.

Table 1-1. Washington DNR Definitions of Suitable Habitat; Western Washington.

Type A Suitable Spotted Owl Habitat: Optimal, old-growth habitat that has the following characteristics:

1) Canopy: multi-layered, multi-species canopy dominated by large (30" or more DBH) overstory trees (typically 15-75 stems/acre);

2) Canopy closure: moderate to high (60-80%);

3) A high incidence of large trees with various deformities (e.g., large cavities, broken tops, dwarf mistletoe infections, and other evidence of decadence);

4) Numerous large snags (30" or more DBH) (typically 2 or more stems/acre);

5) Large accumulations of fallen trees and other woody debris on the ground.

Type B Suitable Spotted Owl Habitat: Mature forest habitat that has the following characteristics:

1) Canopy: few canopy layers, multi-species canopy dominated by large (20" or more DBH) overstory trees. Typically tree densities are 75-100 stems/acre, although tree densities as low as 35 stems/acre could be possible where large diameter trees are present.

2) Canopy closure: moderate to high (60-80%).

3) Some large trees with various deformities (e.g., large cavities, broken tops, dwarf mistletoe infections, and other evidence of decadence).

4) Large snags present (20" or more DBH).

5) Accumulations of fallen trees and other woody debris on the ground.

Type C Suitable Spotted Owl Habitat: Marginal habitat, usually younger stands with some old-growth/mature components and/or structural characteristics. <u>Type C habitat is defined on the basis of use by spotted owls.</u>

Type C habitat includes some of the "atypical" habitat which has been documented to be used by spotted owls in Washington. Generally, these are naturally regenerated stands resulting from fire or windthrow. Fire and windthrow may result in patchy habitat with remnant old growth/mature forest interspersed among younger stands, and/or retention of old growth/mature structural components.

Examples of Type C suitable habitat are:

1) the "21-blow" stands on the Olympic Peninsula that have retained old growth components within young even-aged stands;

2) remnant old growth forest within even-aged stands resulting from fire, such as the "doghair" stands on the Quilcene Ranger District on the Olympic Peninsula; and

3) portions of the "Yacolt Burn" that have remnant old growth components left.

Type C habitat may also include partially harvested stands that have had less than 40% of the volume removed, which still contain the structural components important to spotted owls (multi-layered canopies, multi-species, moderate to high canopy closure, some large trees, snags, down woody debris, large trees with cavities, broken tops, dwarf mistletoe infections, and other evidence of decadence).

ownership goes beyond Type C to include all types of young forest where the surveyors have personally observed spotted owls elsewhere in the southern Washington Cascades. A similar definition would not be suitable for management purposes, because it would include habitat not currently capable of supporting spotted owls. Since the object of the surveys was to locate any owls that could be impacted by timber harvest on the ownership, the broader definition of potential habitat was considered appropriate. The 1992 surveys of the Murray ownership were focused only on the two areas found to support spotted owls in 1991. Surveys of the remainder of the ownership were not conducted in 1992 because of the limited amount of potential habitat present and because of the absence of owls during six-visit surveys in 1991. Small isolated stands of potential habitat were not surveyed in 1991 or 1992 unless they were part of larger survey areas because the potential for finding owls in such small stands was negligible.

Surveys of the Murray ownership located one territorial owl pair (WDW Site No. 749) and one resident single spotted owl (WDW Site No. 837). The pair was located in the same stand of trees in 1991 and 1992. They were confirmed non-reproductive in 1992, but reproductive status was undetermined in 1991 because the pair was not found until July. The resident single was determined from five detections in 1991 and 1992 over an area of roughly 2 square miles. The possibility of a second resident single spotted owl exists in the vicinity of the known resident single, but surveyors were unable to obtain consistent detections of a second owl during repeated attempts. Within 1.8 miles of the pair site center there are 1,206 acres of suitable nesting, roosting and foraging habitat (19% of the total). Within 1.8 miles of the resident single site center there are 1,991 acres of suitable habitat (32% of the total).

In addition to the two resident owl site centers recently detected within the Murray ownership, eight other site centers lie on or near Murray ownership (i.e., within 2.5 miles) (Table 1-2). Three of the site centers represent pairs, one is a resident single and four are the result of single detections of individual owls and hold the status of "single, status unknown". The two "single, status unknown" home ranges centered on the Murray ownership contain a total of 820 acres of suitable habitat, but most of this (810 acres) is in one circle (Site No. 219) that overlaps heavily with Site No. 749. No owls have been detected in Site No. 219 since 1984, and it is likely this and Site No. 749 represent the same owls. The area of suitable habitat owned by Murray in the adjacent home ranges (i.e., those centered off but within 1.8 miles of the ownership) ranges from 0 to 37 acres.

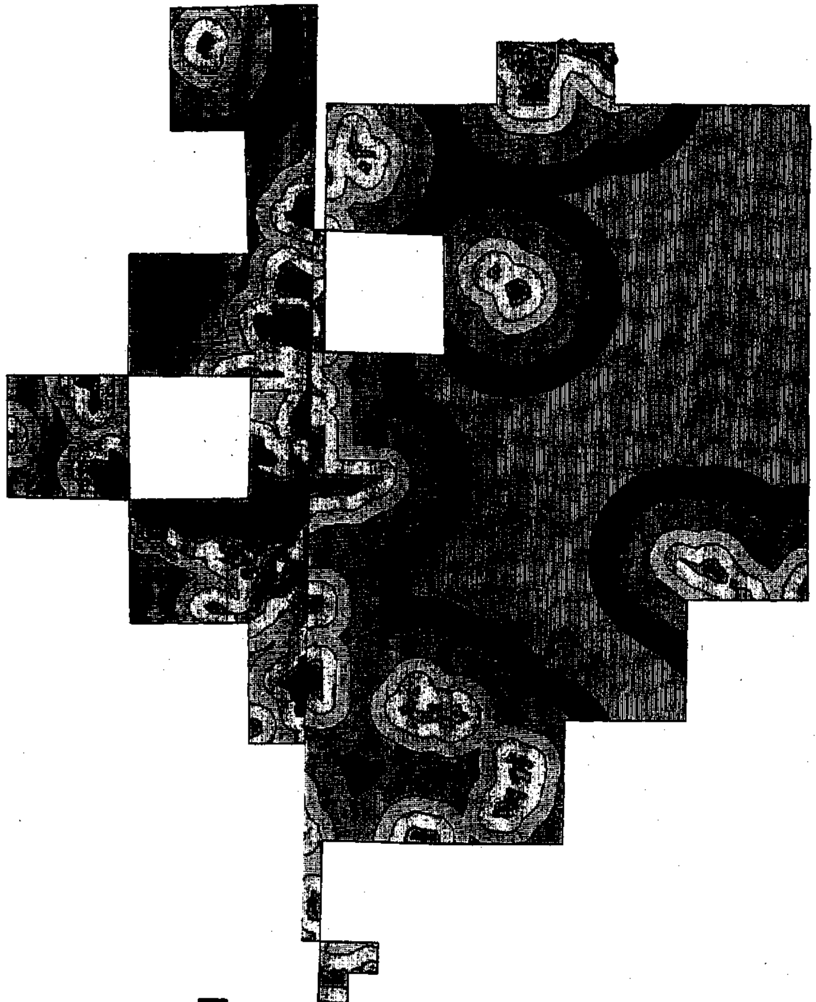

Figure 2-8. Existing (1993ip.

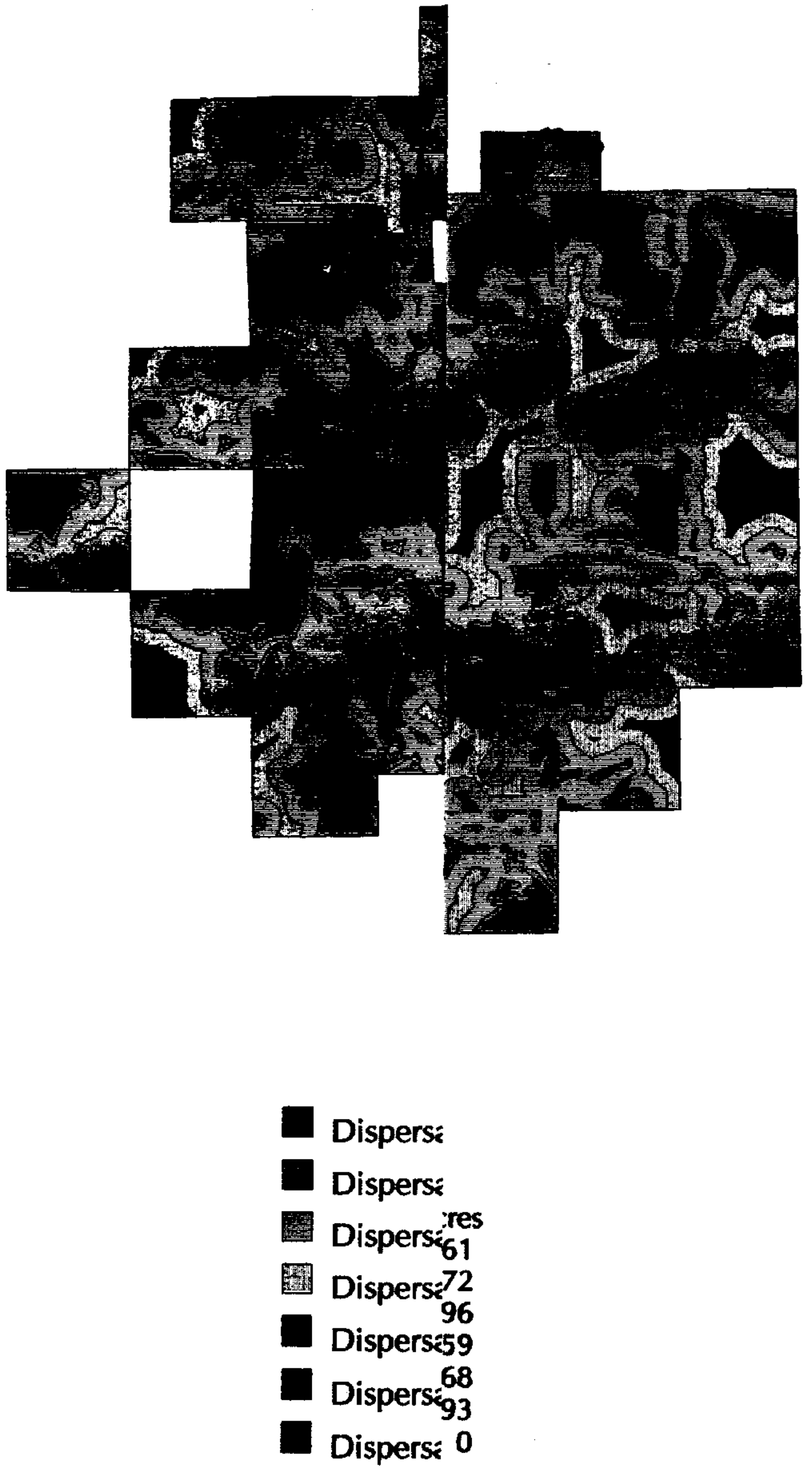

Figure 2-9. Spotted Owl
Ownership ir

Table 1-2. Spotted owl activity centers on or near the Murray ownership as of January 1993.

WDW Site No.	Status	Murray Ownership Within 1.8 Miles (ac.)	Suitable Habitat on Murray Within 1.8 Miles (ac.)	Total Suitable Habitat Within 1.8 Miles (ac.)
217-6291	Resident Single	13	0	N/A[2]
219-1805	Single, Status Unknown	6,470	810	N/A
220-7011	Pair	1,140	37	N/A
233-1972	Single, Status Unknown	2,733	10	N/A
307-6316	Pair	180	0	N/A
701-8872	Pair	0	0	N/A
749-5971	Pair	6,261	1,206	1,206
837-6302	Resident Single	3,316	737	1,991
941-6301	Single, Status Unknown	80	0	N/A
944-6305	Single, Status Unknown	565	28	N/A
	TOTAL[1]	**18,033**	**2,500[3]**	

[1] Total acreage is less than the sum of this column because of overlap between adjacent circles.

[2] Habitat assessments for activity centers on non-Murray lands have not been conducted or were not available to Murray.

[3] Total acreage within 1.8 miles of activity centers with known status is 1,980 acres.

1.4 OTHER SPECIES OF PLANTS AND ANIMALS OF CONCERN WITHIN THE PLAN AREA

1.4.1 Plants

No federally-listed threatened or endangered plant species exist on the Murray ownership. Forty-seven federal candidates for listing exist in Washington, but only one, the pale larkspur (*Delphinium leucopinaeum*), occurs in Lewis County. The pale larkspur inhabits dry bluffs and open ground. It grows on cliffs and ledges along the lower Columbia River and would not occur on the Murray ownership.

The State of Washington Natural Heritage Program (WNHP) maintains a list of plant species considered to be threatened, endangered or sensitive within the state. The only state-listed endangered plant species known or expected to occur in Lewis County is the pale larkspur. The hairy-stemmed checker mallow (*Sidalcea hirtipes*) and Kincaid's sulfur lupine (*Lupinus sulphureus* var. *kincaidii*) are the only state-listed threatened species which occur in Lewis County. The hairy-stemmed checker mallow is found on coastal mountains and bluffs and would not occur on the Murray ownership. Kincaid's sulfur lupine is a disjunct species (widely separated from the main population known to occur in the Willamette Valley of Oregon) which inhabits low elevation meadows, and is not expected to occur within the Murray ownership. Fifteen of the state-listed sensitive species could be found in forested areas of Lewis County (Table 1-3), all of which could be present on the Murray ownership. Consultation with the WNHP revealed the known occurrence of one state-listed sensitive plant, common blue-cup (*Githopsis specularioides*), along the southern boundary of the ownership. A field survey conducted in August 1992 found no evidence of common blue-cup in the area. However, the survey was performed after the peak flowering period of the common blue-cup, and extremely dry conditions and heavy livestock trampling within the suitable habitat made positive identification of common blue-cup difficult. The WNHP also indicated the presence of one high quality, mid-elevation freshwater wetland on Murray ownership. A survey of this wetland was also conducted in August 1992. None of the listed sensitive plants were observed during the survey.

Table 1-3. Plant species native to forested areas of Lewis County that are listed as Sensitive by the State of Washington (WNHP 1990).

1. **Moist to dry coniferous forest**
   - Lance-leaved grape fern (Botrychium lanceolatum)
   - Moonwort (*B. lunaria*)
   - St. John's moonwort (*B. pinnatum*)
   - Tall bugbane (*Cimicifuga elata*)
   - Pink fawn lily (*Erythronium revolutum*)
   - Branching montia (*Montia diffusa*)
   - Pine broomrape (*Orobanche pinorum*)
   - Fringed pinesap (*Pleuricospora fimbriolata*)
   - Small-flowered trillium (*Trillium parviflorum*)

2. **Mixed deciduous/coniferous forest**
   - Lance-leaved grape fern (*Botrychium lanceolatum*)
   - St. John's moonwort (*B. pinnatum*)
   - Tall bugbane (*Cimicifuga elata*)
   - Pink fawn lily (*Erythronium revolutum*)
   - Branching montia (*Montia diffusa*)
   - Great polemonium (*Polemonium carneum*)
   - Small-flowered trillium (*Trillium parviflorum*)

3. **Dry meadows (low to mid elevation)**
   - Lance-leaved grape fern (*Botrychium lanceolatum*)
   - Moonwort (*B. lunaria*)
   - St. John's moonwort (*B. pinnatum*)
   - Common blue-cup (*Githopsis specularioides*)
   - Mt. Rainier lousewort (*Pedicularis rainierensis*)

4. **Ponds/lakes/lake margins/streambanks**
   - Green-fruited sedge (*Carex interrupta*)
   - Saw-leaved sedge (*C. scopulorum* var. *prionophylla*)
   - Giant helleborine (*Epipactis gigantea*)
   - Pink fawn lily (*Erythronium revolutum*)

5. **Wet meadows/marshes/seeps (low to mid elevation)**
   - Moonwort (*Botrychium lunaria*)
   - St. John's moonwort (*B. pinnatum*)
   - Saw-leaved sedge (*C. scopulorum* var. *prionophylla*)
   - Giant helleborine (*Epipactis gigantea*)
   - Pink fawn lily (*Erythronium revolutum*)
   - White meconella (*Meconella oregana*)
   - Mt. Rainier lousewort (*Pedicularis rainierensis*)

6. **Bogs**
   - Saw-leaved sedge (*C. scopulorum* var. *prionophylla*)

7. **Gravel/scree/rock outcrops/open ridges (mid to high elevation)**
   - Lance-leaved grape fern (*Botrychium lanceolatum*)

1.4.2 Marbled Murrelet *(Brachyramphus marmoratus)*

The marbled murrelet, in the family Alcidae, is found in North America from Alaska south to central California (USFWS 1991, American Ornithologist's Union 1983). The USFWS has designated the "status trend" (the species' population trend in total numbers) for the marbled murrelet as declining (USFWS 1991) and recently listed the species as threatened in Washington, Oregon and California (USFWS 1992). Populations were estimated to be 3,800 to 5,000 individuals in 1979, and 1,900 to 3,500 breeding pairs in 1991 (Speich et al. unpublished).

In Washington, the marbled murrelet forages in coastal waters year-round and nests in coniferous forest (Rodrick and Milner 1991). It forages within 1.2 miles of land in the northern portion of its range (including Washington), and up to 34 miles from shore in the southern portions of its range. It also utilizes inland freshwater lakes such as Lake Quinault and Lake Washington (Carter and Sealy 1986). Large concentrations of foraging marbled murrelets have been observed in the San Juan Islands, the Strait of Juan de Fuca, the Great Bend area of Hood Canal and along the outer coast of Washington (Marshall 1988).

At Barkley Sound and near Langara Island in British Columbia, major prey items were found to be sand lance (*Ammodytes hexapterus*), Pacific herring (*Clupea harengus*), other fish and euphausids (crustaceans) (Sealy 1975 and Carter 1984). In addition to these prey items, a study in Kachemak Bay, Alaska found capelin (*Mallotus villosus*) to be important (Sanger 1987).

Until recent times, the nesting sites of marbled murrelets were unknown. They do not breed in colonies on islands or in coastal areas as do most other sea birds (Marshall 1988). Some evidence existed of murrelets having been seen flying into or out of forested areas and some young murrelets were also found in forested areas, but no well documented nests were found in North America until 1974 (Binford et al. 1975). The nest found in 1974 was on a large, moss-covered, horizontal Douglas-fir branch 148 feet above the ground. As of 1992, 22 nest areas have been found in Washington, and within those a total of five nest trees have been identified. Nearly all of the nest areas were in stands of conifers that were 150+ years of age and had average diameters at breast height of greater than 35 inches. Nest stands are typically composed of Douglas-fir, western hemlock and western red cedar below 3,300 feet in elevation.

Some ground nests have been found in tundra-edged coastal areas of Alaska (Marshall 1988), but not in Washington. Nesting in Washington occurs from 1 April to 15 September (Rodrick and Milner 1991).

Marbled murrelets have been observed up to 52 miles inland over coniferous forest during the breeding season in Washington (Beak 1992a). In a survey of marbled murrelets in Washington, abundance was found to be the greatest in areas where old-growth/mature forest comprised more than 30 percent of the landscape. Murrelets were found to be most abundant in old-growth forest along the North Fork of the Stillaguamish River from 18 to 36 miles inland (Hamer 1990).

A habitat review was conducted for the Murray ownership in 1992 to identify any sites with the potential to support marbled murrelet nesting. Approximately 1,039 acres of forest were considered to be potentially suitable for murrelets based on a definition provided by Hamer (pers. comm. 1992) which included the number of trees in the stand having horizontal limbs with diameters of at least 7 inches, the number of potential nest platforms observed in those trees and the size of the stand (Figure 1-6).

A general survey for marbled murrelet presence was conducted in and around the potential habitat in 1992 (Beak 1992b). The survey covered all suitable habitat on the ownership except small, isolated stands in Sections 33 and 35 of Township 13 North, Range 6 East and Section 21 of Township 13 North, Range 7 East. It consisted of 2-hour survey stations starting 45 minutes before sunrise and lasting until 75 minutes after sunrise. In areas where suitable habitat covers a large portion of a drainage, stations were placed on prominent points throughout the drainage to sample the entire area. This was a modification of the general survey methodology described by Ralph and Nelson (1992). It was felt that the general survey recommended by Ralph and Nelson (1992) was limiting in two areas:

a. it prescribes a driving route with 10-minute stations placed no more than 5 minutes apart, but many roads in mountainous areas of Washington require more than 5 minutes of driving time to get from one stand of suitable murrelet habitat to the next, and

b. the road survey method also allows for as much as 30 percent of the survey period to be spent in the vehicle travelling between stations, at which time no murrelet detections are likely.

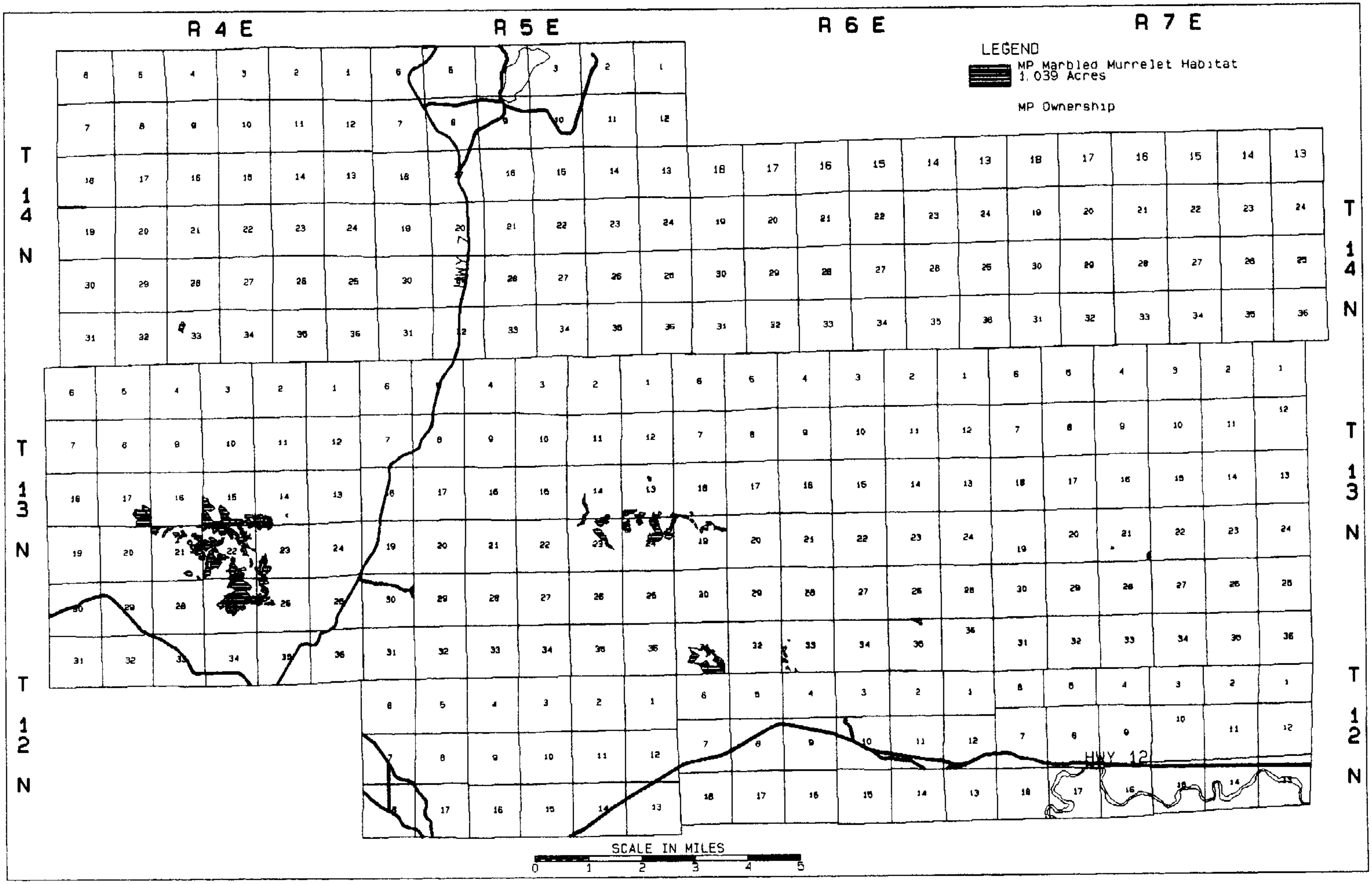

Figure 1-6. Potential marbled murrelet habitat on Murray Pacific lands in the Mineral Block.

The modified general survey method used on the Murray ownership allowed stations to be placed in areas not accessible by vehicles and to be placed on different road systems. This method also allowed the surveyors to spend the entire 2-hour survey period listening for murrelets. The methods for interpreting and recording survey information outlined by Ralph and Nelson (1992) were followed at all times while observers were conducting the survey.

Single marbled murrelet detections were reported in three of the four survey areas on at least one visit in 1992. A single wing beat was also detected below the canopy level and was believed to represent a bird entering the stand of timber. No other detections were recorded for this area. The greatest number of confirmed detections at a single station during one visit was three.

The surveys indicated that marbled murrelets are present on Murray ownership, but detection rates are very low. Additional surveys will be conducted to further define the extent to which murrelets use the Murray ownership.

1.4.3 Other Animals

An estimated 638 species of vertebrates inhabit western Washington (Brown 1985). Of these, Brown lists 414 species associated with coniferous forest ecosystems on the west slope of the Cascade Mountains. All 414 species could potentially occur on the Murray ownership for all or part of the year. The USFWS, under the authority of the ESA, has identified species considered threatened or endangered due to low population numbers or other significant threats to their survival (USFWS 1990), as well as candidate species under consideration for formal listing proposals (USFWS 1991). Among the list of species native to the western Washington Cascades and potentially present on the Murray ownership, the USFWS has identified 16 that are currently listed as threatened or endangered, or are candidates for listing (Table 1-4; Frederick 1992). In addition to species with federal status under the ESA, a number of species have been identified by the WDW as having special status within the State of Washington because they are locally rare or threatened with extinction within the state (WDWb 1991). Nine such species could occur on the Murray ownership, bringing the total number of animal species of special interest potentially on Murray ownership to 25 (Table 1-4). This list includes the northern spotted owl, which is the focus of this HCP. The list also includes the marbled murrelet, which was formally listed by the USFWS as threatened effective 28 September 1992. A discussion of the marbled murrelet is included in Section 1.4.2. Many of the remaining 23 species with special status are extremely rare in western Washington and unlikely to be present on the Murray ownership, or are poorly understood and the potential for their occurrence is difficult to predict. A brief discussion of each species is provided below.

Columbia pebblesnail *(Fluminicola columbianus)*

The Columbia pebblesnail (or giant Columbia River spire snail) is a freshwater snail of the family Hydrobiidae found in Idaho, Oregon and Washington (USFWS 1991). Habitat requirements of this species are not well known, but it is believed they require cold, well-oxygenated, permanently-flowing streams with cobble and boulder substrate. While earlier researchers associated them primarily with major rivers such as the Columbia, they have been found in streams as narrow as 100 feet (Taylor 1982). Burch (1989) listed the Columbia pebblesnail as occurring in the middle portions of the Columbia River in Washington and the lower Snake River in Washington and Idaho. Prior to the preliminary phase of a survey for *F. columbianus* by Neitzel and Frest (1989), the mollusc had been collected only in the Columbia River (between Portland and the Wenatchee River) and the Black Canyon of the Payette River in Idaho. Neitzel and Frest (1989) found these molluscs at 15 sites in six different streams (the Columbia, Okanogan, Wenatchee and Methow Rivers in Washington, the Deschutes River in Oregon and the Snake River in Idaho). Based on habitat considerations found in the survey, additional sites were targeted for continuing surveys, including the Cowlitz River below Mayfield Lake. The Columbia pebblesnail has not been reported within the streams on the Murray ownership, but there is the potential for its occurrence in the larger tributaries to the Cowlitz River that drain the ownership.

Table 1-4. Animal species with special state or federal status that may be present on or near Murray lands in the Mineral Block.

Common Name	Scientific Name	Federal Status[1]	State Status[1]	Occurrence	Habitat
INVERTEBRATES					
Columbia pebblesnail	*Fluminicola columbianus*	C2	—	possible	streams
Fender's soliperlan stonefly	*Soliperla fenderi*	C2	—	possible	streams
FISH					
Bull Trout	*Salvelinus confluentus*	C2	G	possible	streams
Mountain sucker	*Catostomus platyrhynchus*	—	SC	unlikely	streams
Pygmy whitefish	*Prosopium coulteri*	—	SC	unlikely	streams
AMPHIBIANS					
Van Dyke's salamander	*Plethodon vandykei*	—	SC	historic sightings	moist forest floor
Tailed frog	*Ascaphus truei*	—	SC	likely	streams
Northern red-legged frog	*Rana aurora aurora*	C2	—	likely	ponds, streams, lakes
Spotted frog	*Rana pretiosa*	C2	SC	unlikely	ponds, streams, lakes
REPTILES					
Northwestern pond turtle	*Clemmys marmorata marmorata*	C2	ST	unlikely	ponds

Table 1-4. Continued.

Common Name	Scientific Name	Federal Status[1]	State Status[1]	Occurrence	Habitat
BIRDS					
Great blue heron	*Ardea herodias*	—	SM	likely	forest near wetland
Harlequin duck	*Histrionicus histrionicus*	C2	G	likely	stream & forest
Marbled murrelet	*Brachyramphus marmoratus*	FT	SC	present	old-growth forest
Mountain quail	*Oreortyx pictus*	C2	G	possible	brushy slopes
Golden eagle	*Aquila chrysaetos*	—	SC	present	extensive open areas
Bald eagle	*Haliaeetus leucocephalus*	FT	ST	possible	mature forest near water
Northern goshawk	*Accipiter gentilis*	C2	SC	likely	closed canopy forest
Osprey	*Pandion haliaetus*	—	SC	possible	forest near large lakes & rivers
Northern spotted owl	*Strix occidentalis caurina*	FT	SE	present	mature forest
Vaux's swift	*Chaetura vauxi*	—	SC	present	mature forest
Pileated woodpecker	*Dryocopus pileatus*	—	SC	present	closed canopy forest

Table 1-4. Continued.

Common Name	Scientific Name	Federal Status[1]	State Status[1]	Occurrence	Habitat
MAMMALS					
Gray wolf	*Canis lupus*	FE	SE	possible	remote areas
Grizzly bear	*Ursus arctos*	FT	SE	unlikely	remote areas
California wolverine	*Gulo gulo luteus*	C2	SC	unlikely	high-elevation forest
Pacific fisher	*Martes pennanti*	C2	SC	possible	remote forest

1 Status Codes:

SE - State Endangered
ST - State Threatened
SS - State Sensitive
FT - Federally Threatened

SC - State Candidate (for Endangered, Threatened, or Sensitive)
SM - State Monitor
G - State game species
C2 - Federal Candidate for listing, Category 2

Fender's soliperlan stonefly (*Soliperla fenderi*)

Fender's soliperlan stonefly is found only in Washington State. Stoneflies have aquatic larvae and are mostly found associated with streams (Thorp and Covich 1991). The greatest number of species are found associated with fast, cold mountain streams. Jewett (1955) describes *S. fenderi* as a new species, with the holotype from St. Andrew's Creek in Mount Rainier National Park. Stark (1983) describes specimens of this species from seeps along St. Andrew's Creek, a small un-named stream near the Reflection Lakes, and from seeps along the Puyallup River and Christina Falls, all in Mount Rainier National Park. He states that a specimen from near Snoqualmie Pass may be this species as well. St. Andrew's Creek in Mount Rainier National Park is at elevations of 2,750 feet (park boundary) to 5,886 feet (St. Andrew's Lake), and flows into the South Fork of the Puyallup River outside the Park. Reflection Lakes are at an elevation of 4,854 feet, and the two forks of the Puyallup River range from approximately 2,600 feet (boundary) to as high as 7,200 feet (glaciers). Christine Falls is at an elevation of 3,680 feet. Snoqualmie Pass is at an elevation of 3,022 feet. The Fender's soliperian stonefly may be associated with the larger permanent streams and rivers on the Murray ownership.

Bull trout (*Salvelinus confluentus*)

The bull trout is found in California, Idaho, Montana, Nevada, Oregon and Washington and its status trend is listed as unknown (USFWS 1991). Rodrick and Milner (1991) list the bull trout (and Dolly Varden) as being found throughout the coastal and inland streams and lakes of Washington. The taxonomic status of the bull trout is connected with that of Dolly Varden (*Salvelinus malma*) and the two are often confused (Cavender 1978). The bull trout is considered to be primarily an inland, non-anadromous species, with Dolly Varden being a mostly coastal and anadromous species (Cavender 1978). Bull trout are opportunistic feeders on aquatic insects, snails, amphibians, leeches, salmon eggs and fish (Wydoski and Whitney 1979). The bull trout may be present on the Murray ownership in larger creeks and rivers.

Mountain sucker (*Catostomus platyrhynchus*)

The mountain sucker is found in the Great Basin and in the upper Missouri, upper Colorado, Fraser and Columbia River systems (Wydoski and Whitney 1979). In Washington it is found only in the upper Columbia River and its tributaries east of the Cascade Mountains (Rodrick and Milner 1991). It is less abundant in Washington than in other portions of its range. Wydoski and Whitney (1979) state that it prefers the clear, cold water of mountain streams with bottoms of sand, gravel or boulders. The food of the mountain sucker, which has a specialized lower jaw, consists of algae scraped off of rocks. Since the mountain sucker has not been associated with tributaries of the Columbia River west of the Cascades, it is not expected to occur in the rivers and streams on the Murray ownership.

Pygmy whitefish (*Prosopium coulteri*)
The pygmy whitefish is found in the Columbia River system in Washington, Montana and British Columbia (Scott and Crossman 1973). Rodrick and Milner (1991) state that in Washington relict populations are found in lakes and cold streams associated with the Columbia River system and have been reported in Diamond Lake near Spokane, Crescent Lake on the Olympic Peninsula and Lake Chester Morse near Seattle. Pygmy whitefish feed on bottom organisms including aquatic insects, crustaceans, and small molluscs (Wydoski and Whitney 1979). Their presence on the Murray ownership is unlikely.

Van Dyke's Salamander (*Plethodon vandykei*)
Van Dyke's salamander is found in western Washington, northern Idaho, northwestern Montana and southern British Columbia (Nussbaum et al. 1983, Brodie and Storm 1970, Wilson et al. 1988). In western Washington it has been collected in Clallam, Jefferson, Mason, Grays Harbor, Pierce, Lewis, Skamania, Pacific and Wahkiakum Counties (Nussbaum et al. 1983). Rodrick and Milner (1991) list its habitat as being along rocky streams in wet talus and forest litter from sea level to 5,000 feet. They cite Jones and Atkinson (1989) in saying that it is presumably associated with riparian habitats in mature and old-growth coniferous forests where it utilizes downed logs. No information is available on its diet. The Van Dyke's salamander has been found in Lewis County, and suitable habitat does exist on the Murray ownership. Collections of the Van Dyke's salamander reportedly were made along the West Fork of the Tilton River on Murray ownership in 1948 and 1970, and a population could still exist in that area.

Tailed Frog (*Ascaphus truei*)
The tailed frog is found in British Columbia, Washington, Oregon, Idaho, northern California and western Montana (Nussbaum et al. 1983). It has been reported throughout western Washington (including east-central Lewis County), in Chelan County and in the southeastern corner of the state. The tailed frog

is found from sea level to near timberline, occurring in or near fast-flowing, permanent streams within forested areas (Nussbaum et al. 1983). Tailed frog adults feed on insects and other invertebrates. The tailed frog may be expected to occur within the permanent streams within the Murray ownership.

Northern Red-legged Frog *(Rana aurora aurora)*

The northern red-legged frog is found in California, Oregon, Washington and Canada and its status trend is listed as unknown (USFWS 1991). Nussbaum et al. (1983) show it as being found in western Washington (including Lewis County), Oregon and southwestern British Columbia. Its habitat is moist forests and valley riparian habitats west of the Cascades and below about 2,800 feet in elevation (Nussbaum et al. 1983). The red-legged frog feeds on beetles, caterpillars, isopods and other invertebrates, but little data exist on its food sources. The northern red-legged frog may occur in or around the open-water wetlands on the Murray ownership.

Spotted Frog *(Rana pretiosa)*

The spotted frog is found in California, the Pacific Northwest and the northern Rocky Mountains. Its status trend is listed as declining (USFWS 1991). In Washington, is known to occur at several locations east of the Cascades (McAllister and Leonard 1991, Rodrick and Milner 1991). Historically there were populations west of the Cascades in Washington and in the Willamette Valley in Oregon, but it is believed the non-native bullfrog (*Rana catesbeiana*) and other aquatic predators have seriously reduced these populations. Searches in 1989 and 1990 of several locations in western Washington known to have historically supported spotted frogs resulted in no detections, but a single spotted frog was found serendipitously by the same researchers in a tributary to the Black River in Thurston County (McAllister and Leonard 1991). This is the only recent sighting of a spotted frog in western Washington. Spotted frogs consume invertebrates, and are found in the marshy edges of ponds, streams and lakes (Nussbaum et al. 1983). The spotted frog may be found associated with the small lakes and beaver ponds on the Murray ownership, but it is highly unlikely.

Northwestern Pond Turtle *(Clemmys marmorata marmorata)*

The northwestern pond turtle is found in California, Nevada, Oregon and Washington, where its status trend is listed as declining (USFWS 1991). Rodrick and Milner (1991) state the only confirmed populations are in Klickitat and Skamania Counties in Washington. Historically they were also found in King, Pierce, Thurston and Clark Counties with a few recent sightings in King and Pierce Counties. Northwestern pond turtles inhabit marshes, ponds, sloughs and small lakes. They require abundant aquatic vegetation, protected shallows for juveniles and logs, banks or floating vegetation for basking adults (Rodrick and Milner 1991). They are opportunistic feeders on aquatic vegetation and small animals. There are no records of the northwestern pond turtle occurring in Lewis County. It is not expected that northwestern pond turtles are present on the Murray ownership.

Great blue heron *(Ardea herodias)*

The great blue heron, in the family Ardeidae, is found throughout most of North America (Peterson 1961). In western North America it breeds from southeast Alaska to Mexico, and winters from British Colombia to northern South America. The great blue heron is found statewide in Washington, where its habitat is listed as occurring near all types of fresh and saltwater wetlands including seashores, rivers, swamps, marshes and ditches (Rodrick and Milner 1991). They are found at most elevations, but are more common in the lowlands. Habitat requirements for the great blue heron include large nesting trees (both coniferous and deciduous), shallow-water feeding sites in close proximity to nests and protection from the human disturbance (Rodrick and Milner 1991).

Prey of great blue herons include shallow-water aquatic and marine animals (Rodrick and Milner 1991). In a study conducted by Collazo (1985) in northern Idaho the main prey items of great blue herons were brown bullheads (*Ictalurus nebulosus*), tench (*Tinca tinca*) and meadow voles (*Microtus pennsylvanicus*), which comprised 25 percent to 40 percent of their diet. Forbes (1987), in a study of feeding habits of great blue herons at lake and creek marsh sites adjacent to the Kootenai River near Creston, British Columbia, found that the main prey of herons at the marsh site was black bullhead (*Ictalurus melas*).

Great blue herons are colonial breeders, generally nesting in tall trees near wetland areas where colonies remain at the same sites from year to year (Rodrick and Milner 1991). At one site near Monroe, Washington great blue herons utilized the upper branches of 60 to 100 year old second-growth Douglas-fir trees for nests (Julin 1986). The trees utilized for rookeries were found to suffer damage such as defoliation and disease due to exposure of foliage to heron excrement. Short and Cooper (1985) state that in the majority of cases, feeding areas for great blue herons are found within a radius of 2.5 to 3 miles of the nesting trees. Thompson and Tabor (1981), who studied herons on the Columbia River found that nesting activities of the great blue heron from egg laying to fledgling ranged from late February through mid-August. The peak percentage of nests with eggs were found from late March to mid-April, and the peak percentage of nests with young were found in mid-May. Nesting activities were not synchronous, but spread over this six month period in the colonies studied.

Great blue herons may be present on or near the Murray ownership, particularly at lower elevations where they could feed on nearby lakes and rivers. No nesting is known to have occurred on the ownership.

Harlequin duck *(Histrionicus histrionicus)*

The harlequin duck is found in northeast Asia, Alaska, Canada, the western United States, Greenland and Iceland (Peterson 1961). Its status trend is listed as declining (USFWS 1991). In western North America, it breeds locally in mountainous areas from the Aleutian Islands and central Alaska south to central California and Wyoming, and winters in rough coastal waters along the Pacific coast. In mountainous areas the harlequin duck is found alongside fast-moving mountain streams, where it nests on the ground or in holes in cliffs or trees. Rodrick and Milner (1991), in regard to the Washington distribution, state that harlequins breed in the Olympic, Cascade, Blue and Selkirk Mountains. Wintering areas include northern Puget Sound, northern Hood Canal, the Strait of Juan de Fuca, the San Juan Islands and the outer coast. Cottam (1939) lists prey items of harlequin ducks as including crustaceans, molluscs and aquatic insects. In wintering areas in Sequim Bay, Washington and in the Strait of Georgia, British Columbia, the food of harlequin ducks consisted of marine snails, fish eggs, limpets, crabs, chitons and bivalves from rocky shorelines (Gaines and Fitzner 1987, Vermeer 1983). It is likely that harlequin ducks are present on the Murray ownership during the breeding season, as the area contains suitable nesting habitat along the larger streams.

Mountain quail *(Oreortyx pictus)*

The mountain quail is found from northern Washington and Idaho south through Oregon, Nevada and California (Peterson 1961). Its status trend is listed as declining (USFWS 1991). The American Ornithological Union (1983) lists the habitat of the mountain quail as brushy mountainsides, coniferous forest, forest and meadow edges, dense undergrowth, and in more arid conditions in sagebrush, pinyon and juniper. Larrison and Sonnenberg (1968) list the mountain quail as an uncommon and scattered resident throughout Washington, particularly in southwestern Washington. They are associated with brushy areas on mountainous slopes, dense brush-grown burns, logged-off lands and groves along streams. The mountain quail may be present on Murray ownership, as its preferred habitat exists in the area.

Golden eagle *(Aquila chrysaetos)*

The golden eagle is found throughout the northern hemisphere in both arctic and temperate zones (Rodrick and Milner 1991). According to the American Ornithological Union (AOU), it breeds throughout western North America from western Alaska to northern Mexico (AOU 1983). The wintering range extends from south central Alaska, across the southern Canadian provinces, south to central Mexico and the Gulf coast of the United States. Rodrick and Milner (1991) state the golden eagle is found throughout Washington, mainly in the upper Columbia River Basin. It breeds in most counties, but is absent from the lower Columbia Basin and parts of the Puget Trough. Larrison and Sonnenberg (1968) consider it an uncommon summer resident of the open alpine areas of the Cascades, a fairly common scattered resident in eastern Washington and uncommon in western Washington except the San Juan Islands where it is regularly seen. Rodrick and Milner (1991) state the golden eagle requires large open areas for feeding, with nests being in large trees or on cliffs.

Bruce et al. (1982), in a survey of golden eagle nesting territories in western Washington, found four territories on the western slopes of the North Cascades, four in southwestern Washington, three on the Olympic Peninsula, and two in the San Juan Islands. Twelve of the 13 territories contained nests in large Douglas-fir trees in mature to old-growth forests. The remaining territories had nests found on cliffs. Nests were located at or below canopy height, with all of the nests adjacent to or within 1,650 feet of large clearcuts or open fields. Golden eagles were found to prey upon mountain beaver (*Aplodontia rufa*), snowshoe hare (*Lepus americanus*) and european rabbit (*Oryctolagus cuniculus*), which lived in clearcuts or open fields. Sightings of golden eagles have been reported on and near the Murray ownership and it is expected that they will continue to be present. One active golden eagle nest is known to occur in the western portion of the ownership.

Bald eagle *(Haliaeetus leucocephalus)*

The bald eagle is found throughout North America, primarily along coastlines, lakes and rivers (Peterson 1961). In western North America it breeds from central Alaska to southwestern New Mexico (AOU 1983). Its wintering range is similar but more concentrated from southern Alaska and Canada southward. In Washington it is most common along saltwater, lakes, and rivers in the western portion of the state and along the Columbia River east of the Cascade Mountains (Larrison and Sonnenberg 1968). Rodrick and Milner (1991) list its primary wintering range in Washington as Puget Sound and its major rivers (where spawned-out salmon carcasses are available). The bald eagle is listed as endangered in all western states except Washington and Oregon, where it is listed as threatened (USFWS 1990).

The habitat of the bald eagle is primarily near seacoasts, rivers and large lakes, breeding in tall trees or on cliffs (AOU 1983). Bald eagle nesting territories in 1981 to 1985 were scattered throughout western Washington, with higher concentrations in northern Puget Sound and the north and west coasts of the Olympic Peninsula (McAllister et al. 1986). There were 124 known territorial pairs in 1981 and 227 in 1985. An estimated 12 territories were also found along the Cowlitz River drainage from the Columbia up to north-central Lewis County near the Mineral Block. By 1991, 444 occupied nests were documented in Washington, 18 of which were in eastern Washington (WDW 1991b). This represented an increase of 44 new nests from the 1990 surveys. Productivity was slightly below 1 young per occupied nest for 15 consecutive years, which is a federally established recovery goal adopted by WDW. Reproduction of bald eagles along the Washington shoreline of the lower Columbia River continued to be low, with a productivity of only 0.14 young per occupied nest.

Bald eagles utilize nesting trees which are taller than surrounding trees and near water (Anderson et al. 1986). Breeding territories in Washington are located in predominantly coniferous, uneven-aged stands with old-growth components (Anthony et al. 1982). Douglas-fir and Sitka spruce (*Picea sitchensis*) trees within 300 yards of open water are often used as nesting trees, as are black cottonwood (*Populus trichocarpa*)trees near rivers (Anderson et al 1986). Most of the bald eagle nests in Washington are on islands and points along marine shorelines. The majority of nest building activity takes place in January and February in Washington, with egg laying in March and early April. Eggs hatch in mid-April and early May. Communal night roosts are used near feeding areas during the winter, usually in old-growth forest stands near rivers with salmon (Rodrick and Milner 1991).

Bald eagle prey include small fish such as herring (when abundant), large fish, water birds and small mammals (Anderson et al. 1986). In the winter bald eagles feed on carrion, waterfowl and spawned-out salmon along river banks. Knight and Knight (1983), in a study of food habits of wintering bald eagles, found that the numbers of eagles present along the Nooksack River, Washington corresponded closely with the number of salmon carcasses available; both peaked in January. The golden eagle nest on the Murray ownership previously was reported to be a bald eagle nest. No active bald eagle nests are known to occur on the Murray ownership.

Northern goshawk *(Accipiter gentilis)*

The northern goshawk is found in North America and Eurasia (Peterson 1961) and its status trend is listed as stable (USFWS 1991). In western North America it breeds from western and central Alaska to central California, southern Nevada, Arizona and New Mexico (AOU 1983). In Washington, the northern goshawk is an uncommon migrant and permanent resident throughout the state in timbered areas. It is less numerous west of the Cascades and more common east of that range, particularly in the forests of the northeastern and southeastern corners (Larrison and Sonnenberg 1968).

Larrison and Sonnenberg (1968) state that in eastern Washington the northern goshawk breeds most commonly in stands of Douglas-fir, lodgepole pine (*Pinus contora*) and aspen (*Populus* spp.), frequently along the edges of clearings. Nests consist of platforms of sticks in trees (Peterson 1961). Approximately 80 nests are known in Washington at the present time (Washington Environment 2010 1992). In a study of northern goshawk nest site characteristics in northern Idaho and western Montana, Hayward and Escano (1989) found the average nest tree was 85 feet tall, and 20 inches in dbh, with the nests being an average of 40 feet up the tree. Nests were found in mature and old-growth coniferous forest stands with a closed canopy near the bottom of north-facing moderate slopes. The nests were generally within 1,650 feet of water and large forest openings (Hayward and Escano 1989). In a 4-year study of breeding chronology of hawks in northeast Oregon, Henny et al. (1985) found that most northern goshawks observed in the study completed their egg laying in April. Larrison and Sonnenberg (1968) report that the northern goshawk preys upon snowshoe hares, ruffed grouse, ground squirrels and small birds. There are 4,505 acres of mature and old-growth forest on the Murray ownership where goshawks could be present.

Osprey *(Pandion haliaetus)*

The osprey, in the family Pandionidae, is found worldwide (Peterson 1961). In western North America it breeds from northwestern Alaska, the central Yukon and Great Slave Lake south to Mexico and northern New Mexico. It winters from southern California, Nevada, southern Arizona and southern Texas south. The habitat of the osprey is primarily along rivers, lakes and seacoasts (AOU 1983). In Washington, Rodrick and Milner (1991) state that the osprey is a summer resident along waterways east and west of the Cascade Mountains. Ospreys are found in western Washington from Bellingham to the Columbia River, and in forested portions of eastern Washington. Habitat requirements of the osprey include a source of live fish, available perch sites and nesting trees which consist of large snags or live trees with flat, broken tops near water and the relative lack of human disturbance (Rodrick and Milner 1991). Breeding pairs tend to return to particular nesting trees year after year.

The prey of ospreys are almost entirely live fish. In a study of osprey living near Cascade Reservoir in west-central Idaho, Van Daele and Van Daele (1982) found the prey fish of the ospreys to consist primarily of brown bullhead, rainbow trout, coho salmon (*O. kisutch*), kokanee salmon (*O. nerka*) and mountain whitefish (*Prosopium williamsoni*), northern squawfish, yellow perch (*Perca flavescens*) and largescale sucker (*Catostomus macrocheilus*). They found that ospreys with nests more than 4,900 feet from human disturbance were most productive, but ospreys did nest near human activity. Some birds are more tolerant of human disturbance than others.

It is possible that the osprey is an occasional visitor to the Murray ownership, along rivers and small lakes. The lack of large rivers and lakes makes nesting by ospreys unlikely on the ownership.

Vaux's swift *(Chaetura vauxi)*

Vaux's swifts breed in western North America from southeastern Alaska to central California, mainly west of the Cascades and Sierra Nevadas (AOU 1983). Vaux's swifts winter from central Mexico south through Central America and Venezuela. In Washington, it is a summer resident from April to

September in forested areas of the state (Larrison and Sonnenberg 1968). Rodrick and Milner (1991) and others state that Vaux's swifts nest in mature and old-growth coniferous forests. Carey (1989) lists it as dependent on old-growth Douglas-fir forests in western Oregon and Washington. Manual and Huff (1987) in a study of bird species associated with differing age Douglas-fir stands in the southern Washington Cascades, found Vaux's swifts to be the most strongly associated with old-growth stands of all species observed.

Vaux's swifts nest and roost at night inside large hollow snags or live trees with broken tops (Baldwin and Zaczkowski 1963, Bull 1991). They are also known to utilize chimneys for nesting and roosting (Baldwin and Hunter 1963, Baldwin and Zaczkowski 1963). Brown (1985) lists appropriate nest snags as having an average dbh of 25 inches and height of 40 feet. Rodrick and Milner (1991) recommend leaving forest stands older than 100 years as habitat for the Vaux's swift. Vaux's swifts feed on flying insects (Brown 1985). Vaux's swifts are known to be present seasonally in the summer on the Murray ownership and have been seen as recently as 1991 and 1992 (Bruce, pers. comm. 1993).

Pileated woodpecker *(Dryocopus pileatus)*
The pileated woodpecker is found in western North America from British Columbia to northern California (AOU 1983). It lives in both deciduous and coniferous forests. In Washington it is found throughout the state in dense forests of low to moderate elevation (Larrison and Sonnenberg 1968). Rodrick and Milner (1991) state that pileated woodpeckers inhabit mature and old-growth forests and second-growth forests with significant numbers of large snags and fallen trees. Bull (1987) found that the optimum habitat is in coniferous forest with two or more canopy layers, with the upper canopy being at approximately 80 to 100 feet high.

In a study in the Blue Mountains of northeastern Oregon, Bull (1987) found that typical nests (excavated in the wood) were in large-diameter dead trees with little bark, few limbs and broken tops. The trees were predominately ponderosa pine (*Pinus ponderosa*) (73%) and western larch (*Larix occidentalis*) (25%) that were on average 33 inches in dbh. Nest height averaged 49 feet. Comparing five studies conducted in Washington and Oregon (including Bull 1987), average nesting trees were greater than 27 inches in dbh, and 87 feet high, with preferred species being ponderosa pine, western larch, and black cottonwood east of the Cascades, and Douglas-fir and grand fir (*Abies grandis*) west of the Cascades

(Rodrick and Milner 1991). Pileated woodpeckers breed from mid-March to mid-July and spend most of the time foraging in forest stands older than 40 years. Roosting trees have similar characteristics to nesting trees.

Mannan (1984), in a study conducted in the Coast Range of Oregon, found that home ranges of pileated woodpeckers varied from 1,008 to 1,356 acres. The home range of pileated woodpeckers in Bull's 1987 study in northeastern Oregon averaged roughly 543 acres per pair. The pileated woodpecker is known to be present on the Murray ownership.

Gray wolf *(Canis lupus)*

The gray wolf was once found in most of North America, but is now restricted to Alaska, Canada, northern Washington, northern Idaho, northern Montana, Isle Royal National Park, Michigan and northeast Minnesota (Whitaker 1980). Hall (1981) shows it ranging throughout the Pacific Northwest prior to the 20th century. In Washington the gray wolf was eliminated as a breeding resident by 1930 (Young 1944). The last populations on the Olympic Peninsula, and in the Blue, Cascade and Selkirk Mountains were eliminated by the 1940s (Washington Environment 2010 1992). Laufer and Jenkins (1989) evaluated gray wolf sightings in Washington from the period 1973 to 1988. They estimated that 31 observations were "probable" or "possible", with the reports being concentrated in the areas near Baker Lake and Ross Lake in the North Cascades, and near Mount Rainier. More than twice as many of these sightings were in the years 1986 to 1988 as in the previous years. These recent sightings, along with the proximity of viable wolf habitat in nearby areas in southern British Columbia, led to the conclusion that gray wolves were recolonizing the Cascade Mountains. A set of wolf tracks in the North Cascades was confirmed by biologists in 1989 (Washington Environment 2010 1992). In 1990, breeding wolves were confirmed in Washington for the first time since the early 1900s, with the discovery of two dens (WDW 1991b, Washington Environment 2010 1992). In the spring and summer of 1991 wolves were again confirmed in the North Cascades. Wolf pack activity has been recorded in North Cascades National Park, the Wenatchee National Forest, and Lake Chelan National Recreation Area. The USFWS is preparing a Recovery Chapter for the Gray Wolf in Washington that is expected to be completed in late 1993.

Whitaker (1980) lists the habitat of the gray wolf in North America as being open tundra and forests. The habitat of the gray wolf in British Columbia covers areas from sea level to timberline. The presence of wolves in a particular area was found to be due to the availability of suitable prey, and was not linked to the existence of a particular habitat type (Stevens and Lofts 1988). Ingles (1965) lists the prey of the gray wolf as ground squirrels, rabbits and hares and larger mammals such as deer, elk, bighorn sheep and mountain goats. Stevens and Lofts (1988) also add moose, caribou and beavers to this list for British Columbia. Two home ranges for wolf packs on Vancouver Island were 40 and 47 square miles, and in northern British Columbia they varied from 93 to 248 square miles (Scott 1979).

Occasional unconfirmed sightings of gray wolves are made to the northeast and east of the Murray ownership, most recently in 1992 (Behan, pers. comm. 1993). The possibility exists that wolves occasionally use the ownership.

Grizzly bear *(Ursus arctos)*

The grizzly bear was once found throughout the western United States, Canada and the mountains of northern Mexico (Hall 1981). The species is considered to include both the Alaska brown bear and the grizzly bear, although formerly up to 94 species and subspecies of grizzly bear were listed (Hall 1981, Ingles 1965). Its range in the lower 48 states is now limited to relatively small populations in the North Cascades and Selkirk Mountains in Washington, and the northern Rocky Mountains in Idaho, Montana and Wyoming to south central Nevada (Whitaker 1980, Larrison 1976, Washington 2010 1992). Occasional recent sightings of grizzly bears and/or their tracks have been made in the North Cascades of Washington. It is believed that these are recent dispersers from viable populations in southern British Columbia. At the present time it is estimated that there are approximately 10 individuals in the North Cascades and 18 in the Selkirk Mountains in northeast Washington (Washington 2010 1992).

The habitat of the grizzly bear is listed as semi-open country usually in mountainous areas (Whitaker 1980). The grizzly bear is considered omnivorous, consuming many kinds of plants including roots or sprouts, fungi, berries, fish, insects, large and small mammals and carrion (Whitaker 1980). Grizzly bears also tear apart logs and ant hills for insects and excavate tracts of ground for rodents and tuberous roots (Stevens and Lofts 1988). The mating season for grizzly bears is June to July, with cubs being born from January to March (Whitaker 1980). There is no recent evidence of grizzly bear reproduction in western Washington.

The North Cascades in north central Washington and the Selkirk Mountains in northeast Washington have been designated as a grizzly bear recovery areas. Currently no plans exist for recovery in the southern Washington Cascades. The potential exists for grizzly bears to use the Murray ownership due to its proximity to the Cascade Range and Mount Rainier National Park, but the potential is extremely low as the grizzly bear has not been reported south of Interstate 90 for several decades.

California wolverine *(Gulo gulo luteus)*

The California wolverine, in the family Mustelidae, is found in California, Oregon and Washington and its status trend is listed as unknown (USFWS 1991). The USFWS (1991) distinguishes the California wolverine from the North American wolverine, *Gulo gulo luscus*, which is found in Colorado, Idaho, Minnesota, Montana, North Dakota, Nevada, Utah and Wyoming.

Larrison (1976) lists the habitat of the wolverine as mostly coniferous timbered areas, especially in mountains. Stevens and Lofts (1988) list the habitat of *Gulo gulo* in British Columbia as conifer-dominated habitats, alpine tundra and fresh water emergent wetland habitats. Brown (1985) lists the primary habitat for wolverines to be conifer forests of subalpine forest parks and forested wetlands, with large sawtimber, old-growth, grass and shrub habitats used as secondary habitats. Wolverines prey upon carrion, small mammals, birds, bird eggs, insects and insect larvae in summer (Stevens and Lofts 1988). In winter they are capable of preying on large mammals in deep snow. The breeding period for wolverines is April to September, with the young born in early spring in dens located in protected areas such as thickets or rock crevices (Whitaker 1980). Subalpine habitats are rare on Murray ownership and there are only scattered areas of mature and old-growth forest remaining. It therefore seems unlikely but possible that the California wolverine is present on Murray ownership.

Pacific fisher *(Martes pennanti)*

The Pacific fisher, in the family Mustelidae, is found across southern Canada, in forested regions of the western United States and in New England and New York (Whitaker 1980). The range of the Pacific fisher includes most forested areas of Washington, Oregon and northern California, but it is considered rare throughout its range. It is most common in the Olympic Mountains, North Cascades and Okanogan areas in Washington and is absent in the southern Cascades (Yocom and McCollum 1973). It is believed to be associated with closed-canopy forest at low to mid elevations.

The Pacific fisher feeds on porcupines, squirrels, wood rats, hares, mice and grouse. Individual home ranges are large (up to 10 square miles in Canada) and in the opinion of WDW, large undisturbed tracts of mature coniferous forest (at least 100 square miles) are needed to maintain viable populations of fisher (Rodrick and Milner 1991). Because of the fisher's reluctance to use or cross large forest openings, it is believed they are rare in highly fragmented habitats. An unconfirmed sighting of a fisher was made along the eastern edge of the Murray ownership as recently as 1991 (Behan, pers. comm. 1993), signaling the potential that fishers could be present in the HCP plan area.

1.5 OVERVIEW OF THE REGULATORY PROCESS

1.5.1 Federal Endangered Species Act

The Federal ESA was created in 1973 with the purpose of conserving threatened and endangered species of plants and animals and the ecosystems upon which they depend (16 USC 1531-1543). The ESA is administered by the Secretaries of the Interior and Commerce, with the major responsibility for the protection of terrestrial plants and animals lying with the USFWS under the Secretary of the Interior. The ESA has been amended seven times since 1973, most recently in 1988. Under the ESA, species listed as "threatened" or "endangered" are afforded protection from federal actions that would adversely modify critical habitats for the species or jeopardize the continued existence of the species. The ESA also contains provisions prohibiting the "taking" of individuals of listed species by any individual or agency. Taking is defined as any action that would harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect a listed species.

As defined in the ESA, an endangered species is one that is, "in danger of extinction throughout all or a significant portion of its range," and a threatened species is one that "is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range." Factors which are recognized in the ESA as contributing to the listing of a species are: a) the present or threatened destruction, modification or curtailment of its habitat or range; b) over-utilization for commerce, recreation, scientific or educational purposes; c) disease or predation; d) the inadequacy of existing regulatory mechanisms and e) other natural or manmade factors. The Secretaries of Commerce and the Interior are directed by the ESA to determine those species that meet the definitions of threatened and endangered, and concurrent with such determinations, identify critical habitats for the species. Critical habitats are defined as the geographic areas on which are found those physical or biological features essential to the conservation of the species and which may require special management considerations or protection. Review for listing can be initiated by the Secretaries (or their designated agencies), or by petition from an interested party. Listing decisions are to be based on the best scientific data available at the time of review. Once a species is listed, the Secretaries are directed by the ESA to develop plans for the recovery (i.e., de-listing) of the species. Enforcement of the provisions of the ESA with regard to take lies with the USFWS and the National Marine Fisheries Service.

The northern spotted owl was listed by the Secretary of the Interior as threatened throughout its range on 23 July 1990. The basis for listing was declining population numbers due to the loss of habitat from commercial harvest of mature and old-growth coniferous forest throughout the range of the subspecies. Critical habitat was identified in final form in January 1992. A Draft Recovery Plan was issued in April 1992 and a final is expected sometime in 1993. Concurrent with listing of the spotted owl, the USFWS released a guidance document titled *Procedures Leading to Endangered Species Act Compliance For The Northern Spotted Owl*. In that document, the USFWS reviewed the biology and ecology of the spotted owl in an effort to clarify the definition of taking as it pertained to the owl. Available data on habitat use and home range size were used to estimate the habitat requirements of resident spotted owls, and it was suggested that alteration of habitat to the extent that resident owls would be displaced or would cease to attempt reproduction would be considered a taking. For ease of administration, the USFWS recommended circular areas representing the median home range size for spotted owls in each of six physiographic provinces. Home ranges ranged in size from 2,500 acres in the Klamath Province to 9,900 acres on the Olympic Peninsula of Washington. Within each home range, the USFWS interpreted the available data as indicating that an individual spotted owl's ability to feed, breed or find shelter could be significantly impaired if less than 40 percent of the total habitat is in a condition suitable for owls. It is generally believed that foraging efficiency drops and the risk of predation increases as the habitat within a spotted owl's home range becomes increasingly fragmented or interspersed with unsuitable habitat (i.e., forest of trees too small and/or widely spaced to provide cover from predators or support prey). Forty percent suitable habitat in a home range is believed to approximate the threshold below which a significant proportion of resident owls will cease to breed. The USFWS interpreted the definition of taking to include any harvest or forest management activity that would reduce the total available habitat within a known spotted owl home range below the 40 percent level. The USFWS applied similar logic to a smaller circle of 1,000 acres centered on a nest or owl activity center (stating that at least 50 percent of the 1,000 acres should remain suitable for owls) and the best 70 acres immediately surrounding the nest or activity center (recommending that no harvest activity or habitat alteration take place in that area).

The USFWS guidelines defining the risk of take were rescinded on 2 October 1991, but they continue to form the biological basis for the informal determination of taking by a number of federal and state agencies involved with spotted owl management. The two resident spotted owl home ranges centered on the Murray ownership currently (as of 1993) contain 18 and 30 percent suitable habitat for spotted owls, clearly below the 40 percent level recommended by the USFWS. Continued harvest in either circle would, according to the USFWS guidelines, constitute a taking of spotted owls by decreasing the likelihood that they could remain resident on the sites.

Exemptions to the take prohibitions can be issued for "incidental taking", which is defined as taking that is incidental to an otherwise legal activity. Provisions for incidental take are contained in the ESA in Section 7 (for federal agencies) and Section 10 (for individuals and non-federal agencies). An exemption to the take prohibition for a non-federal entity requires the issuance by the USFWS of a permit for incidental take. To receive a permit for incidental take, an applicant must first submit a conservation plan that specifies: a) the impact(s) that will likely result from the taking, b) the measures the applicant will take to minimize and mitigate the impacts, c) the source of funding available to implement the measures, d) alternatives to the taking and the reasons the alternatives were not chosen and e) any other measures considered by the Secretary (i.e., USFWS) as necessary or appropriate for minimizing or mitigating the impacts of the taking. The USFWS may then issue a permit for incidental take if it finds that: a) the taking will be incidental and not intentional, b) the applicant will minimize and mitigate the impacts of the taking to the maximum extent practicable, c) the applicant will ensure adequate funding for minimization, mitigation and monitoring, d) the taking will not appreciably reduce the likelihood of survival and recovery of the species and e) any other measures considered necessary or appropriate by the Secretary will be met. Prior to issuance of the permit, the Secretary must issue public notice of the proposed permit in the Federal Register and accept public comment.

The Murray HCP has been prepared in accordance with Section 10 of the ESA. It will accompany Murray's application to the USFWS for a permit for incidental take. It constitutes Murray's compliance with the requirements of Section 10 and demonstrates that the taking will be incidental, the impacts of the taking will be minimized and mitigated to the maximum extent practicable, mitigation measures will be adequately funded and the incidental taking will not reduce the likelihood of survival and recovery of the spotted owl in the wild.

1.5.2 National Environmental Policy Act

The National Environmental Policy Act (NEPA) of 1969, as amended, requires full public disclosure and analysis of the environmental impacts of a proposed federal action. The issuance of a permit for taking under Section 10(a) of the ESA constitutes a federal action on the part of the USFWS (or Department of Commerce), and therefore requires compliance with NEPA. Such compliance occurs in two stages; a threshold determination as to the significance of potential impacts, and the preparation of an Environmental Impact Statement (EIS) if the potential impacts are found to be significant. The threshold determination is accomplished through preparation of an Environmental Assessment (EA), which is an overview of all potential or anticipated impacts of the proposed action and its alternatives on the natural and human environments. The lead agency for the action (i.e., the USFWS) reviews the EA and makes the threshold determination. A publicly noticed Finding of No Significant Impact (FONSI) on the part of the lead agency concludes the NEPA process for actions with minor or insignificant impacts. Actions that are found to have the potential for significant impacts are subjected to a more detailed review in an EIS, which is prepared in consultation with appropriate regulatory and public groups and distributed for public review. The formal threshold determination and preparation of an EA can be foregone for those actions that clearly will have significant environmental impacts, and the lead agency can proceed directly to the preparation of an EIS. Both an EA and an EIS can, and often are, prepared by non-federal applicants or third-party consultants to the applicant and lead agency.

1.5.3 Washington Forest Practices Act

The Washington Forest Practices Act (RCW 76.09) and the implementing Forest Practices Rules and Regulations (WAC 222-08) are the principal means of state control of activities on private forestlands in Washington. Administered and enforced by the Washington Department of Natural Resources, the Forest Practices Rules and Regulations address most issues of concern on forested lands, including harvest practices, regeneration, pesticide application, road construction and the protection of other public resources such as water quality, fisheries and wildlife. Most activities on private forestlands require a Forest Practices Notification or Approval from the DNR, the issuance of which is contingent upon compliance with provisions of the Act and regulations. The most recent revisions to the Forest Practices Rules and Regulations became effective 1 August 1992 and included expanded provisions dealing with watershed analysis, the protection of wetlands, fish and wildlife habitat and overall environmental review under the Washington State Environmental Policy Act (SEPA). Most or all provisions within the Forest Practices Rules and Regulations ultimately influence wildlife habitat by regulating how and when certain activities may take place on private forestlands. Some of these provisions have relatively minor and/or indirect impacts on wildlife or their habitats and will not be discussed here. The regulatory provisions with the greatest and most direct influence on wildlife habitat, particularly on the Murray ownership, include the following:

WAC 222-16-080 Critical Wildlife Habitats of Threatened and Endangered Species

This section provides protection for habitats considered by the Washington State Forest Practices Board to be critical to the survival of forest-dwelling wildlife species listed as threatened or endangered. Forest practices (e.g., timber harvesting) within designated critical wildlife habitats are considered Class IV-Special, requiring environmental review under SEPA prior to approval by the DNR. Currently nine species and their critical habitats are identified in WAC 222-16-080, and provisions are made for future additions to the list. This section also provides for a review of current regulatory protection of wildlife and consideration of a more comprehensive and scientifically-based regulatory system by May 1993. Subparagraph (7)(a) exempts from regulation under this section all lands covered by a conservation plan approved by the USFWS.

An approved HCP for the Murray ownership would constitute a conservation plan under subparagraph (7)(a) and would exempt the ownership from regulation of spotted owls under WAC 222-16-080.

Critical habitat for the northern spotted owl is defined in subparagraph (1) (n) as "the 500 acres of suitable nesting, breeding and foraging habitat surrounding the activity center," of a pair of owls or resident single owl. This definition is stated as interim, pending the resolution of spotted owl protection and recovery plans at the state and federal level. Timber harvest, road construction and general application of pesticides within critical spotted owl habitat are all Class IV-Special forest practices and are subject to SEPA review. Paragraph (2) allows for site-specific management plans prepared by the landowner and approved by the WDW to replace other requirements for protection of critical habitats in this section.

WAC 222-22 Watershed Analysis

This new chapter in the Forest Practices Rules and Regulations creates a framework and methodology for conducting analyses of the cumulative impact of forest practices at the watershed level. While it is directed specifically at the analysis and protection of fish, water and capital improvements, and contains no provision for wildlife or non-aquatic wildlife habitat, it is likely to have an influence on wildlife by altering the type, number and timing of forest practices that occur in a watershed. To-date, no watershed analysis has been completed and implemented under the new regulations, but several landowners, including Murray Pacific, are in the process of conducting analyses.

WAC 222-24 Road Construction and Maintenance

A number of regulatory limitations on road construction and maintenance provided in this chapter have a direct or indirect influence on wildlife habitat. Specifically, WAC 222-24-010 sets limits on the construction of roads in and near wetlands to protect wildlife habitat, among other wetland functions. WAC 222-24-025 requires replacement of wetlands and their functions when greater than 0.5 acre of any one wetland is filled in the course of forest road construction. Other provisions within this section set limits on the placement of fill in wetlands, creation of log landings near wetlands and maintenance and abandonment of roads, all of which have minor but cumulative effects on certain wildlife habitats.

WAC 222-30 Timber Harvesting

The Forest Practices Rules and Regulations set a number of limits on the size, location, timing, spacing and type of harvesting that may occur. These influence wildlife habitat primarily at the landscape level by affecting the size and interspersion of forest successional stages that provide varying types of habitat. Those regulations with the most direct effect on wildlife habitat are:

WAC 222-30-020 (3) Western Washington Riparian Management Zones and (5) Riparian Leave Areas (establish protective buffers of varying widths along streams and wetlands)

WAC 222-30-020 (6) Forested Wetlands; (7) Wetland Management Zones and (8) Non-Forested Wetlands (set standards for harvesting in and near wetlands)

WAC 222-30-020 (10) Wildlife Habitat (encourages landowners to protect wildlife habitat through the use of appropriate silvicultural and harvest methods)

WAC 222-30-020 (11) Wildlife Reserve Tree Management (requires landowners to leave three wildlife reserve trees (snags) two green recruitment trees (potential future snags) and two down logs for each acre of forestland harvested; snags must be at least 10 feet tall and 12 inches in dbh; green recruitment trees must be at least 30 feet in height and 10 inches in dbh with at least 1/3 of the total tree height in live crown; down logs must be at least 20 feet long and 12 inches in diameter at the small end; trees may be clumped, but no point in a harvest unit can be more than 800 feet from a snag or green recruitment tree.

WAC 222-30-025 Even-aged Harvest Size and Timing

This new section sets an upper limit on even-aged harvest (e.g., clearcutting) at 240 acres; with harvests over 120 acres subject to review by an interdisciplinary team at the discretion of the DNR. The spacing and timing of harvest are controlled by specifying that: a) at least 30 percent of the perimeter of a proposed harvest unit must border trees that are at least 30 years old, or b) at least 60 percent of the perimeter must border trees that are at least 15 years old or c) at least 90 percent of the perimeter must border trees that have survived on the site at least 5 years or reached an average height of 4 feet.

WAC 222-34-010 Required Reforestation West of Cascades Summit

Reforestation is required on all forestlands following even-aged harvest, with few exceptions. Reforestation may be natural or through artificial means (i.e., planting of seedlings). Under artificial regeneration, which is widely practiced on industrial forestlands, there must be a minimum of 190 well-distributed, vigorous, undamaged seedlings per acre of a commercial species within 3 years after harvest.

Regulation of the Murray ownership under the Forest Practices Act will not change as a result of the HCP, with the exception that state protection of spotted owls will be preempted by the approved HCP. All other provisions of the Forest Practices Rules and Regulations will be in effect on the Murray ownership, as they would be in the absence of an HCP. Management under the HCP must proceed in compliance with the state act and regulations.

2.0 THE HABITAT CONSERVATION PLAN

2.1 OBJECTIVES

2.1.1 Recommendations of the Interagency Scientific Committee to Address the Conservation of the Northern Spotted Owl

Prior to the formal listing of the spotted owl under the federal ESA, the ISC was established by the USFS, BLM, USFWS and National Park Service (NPS) to prepare a plan for the management of the owl. Biologists of the sponsoring federal agencies, along with representatives from the states of California, Oregon and Washington, the forest products industry and the Wilderness Society, prepared a comprehensive plan for spotted owl management known as the ISC Report (Thomas et al. 1990). By definition, the ISC Plan is a strategy for maintaining a viable, well-distributed population of northern spotted owls over the next 100 years. The ISC Report has been widely recognized as a benchmark accomplishment in endangered species management and has served as a basis for much of the planning and management that has occurred since.

The plan presented in the ISC Report is based on the management of spotted owl habitat in geographic units known as Habitat Conservation Areas (HCA). Each HCA is designed to contain sufficient habitat to support a minimum of 20 breeding pairs of owls (with some exceptions). Twenty is believed to be the minimum number of pairs necessary to minimize the chances of local extinction within each HCA. Individual HCAs are to be spaced no more than 12 miles apart, which is the theoretical distance that at least 66 percent of juvenile birds will disperse. By managing for local populations of 20+ breeding pairs within HCAs and adequate dispersal of juvenile owls between HCAs, the ISC believed the chances of local or widespread extinction would be negligible and the species would persist at least 100 years.

The ISC Plan included a set of maps designating HCAs according to the criteria described above. Three HCAs were identified in the immediate vicinity of the Murray lands; HCA W-10 encompasses the USFS lands in the Mineral Block west of Murray ownership and HCAs W-2 and W-3 lie on USFS lands to the east of Murray, within the main body of the Cascade Mountains (Figure 2-1). HCA W-10 is of particular interest because it illustrates a number of the exceptions encountered by the ISC when designating the management areas. W-10 represents the western-most HCA associated with the Cascade Mountains in Washington, and therefore becomes important as a link between the Cascades and the Olympic Peninsula. The isolation of the Olympic Peninsula population of spotted owls was of particular concern to the ISC, and every effort was made to form a link of suitable habitat between the two. HCA W-10 is part of that link. Unfortunately, W-10 is not large enough to support 20 pairs of owls, nor is it within 12 miles of the next nearest HCA. The estimated future capacity of W-10 (under full habitat recovery) is only nine pairs of owls. The distance from W-10 to W-3 (the nearest HCA) is at least 13 miles. The distance to W-43, the nearest HCA to the west, is roughly 16 miles. When the capacity of an HCA is less than 20 pairs of owls, the ISC recommends a maximum spacing between HCAs of 7 miles. Neither option is available in the Mineral Block without reliance on non-federal lands. Murray lands (and other non-federal lands) in the Mineral Block, therefore, become important to successful implementation of the ISC Plan.

The following recommendations from the ISC Report are relevant to non-federal lands in the Mineral Block:

a. "The Committee (ISC) ... also recommend(s) that resource managers of other State lands, tribal lands, other Federal lands and private lands use forestry and silvicultural techniques and practices that maintain or enhance habitat characteristics associated with spotted owls," (Thomas et al. 1990, p. 29)

b. Lands between designated HCAs (i.e., "matrix lands") should be managed to provide, at a minimum, "connectivity" of HCAs and facilitate successful dispersal of juvenile owls from one HCA to another. (Thomas et al. 1990, p. 26). Narrow, well-defined corridors of suitable dispersal habitat are not considered beneficial to owls. Rather, a "general forest landscape ... amenable to dispersal by juvenile owls," is recommended.

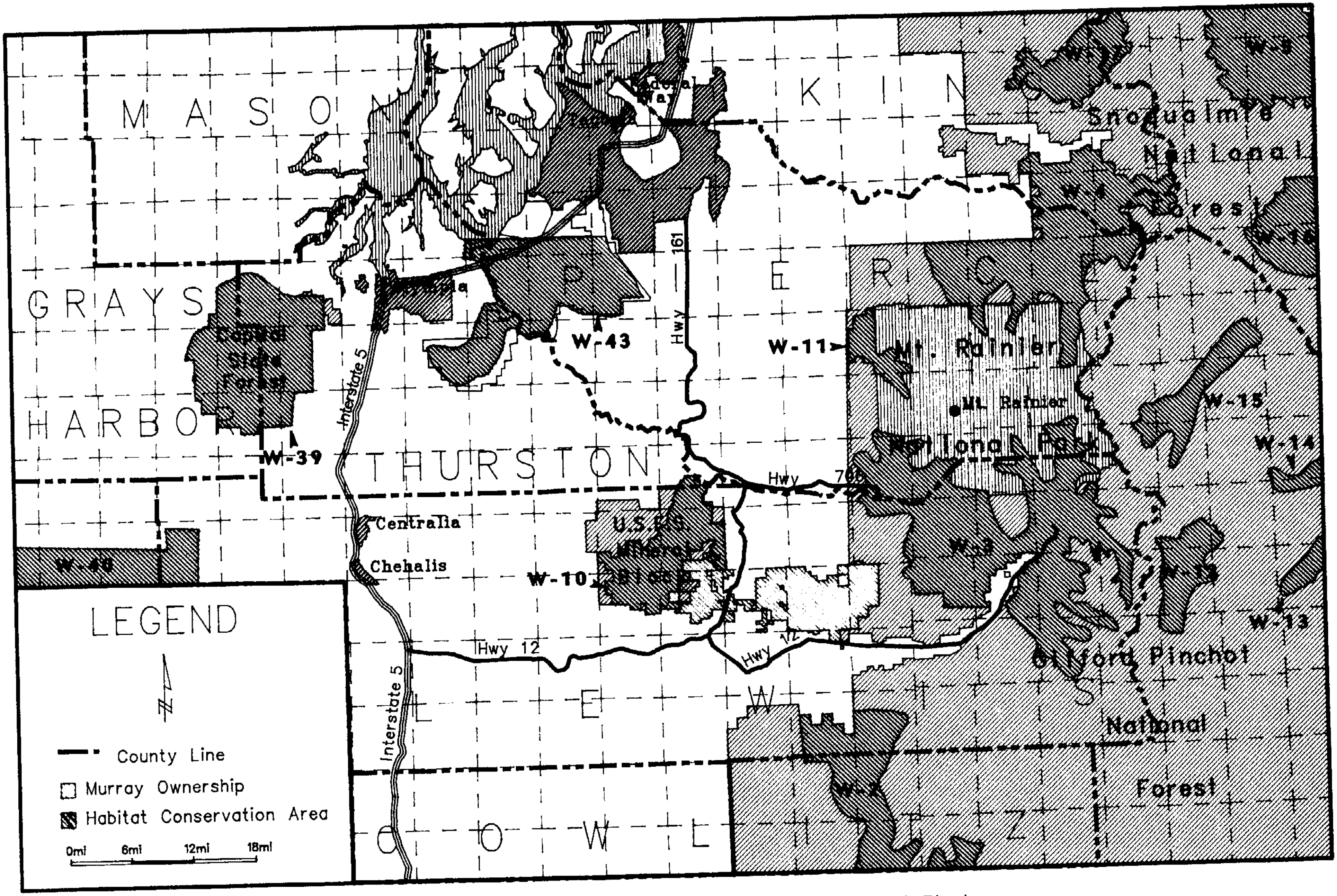

Figure 2–1. Spotted Owl Habitat Conservation Areas in the vicinity of the Mineral Block.

2.1.2 Recommendations in the Draft Federal Recovery Plan for the Northern Spotted Owl

A Draft Recovery Plan for the northern spotted owl was issued in April 1992 in accordance with Section 4(f)(1) of the ESA. While the Draft Recovery Plan (and presumably the Final) has a biological basis similar to the ISC Report, the objective of the Recovery Plan goes beyond maintenance or survival of the species to full recovery (i.e., de-listing).

The Draft Recovery Plan builds largely upon the biological principals and management recommendations presented originally in the ISC Plan. A system of population management areas (now called Designated Conservation Areas, or DCAs) interconnected by dispersal habitat forms the basis for the Draft Recovery Plan. Most of the HCA's identified in the ISC Plan (including W-10) are included in the Draft Recovery Plan with only minor modification. The most significant difference between the two plans is that the Draft Recovery Plan places greater reliance on the contribution of non-federal lands to future habitat management.

One of the primary objectives of the Draft Recovery Plan is that it, "... should be comprehensive... and serve as a guide to future federal, state and private activities affecting the owl, "(Lujan et al. 1992, p. 99). The Draft Recovery Plan states that contributions to recovery should be recognized, including those on non-federal lands, but only those non-federal contributions necessary to recovery should be required so as to minimize the cost of recovery and provide an incentive for non-federal landowners to prepare long-term conservation plans (Lujan et al. 1992, p. 99). Non-federal contributions suggested by the preparers of the Draft Recovery Plan include: a) helping to meet DCA objectives on non-federal lands inter-mixed with federal lands (i.e., non-federal lands within DCA boundaries, b) providing clusters of breeding pairs on non-federal lands outside DCAs, c) providing habitat for individual owl pairs outside DCAs and d) providing dispersal habitat (Lujan et al. 1992, p. 106).

The Draft Recovery Plan includes the Mineral Block within the Western Washington Cascades Province. Specific objectives for the Mineral Block that pertain to non-federal land are:

a. Supplemental pair areas on non-federal lands within and directly adjacent to DCA WD-10 (referred to as HCA W-10 in the ISC Plan) are recommended to increase the capacity of the DCA from the current projection of eight (on federal lands) to a minimum of 15.

b. Management for dispersal habitat is recommended between DCA WD-10 and DCAs WD-2N and WD-3 (referred to as HCAs W-2 and W-3 in the ISC Plan).

The Draft Recovery Plan states that both objectives are "extremely important to the development of stable owl subpopulations in the province", (Lujan et al. 1992, p. 157).

The Murray HCP is prepared to assist survival of the spotted owl as a species in keeping with Section 10(a) of the ESA. It is consistent with the biological principals and objectives of the Draft Recovery Plan, and should contribute to eventual recovery of the species, even though this is neither a requirement nor a primary objective of an HCP.

2.1.3 Objectives for the Murray HCP

The HCP Team established the following objectives for the Murray plan:

a. The HCP should provide a system that allows Murray the flexibility to manage its timberlands economically while contributing in a meaningful way to the conservation of the northern spotted owl.

b. The HCP should provide a framework for management of the Murray lands that will meet the needs of Murray and the spotted owl over the 100-year life of the take permit.

c. The HCP should incorporate, wherever possible, habitats created or protected under other regulatory and/or management programs (e.g., riparian management zones, un-harvestable slopes, wetlands, upland wildlife management areas, etc.).

d. The HCP should consider the effects of owl management on other species of plants and animals within the Murray lands and provide habitat for those species wherever possible without compromising the benefits to spotted owls or foreclosing Murray's management options.

e. The HCP should comply with all other local, state and federal laws and regulations pertaining to the management of forestlands and wildlife.

2.2 REVIEW OF DISPERSAL HABITAT

Dispersal has been defined as "... the movement the animal makes from its point of origin to the place where it reproduces or would have reproduced if it had survived and found a mate" (Howard 1960). It is distinguished from movements made by individual animals within their home ranges and seasonal migrations made between winter and summer habitats. Juvenile dispersal best fits the definition offered by Howard (1960) of "innate dispersal", which is a spontaneous, random movement related more to the genetics of the individual rather than proximal environmental conditions. "Environmental dispersal", as defined by Howard (1960) is the movement of animals in response to unfavorable conditions and it is usually more directed and of a shorter distance than innate dispersal.

In a review of movements among a wide range of vertebrates, Howard (1960) found that innate dispersers: a) initiate dispersal at about the time of puberty or the onset of sexual maturation; b) disperse regardless of environmental conditions at the natal area such as over-crowding, lack of food or aggressive behavior by the parents; c) move rapidly away from the natal area and select a new territory within a short period of time; d) move randomly through the landscape during dispersal, frequently crossing unfavorable habitat while passing-up favorable habitat; e) move farther than they need simply to avoid competition with their parents or locate a suitable breeding site and f) rarely re-initiate dispersal once they have settled and become sexually active.

Juvenile spotted owls initiate dispersal in September and October of their first year. In Oregon, Forsman et al. (1984) monitored two owls that moved out of the nest area during the second week of October. Miller (1989) found initiation of dispersal to occur between 21 August and 4 November in Oregon, with 84 percent of his owls dispersing between 11 September and 20 October. Gutierrez et al. (1985) reported a similar trend in California, where 64 percent of the juvenile owls initiated dispersal between 19 and 23 September. In Washington, Allen and Brewer (1985) reported that owls dispersed in September and early October and Herter (1992) found owls at high elevations in the Washington Cascades began dispersing in early October.

Dispersal is rapid at first, but is interrupted by a period of "settling" in the winter. Both Gutierrez et al. (1985) and Miller (1989) reported active and settled phases to dispersal. After a few weeks of active dispersal, during which the owls moved an average of 1.0 mile/day (Miller 1989) or 1.3 to 5.0 miles/day (Gutierrez et al. 1985), they settled into winter areas. During the settled phase, home range size ranged from 882 to 1,125 acres in California (Gutierrez et al. 1985) and from 128 to 5,414 acres in Oregon (Miller 1989). Juveniles that died during the settled phase in Oregon had considerably smaller home ranges than those that survived and re-initiated dispersal. Average home range size for juveniles that survived the first winter in Oregon was 3,173 acres, with a range from 1,213 to 5,414 acres (Miller 1989).

Total straight-line distance between the nest and the final point of detection (which represented the location of death for many juvenile owls) has been reported to average 28.3 miles in California (Gutierrez et al. 1985), 17.5 miles in Oregon (Miller 1989) and more than 30 miles in some cases in Washington (Allen and Brewer 1985). Gutierrez et al. (1985) also reported maximum distances traveled by owls of 19.0 to 97.6 miles, but since the dispersal movements were not strongly directional the total distance from the nest to final location was considerably less. Miller (1989) noted that owls that survived until their second year had a mean straight-line dispersal distance of only 9.4 miles, considerably less than the overall average of 17.5 miles that included first-year mortalities. It could be inferred from this that first-year survival depends on how quickly an owl locates suitable, vacant habitat in which to settle.

Spotted owls appear to move randomly across the landscape while dispersing, but they tend to show some preference for roosting in older forest stands. Forsman et al. (1984) noted that one dispersing juvenile they studied, "apparently traveled across extensive areas of open ponderosa pine forest," to reach a stand of old-growth Douglas-fir, true fir and pine. Gutierrez et al. (1985) documented dispersing juveniles readily crossing major topographic ridges and rivers as well as habitats that would otherwise be considered unsuitable. They noted, however, that the owls frequently died in these unsuitable habitats. Dispersing juveniles in Washington followed by radio-telemetry were found to use a variety of habitats, only a few of which fit the definition of suitable adult spotted owl habitat (Allen and Brewer 1985). Miller (1989) who performed the most detailed analysis to date of habitat used during dispersal, found no correlation between the degree of fragmentation of the landscape (i.e., inter-mixing of old and young forest) and either the total distance traveled or the ultimate survival of the owl. He did find, however, that dispersing owls selected mature and old-growth forest for roosting. The owls were observed roosting in a wide variety of habitats, but mature and old-growth forest were used disproportionate to their availability. Closed sapling pole/sawtimber habitat was used roughly in proportion to its availability, while younger forest types were avoided. The closed sapling pole/sawtimber forest stand condition is defined by Hall et al. (1985) as coniferous forest with average stand dbh between 1 and 21 inches and canopy closure exceeding 60 percent. Understory ground cover is typically sparse in this stand condition. Obviously, the wide range of tree sizes included in this stand description makes accurate estimation of spotted owl habitat requirements difficult, and probably accounts for the neutral preference for this habitat type observed by Miller (1989). In all likelihood, dispersing owls selected for the stands of larger trees in this type, and against stands at the smaller end of the range.

A model of spotted owl dispersal emerges from the available data, and it fits the definition by Howard (1960) of innate dispersal. Juveniles leave the natal area rather abruptly during their first fall, at about the time they reach physical maturity. Few data exist on parent-juvenile interactions prior to dispersal, but the fact that dispersal takes place during a time when adult territoriality is at an annual low suggests juveniles are not forced to leave by their parents. Mean final dispersal distances exceeded 15 miles in all studies (Allen and Brewer 1985, Gutierrez et al. 1985 and Miller 1989) which is considerably longer than the average home range radius of 1.2 to 2.2 miles (Thomas et al. 1990), further suggesting that juveniles are not dispersing simply to avoid competing with their parents. It is possible that juveniles disperse in response to decreased availability of prey in the natal area, as this has been suggested as a reason for the seasonal shift in home range among adults (Forsman et al. 1984), or they may leave in search of food after the adults stop feeding them in late August or early September (Miller, pers. comm. 1992), but the tendency for juvenile owls to pass over patches of suitable habitat along the dispersal path suggests they are searching for something other than the nearest available foraging habitat. While the exact reasons for dispersal are not known, Howard's hypotheses of gene flow and recolonization of vacated habitats are the most likely (Howard 1960).

Once they begin dispersing, juvenile owls move quickly through the landscape, utilizing mature and old-growth habitat in their paths, but apparently not being deferred in their movements by fragmentation of the habitat. Dispersing owls select the traditional "suitable" habitat types when they are available, but they will readily cross and roost in other habitat types if older forest is not present. This is not necessarily maladaptive behavior, given the assumption that dispersal serves to maintain the flow of genes between segments of the population and re-colonize vacant habitats. The habitats and populations in most need of contact by dispersing juveniles are those that are physically isolated by interruptions in the habitat. The hazards associated with crossing unsuitable habitat are probably outweighed by the genetic advantages of reaching a vacant habitat patch or introducing a new genotype into a population. Nevertheless, from a management standpoint it would be futile to create a landscape that would require juvenile owls to follow a particular course during dispersal. If they are truly moving in a random manner, they are just as likely to move into unsuitable habitat as into suitable. Rather, the emphasis should be on providing suitable roosting and foraging habitat in such a manner that an owl moving randomly across the landscape is more likely to encounter suitable habitat than unsuitable habitat. This is the approach described in the ISC Report as a "general forest landscape ... amenable to dispersal" (Thomas et al. 1990).

Most dispersing owls move well beyond the limits of their parents' territories before settling. Some settle temporarily during their first winter, only to settle on a more permanent basis once they establish a territory and become reproductively active. Dispersal among adults is rare, and may be due to disruption of the territory and/or loss of a mate rather than in response to innate drives. Dispersal among adults, when it does occur, is usually not far; adults that do move are frequently found paired in subsequent years with neighboring owls.

First-year mortality is high but variable among dispersing owls (averaging 81% and ranging from 78 to 95% over three years in Oregon; Miller 1989). Starvation and predation are the major causes of death. High dispersal mortality is not entirely unexpected in a long-lived species inhabiting an historically stable environment, but mortality rates in "unmanaged" or unfragmented habitats are not known. All data currently available are for juvenile owls dispersing through at least some degree of managed forest with recent harvest. It is not known whether juveniles die because they are made more vulnerable by habitat that encourages predation and contains few prey, or simply because they have not yet fully developed the skills necessary to feed themselves and avoid predation. In any event, a landscape designed to accommodate dispersal should include protective cover and available prey. Owls ultimately move an average of 15 to 30 miles (straight-line distance) from their natal areas, and sometimes further. A plan to allow successful dispersal between local populations should have the spacing between population centers with the range traveled by a reasonable proportion of dispersing birds.

The ISC conducted a review of the above-referenced research on dispersal and made recommendations for landscape management for dispersing spotted owls (Thomas et al. 1990). They emphasized the need to manage for a general landscape rather than corridors due to the lack of evidence that owls use corridors and the concern for increased predation pressure in corridors. Recognizing the lack of any definitive means of determining an appropriate spacing between blocks of breeding habitat, the ISC recommended the distance traveled by at least two-thirds of all juveniles studied (12 miles). Lacking extensive field data on habitat used by dispersing spotted owls, the ISC relied upon data collected for resident adult owls to define suitable dispersal habitat at the stand level (Hays, pers. comm. 1992). The youngest, and least structurally diverse habitat used by resident owls was considered by the ISC to be coniferous forest with an average dbh of 11 inches and a minimum canopy closure of 40 percent (Thomas et al. 1990). The ISC recognized that dispersing owls probably have less stringent habitat requirements than resident owls, and believed habitat that provides minimal roosting and foraging opportunities for resident owls would meet the minimum requirements of dispersers. To describe suitable habitat at the landscape level, the ISC used a consensus approach among the expert researchers on the team. In this manner, the ISC prescribed a landscape in which 50 percent of the area is occupied by forest stands with an average dbh of 11 inches and canopy closure of 40 percent (Thomas et al. 1990). They also recommended retention of up to seven, 80-acre blocks of suitable breeding habitat per township, but noted these are intended not specifically for dispersal but for future reproduction. The Federal Recovery Team recommended a similar prescription for non-federal lands between DCAs, but allowed for flexibility on a site-by-site basis (Lujan et al. 1992).

2.3 HABITAT CONSERVATION AND MANAGEMENT MEASURES

Murray lands in the Mineral Block will be managed to provide dispersal habitat and contribute to the maintenance of a general landscape amenable to the dispersal of juvenile spotted owls, as recommended in the ISC Report (Thomas et al. 1990). The shape of the Murray ownership and its location relative to HCAs W-2, W-3 and W-10 will allow dispersal habitat within the ownership to function as a link connecting the HCAs. The degree to which dispersing owls are confined to the Murray ownership will depend on the management of adjacent non-federal ownerships, and the availability of dispersal habitat on those lands.

The maintenance of dispersal habitat at the landscape level will involve three elements: a) protection of habitat around active nests if any occur in the future, b) habitat reserves and c) dispersal habitat within managed stands. Each element is addressed separately below.

2.3.1 Seasonal Protection of Future Active Nests

The Murray ownership currently supports two resident spotted owl activity centers, one of a non-reproductive pair and one of a resident single spotted owl. The available suitable habitat within 1.8 miles of each activity center is less than 33 percent in both cases, but future nesting is possible in either activity center for at least two reasons. First, spotted owls have been known to nest successfully in marginal habitats in years of mild weather and/or abundant prey. The exact mechanisms of occasional breeding in marginal habitats are not known, but the potential exists that any home range known to support resident spotted owls could support a nest in favorable years. Second, the non-suitable habitat within the two existing home ranges on the Murray ownership varies from recent clearcut to pole stage coniferous forest. Some of the young coniferous forest will reach a condition suitable for spotted owl foraging in the next several decades. Harvest during the same time interval will remove suitable habitat, but depending on specific harvest patterns, the total amount of suitable habitat could increase. In addition, management

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measures described in subsection 2.3.3 could also add to the total amount of foraging habitat among second-growth stands.

In response to the potential for nesting in the future, Murray will annually monitor the two known activity centers and any other areas likely to support nesting and implement protection measures around any active nests that are found. Monitoring will be done according to USFWS protocol for spotted owl surveys, and a determination of nesting or non-nesting will be made for each of the sites by 15 May. If an active nest is found, Murray will conduct no harvest or alteration of suitable habitat within 1/4 mile of the nest between 1 March and 30 September. Between 1 October and 1 March, harvesting around known nests will continue in accordance with all other specifications of the HCP, and seasonally inactive nest sites could be harvested.

2.3.2 Habitat Reserve Lands

Washington Forest Practices Rules and Regulations require the special management of forested habitat for a number of reasons, including riparian management, wetland protection and maintenance of slope stability (see subsection 1.5.3; Washington Forest Practices Act). These reserve areas will vary in size, shape and stand structure, but many will meet the minimum requirements of spotted owl dispersal habitat and contribute to an overall landscape conducive to dispersal. Under current regulations and management, the Murray ownership contains approximately 1,222 acres of reserve areas (Figure 2-2, Table 2-1). Washington Forest Practices Rules and Regulations allow partial timber harvest in many of these, but under the HCP they would be protected from all harvest. Approximately 595 acres of these reserves currently meet the definition of dispersal habitat provided in subsection 2.3.3, and another 627 acres will reach that point within the first 50 years of the plan. Some of the existing riparian management zones (RMZs) contain all stand characteristics necessary to meet the definitions of dispersal habitat except stand size; most are long and narrow and consist mainly of edge habitat. These are not optimal roosting or foraging habitat, but they may be used by dispersing owls and were included in the total acreage of suitable habitat. Such long, narrow stands would not be created by design to provide dispersal habitat, but the potential for their contribution to the overall dispersal landscape warranted inclusion in the acreage total.

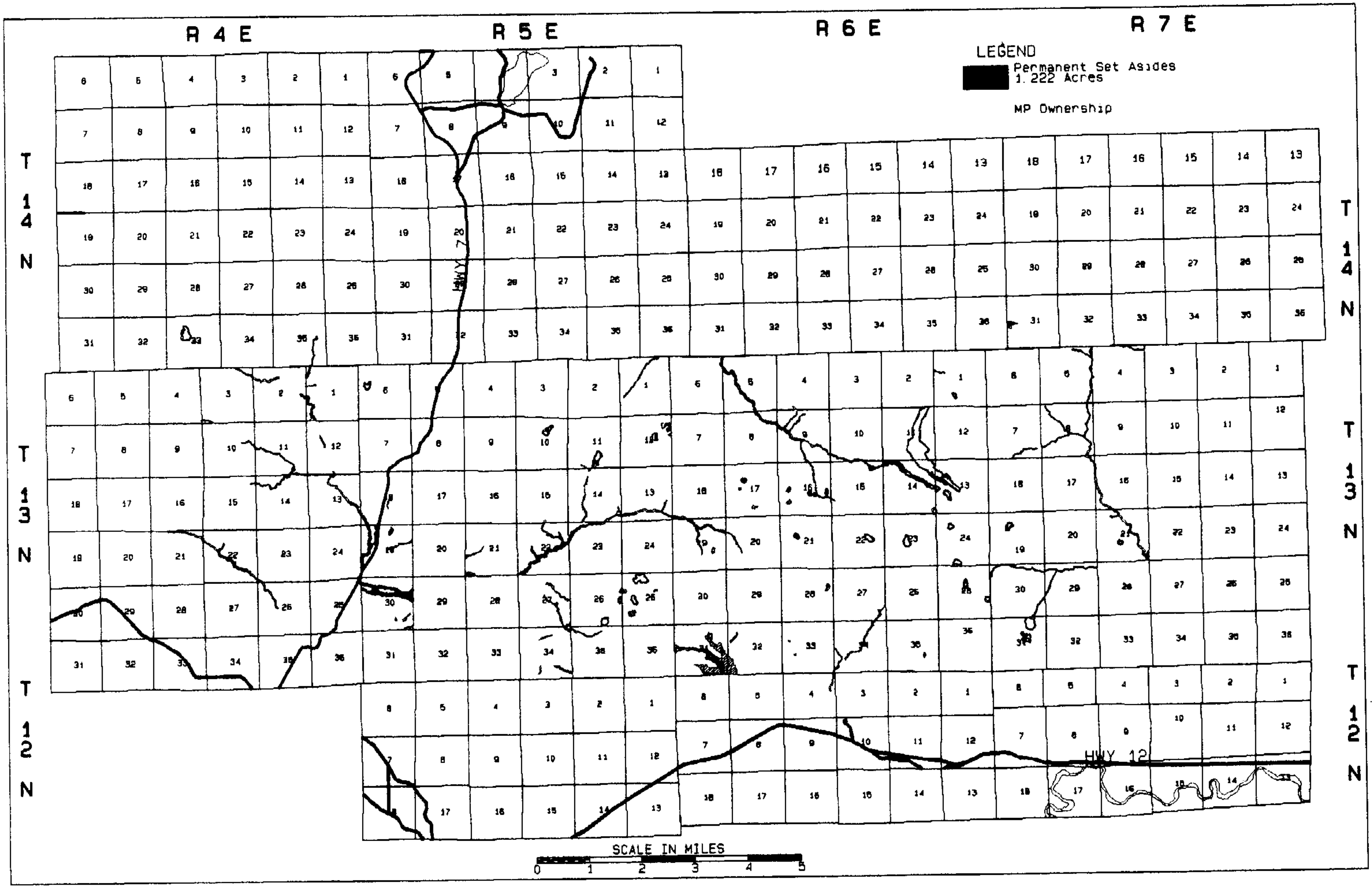


Figure 2-2. Existing and proposed reserve areas on Murray Pacific lands in the Mineral Block.

Table 2-1. Existing and future forested habitat reserves on the Murray ownership.

Reserve Type	Number	Area (acres) Existing Dispersal (1993)	Additional Future Dispersal by 2043	Total Future Dispersal by 2043
Riparian Management Zone	38	452	419	871
Wetland Buffer Zone	35	16	165	181
Upland Management Area	24	73	0[1]	73
Steep / Unstable Slope	2	54	43	97
TOTAL	**99**	**595**	**627**	**1,222**

[1] Additional UMAs will be designated on the Murray ownership between 1993 and 2043, but the acreages and locations of future UMAs are not known at the present time.

2.3.3 Stand Management for Dispersal Habitat

The third, and most important element of the HCP will be management of all commercial timberlands within the Murray ownership to provide dispersal habitat for a portion of each rotation. Murray lands are currently managed on an even-aged rotation of 40 to 60 years, with clearcutting as the primary method of final harvest. Murray will adjust its management according to the guidelines listed below so that the structure and interspersion of forest stands on the ownership are conducive to roosting and foraging by dispersing spotted owls. Murray will continue to harvest timber at an economic rotation age of 40 to 60 years where it does not conflict with the maintenance of dispersal habitat, but the management of stands between harvests and the size and timing of harvests will be modified from current standard practices when necessary to create a landscape conducive to dispersal, as defined below. The size and interspersion of harvest areas will be adjusted to avoid large areas of very young forest (i.e., gaps in the dispersal landscape), intensive reforestation will be used to reduce the amount of time stands exist in early successional condition, thinning will be employed where practicable to hasten the development of suitable habitat conditions and structural features such as logs and snags will be retained during harvest to increase habitat diversity for owl prey. These measures are all described in detail below.

Like any natural landscape, the Murray ownership is a complex mosaic of physical and biological conditions. Management of such a mosaic over time is a dynamic and iterative process; it cannot be done according to a rigid set of rules established at one point in time. For this reason the Murray HCP consists of the guidelines discussed below, rather than an inflexible set of rules. The overall objective of the HCP is to produce a dispersal landscape. Progress toward and achievement of this objective will be determined by monitoring the ownership over time as described in Section 2.5. Individual harvest units and harvest operations may deviate from the guidelines, but only when the deviations fit within the overall landscape objectives.

Species Composition: *Dispersal habitat should be dominated by coniferous trees (greater than 70% by canopy cover).* Same as required for timber management.
Dispersal habitat is used primarily during the fall and winter, when thermoregulation and protection from the weather are important. This is particularly important for juveniles that are inexperienced hunters and

likely have low caloric intake. Stands dominated by coniferous trees will provide protection from precipitation and radiant heat loss during the fall and winter. — need trees for timber, too!

Tree Size and Density: *Dispersal habitat should have a minimum of 130 trees/acre that have a minimum diameter at breast height of 10 inches (or an equivalent basal area of larger trees). Total tree density should not exceed 300 trees/acre.* — because tree mortality occurs.

Tree size, tree density and resulting canopy closure are the predominant factors controlling the structure and character of forest habitat. The relationship between tree size (dbh and height) and stand density is best illustrated by the density management diagram developed for Douglas-fir by Drew and Flewelling (1979) (Figure 2-3). The diagram is based on the principal that maximum tree density is inversely related to individual tree size. As individual trees get larger, competition for growing space reduces the total number of trees a particular site will support. The relationship between tree size and maximum density (Line A in Figure 2-3) varies by tree species due to crown configuration and shade tolerance. The diagram presented in Figure 2-3 applies to coastal Douglas-fir, the predominant tree cultivated on the Murray ownership. For most tree species (including Douglas-fir), stand canopy closure (Line C in Figure 2-3) occurs at densities considerably below the maximum size-density relationship. Canopy closure represents the density at which trees begin to compete for direct solar radiation, but greater densities are accommodated by a decrease in individual crown size (and bole size). Eventually crowns become so small that they no longer support enough photosynthetic surface to compensate for respiratory energy demands, and individual trees begin to die. The density at which this appears is shown as the lower limit of imminent competition mortality (Line B in Figure 2-3).

Between canopy closure and the maximum size-density relationship, variations in tree density result in variations in individual tree size. This is the premise for thinning of commercial forest stands, whereby individual tree size is increased by removing some trees and reducing competition for space and light. Total stand biomass is reduced by removing live trees, but commercial value is increased by producing trees of merchantable size in a shorter period of time than would be required in a natural stand.

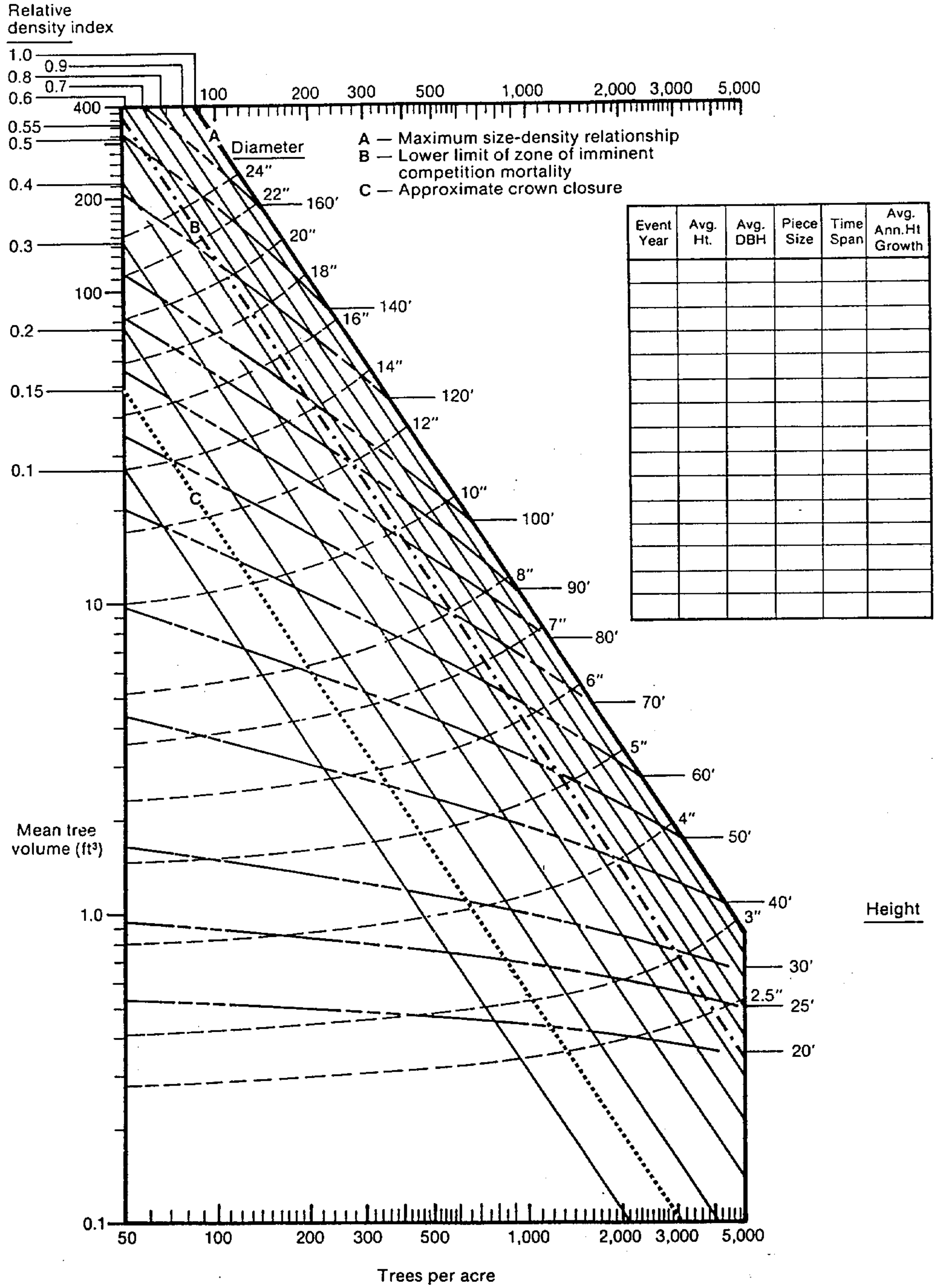


Figure 2-3. Density management diagram for Douglas-fir (Drew and Flewelling 1979).

The density management diagram was originally developed to guide and predict the commercial production of trees of a certain size and number, but it is also useful for producing and predicting structural stand characteristics related to wildlife habitat. In the case of spotted owl dispersal habitat, the three important structural characteristics are canopy development, limb size and canopy lift.

<u>Canopy Development</u>: A forest canopy must have sufficient vertical depth and horizontal coverage to provide protection from rain and radiant heat loss, offer a range of thermal microenvironments and give protection from overhead predators. Direct observation of stands in the Mineral Block indicate Douglas-fir retain between 30 and 50 feet of live crown in stands of 130 to 200 trees per acre with a dbh of 10 inches or greater. This should be adequate to provide protection from adverse winter weather and cover from aerial predators.

<u>Limb Size, Condition and Location</u>: Spotted owls roost and perch on tree limbs while sleeping, eating and foraging. Limbs must be of sufficient size to support the owl, they must be available at a variety of heights in the forest (within and below the live canopy of the tree) and they must have sufficient length free of live foliage to facilitate owl movement. Trees with a dbh of 10 inches have limbs at least 1.5 inches in diameter (at the base) through a significant portion of the live canopy and below it.

<u>Canopy Lift</u>: Spotted owls move about within and beneath the forest canopy to forage. This has been suggested as one reason they avoid dense, young forest stands with little clear space for flying. Spotted owls do not make long flights beneath the canopy as many forest hawks do, but they prey upon rodents that forage on or near the forest floor (Thomas et al. 1990) and must be able to see and access the prey. Based on observations of adult owls in second-growth forest, we suggest owls need at least 20 feet of clear flying space between the top of the understory vegetation and the bottom of the live canopy. In addition, the portion of the forest beneath the live canopy should be sufficiently free of dead limbs to permit owl flight. Canopy lift is defined as the degree to which overstory trees have self-pruned and provided clear flying space. It is a function of tree size, tree density and tree species. The predominant coniferous species in the Mineral Block provide at least 20 feet of canopy lift when they reach a dbh of approximately 10

inches, provided the trees have not been allowed to grow in open stands where they retain live limbs below 20 feet. For Douglas-fir, this would require a minimum of 130 trees per acre at 10 inches dbh, but it should be noted that natural self-pruning requires several years and the density of trees one to two decades prior to the target diameter of 10 inches is also important. Figure 2-3 suggests that in order to maintain a closed canopy and avoid open-grown trees, stands of Douglas-fir should not be thinned below approximately 250 trees per acre until average tree dbh exceeds 8 inches. This corresponds roughly with the minimum size at which trees could be commercially thinned for the first time.

Stands of dispersal habitat must have dominant trees with a minimum dbh of 10 inches and a high degree of canopy closure to provide protection for owls and self-pruning of the lower limbs. The lowest density at which canopy closure (crown closure on Figure 2-3) occurs in managed stands of 10-inch Douglas-fir is 130 trees per acre. Somewhere between 130 trees per acre and the maximum size-density relationship, the stand becomes so dense that owls have a difficult time flying through it and individual crowns become so short that there is not sufficient depth to the canopy to provide cover. The density management diagram would suggest this is below the lower limit of imminent competition mortality (roughly 380 trees per acre), and empirical field observations of the Murray ownership suggest it is somewhat lower, at approximately 275 trees per acre. As a preliminary guideline, a maximum density of 300 trees per acre will be used. Since 130 trees of the 10-inch dbh size class are capable of providing a closed canopy, it is not necessary that the remaining trees in the stand (if more are present) be of similar size. If the stand contains at least 130 trees per acre that are at least 10 inches in dbh, the remaining trees can be of any size, provided sufficient canopy lift remains below the dominant trees to allow room for owls to fly and forage. In fact, it is preferable to have a wide variety of sizes to add to the vertical structure of the stand.

The age at which a stand reaches the size and character described above is variable, depending on site fertility (Site Class) and the history of stand initiation. Managed, planted stands of Douglas-fir in western Washington reach this size between the ages of 27 years on good growing sites and 40 years on poor growing sites (Curtis et al. 1982). These same stands would have economic rotation ages of roughly 40 and 60 years, respectively, so that each stand will spend approximately 33 percent of each rotation as dispersal habitat. The amount of time each stand provides dispersal habitat may be increased by thinning and/or fertilizing to increase the rate of tree growth, but the intent of this HCP is to make a conservative estimate of the amount of dispersal habitat that can be produced. The estimate of total dispersal habitat without thinning or fertilization is a low estimate of what Murray may be able to produce, and is therefore more conservative.

Residual Live Trees and Snags: *Where possible, stands of dispersal habitat should contain at least two residual live trees and three snags per acre from the dominant or codominant size class of the previous stand. Preference should be given to western red cedar with a minimum dbh of 18 inches.*

There are no data to suggest that dispersing spotted owls need or use snags, but at least one of their principal prey species (the northern flying squirrel) nests in abandoned woodpecker nests and natural cavities in snags, large stumps and live trees. An average of three potential nest trees per acre will meet the nesting requirements of flying squirrels, assuming average flying squirrel densities of approximately one animal per acre (Carey et al. 1992, Rosenberg and Anthony 1992, Weigl and Osgood 1974). As noted above, managed stands are not expected to function as dispersal habitat until they are a minimum of 27 years old. Saving snags alone from the previous stand would therefore not be sufficient, since a relatively small percentage would be expected to survive 27 years (Cline et al. 1980). Live trees have a better chance of surviving, and they can be killed by girdling or topping to create snags if necessary. Tree form is not critical when selecting leave trees, but they must be capable of living another 27 years. Live trees with signs of excavation by pileated and other woodpeckers should be the highest priority trees to leave. When multiple species are present, highest priority should be given to western red cedar, followed by Douglas-fir, western hemlock and true fir. Typically, trees need to be at least 18 inches dbh before pileated woodpeckers (and flying squirrels) can nest in them (Mannan et al. 1980). Where possible, residual trees should be spaced uniformly throughout stands of dispersal habitat to account for the average flying squirrel home range size of roughly 1 to 2 acres. Realizing the technical difficulties and safety concerns associated with leaving trees uniformly distributed in a clearcut, however, the new Washington Forest Practices Rules and Regulations allowing clumping of reserve trees will be followed so that the maximum distance between clumps is no greater than 1,600 feet. In addition to meeting the requirements of flying squirrels in a practicable manner, the clumps will add structural diversity to dispersal habitat that would not occur with uniformly distributed leave trees. The clump size that would result from the maximum allowable spacing under the requirements of the Forest Practices Rules and Regulations would include approximately 90 trees, which would provide 1/2 to 1 acre of well-stocked residual forest per 40 to 45 acres of harvest area. As a practice on the Murray ownership, residual live trees and snags should be spaced uniformly where they can be left safely and cost-effectively, and clumped where safety or economics dictate. This will provide a diversity of snag density over the landscape that will be more similar to natural conditions than one extreme or the other.

Logs: *Leave a minimum of two logs per acre after clearcut harvest, each measuring at least 12 inches in diameter and 20 feet in length. Leave logs distributed throughout harvest unit.*

Current Washington Forest Practices Rules and Regulations require timberland owners to leave logs after harvest in western Washington. Logs are not known to be required by spotted owls, although they are a common component of the old-growth forest historically considered optimal spotted owl habitat (Franklin et al. 1981). It has been suggested that downed and decaying trees are important to the prey of spotted owls, either as structural components of their habitat (i.e., nest sites and/or runways) or as substrate for food. The few data that are available suggest the northern flying squirrel, deer mouse (*Peromyscus* spp.) and voles make up the majority of the diet of spotted owls in the western Cascades of Washington (Thomas et al. 1990). West (1991) conducted the most extensive study to-date of small mammals of the coniferous forest floor. He sampled naturally-regenerated stands ranging in age from 55 to 730 years, between Mount Rainier and the Columbia River. The southern red-backed vole (*Clethrionomys gapperi*), forest deer mouse (*Peromyscus oreas*) and deer mouse (*P. maniculatus*) were the most common rodents trapped in the study. The two species of deer mice were the only mammals in the study that showed significant changes in relative abundance with increasing forest age. West (1991) found deer mice to be more abundant in mature and old-growth than young forest, but noted that deer mice reach peak numbers in early successional forest (i.e., prior to canopy closure). He concluded that the minimum habitat requirements of most forest-floor dwelling mammals are met soon after canopy closure occurs, and that relatively minor changes in species composition and relative abundance occur later in forest stand development. West (1991) cautioned, however, that all his sites were natural stands with greater physical structure and plant species diversity than could be expected in managed second-growth forest. Among the correlations between stand structure and mammal relative abundance, West (1991) found that forest deer mice were more abundant in stands with greater numbers of large coniferous trees and logs in advanced stages of decay and deer mice were more abundant in stands with greater numbers of large conifers, greater percentages of mid-canopy shrubs and tree pits (holes left by the roots of fallen trees). Vole abundance was positively correlated with the presence of large coniferous trees and mid-canopy shrubs, but negatively correlated with logs of advanced decay stages. Most correlations were weak, and none except those for the forest deer mouse occurred in both years the study was conducted, suggesting the relationship between forest floor mammals and physical habitat structure is not well understood.

Most rodent prey of the spotted owl are mycophagous (mushroom-eaters) and it has been suggested decaying logs provide nutrients for the rodents' food supply. As noted by Fogel and Trappe (1978), the larger part of the diet of mycophagous rodents is made up of the hypogeous (subterranean) sporocarps of mycorrhizal fungi. Mycorrhizal fungi form symbiotic relationships with the fine roots of live vascular plants, increasing the water and nutrient absorbing capacity of the plants and receiving complex nutrients in return. They are associated with wood on the forest floor in advanced stages of decay, and are distinct from saphrophytic fungi that attack live and recently killed trees (Maser and Trappe 1984). This may in part explain the correlations found by West (1991) between mycophagous rodents and logs in advanced stages of decay. Under such a scenario, the protection of existing logs on the forest floor during harvest would be at least as important as the creation of new logs from sound trees during harvest. Given the unclear relationship between spotted owls and logs on the forest floor, it is recommended in this plan that the current Forest Practices Rules and Regulations for logs be followed.

Stand Size and Spacing: *Stands of dispersal habitat should be between 5 and 120 acres in size and average 40 acres. They should be no less than 500 feet wide at the narrowest point. The distance between stands should not exceed 1/4 mile (1,320 feet).*

In a managed forest, where stands are periodically harvested, stand size and stand spacing are interdependent. A stand of a given size at one point in time becomes the space between adjacent stands after it is harvested. When choosing a desirable size for stands of dispersal habitat, a compromise was made between a large stand size that would minimize forest edge (where predation presumably occurs) and small stand size that would minimize the distance between stands surrounding a recent clearcut. In the absence of any data relating stand size to use by dispersing owls, the following guidelines were established: a) all suitable dispersal habitat within 200 feet of a clearcut or seedling/sapling stand is considered edge, b) a stand of dispersal habitat should contain at least as much interior (beyond 200 feet from the nearest clearcut) as edge and c) the maximum distance between stands of dispersal habitat should be 1/4 mile. An average stand size of 40 acres will meet these guidelines because a square stand of 40 acres has an edge to interior ratio of 50:50 (assuming all sides of the stand border on recent clearcut - an unlikely situation) and it is 1/4 mile long on each side. Obviously, some stands will be larger than 40 acres (current state regulations allow harvests of up to 240 acres) and some will be smaller. Larger stands will provide more habitat late in their rotation, but large gaps prior to canopy closure. Smaller stands will create smaller gaps but will provide less interior forest. As a result, we prescribe an average size of 40 acres, with a range from 5 acres to 120 acres to accommodate site-specific conditions. Harvests larger than 120 acres will be reviewed by an inter-disciplinary team in accordance with Washington Forest Practices Rules and Regulations.

2.4 HCP IMPLEMENTATION

2.4.1 Stand Management

As of 1993, the Murray ownership contains 11,412 acres of timberlands that meet Murray's definition of suitable foraging and roosting habitat for dispersing owls (Figure 2-4). This includes approximately 595 acres of habitat reserves and 10,817 acres of commercial timberlands. The total acreage was determined by comparing existing stand conditions to the definition of dispersal habitat provided in subsection 2.3.3. All stands identified through aerial photo interpretation as suitable spotted owl habitat Types A, B and C were automatically considered suitable for foraging and roosting by dispersing owls. Stands not considered Types A, B or C were examined further through the use of Murray's GIS and field verification. All stands with a dominant tree height of 80 feet or more, or more than 75 years old, were considered suitable dispersal habitat because these stands will, in virtually all cases, have the characteristics described in subsection 2.3.3. This accounts for roughly 7,000 acres of the current total of dispersal habitat. The remaining acres of dispersal habitat shown in Figure 2-4 were evaluated individually in the field or within Murray's data base relative to the definition of suitable dispersal habitat. All stands with an average dbh of 7 inches or greater were reviewed. Some stands with an average dbh between 7 and 8.5 inches had at least 130 trees per acre over 10 inches dbh and met the definition of suitable dispersal habitat, but most did not. Most stands with an average dbh over 8.5 inches were found to have a sufficient number of trees over 10 inches dbh and sufficient overstory structure to be considered dispersal habitat, but a few were excluded for being too densely stocked or containing too few larger trees.

Murray will follow the silvicultural guidelines presented in subsection 2.3.3 so that all coniferous forest stands on the Murray ownership will provide foraging and roosting habitat for dispersing spotted owls for part of each rotation. Future dispersal habitat was estimated by modeling the growth of existing stands using the Stand Projection System (SPS) growth and yield model (Arney 1986), with emphasis on the first 50 years of the HCP when habitat conditions will undergo the most improvement. All stands currently considered suitable will remain suitable unless they are harvested. All stands not currently

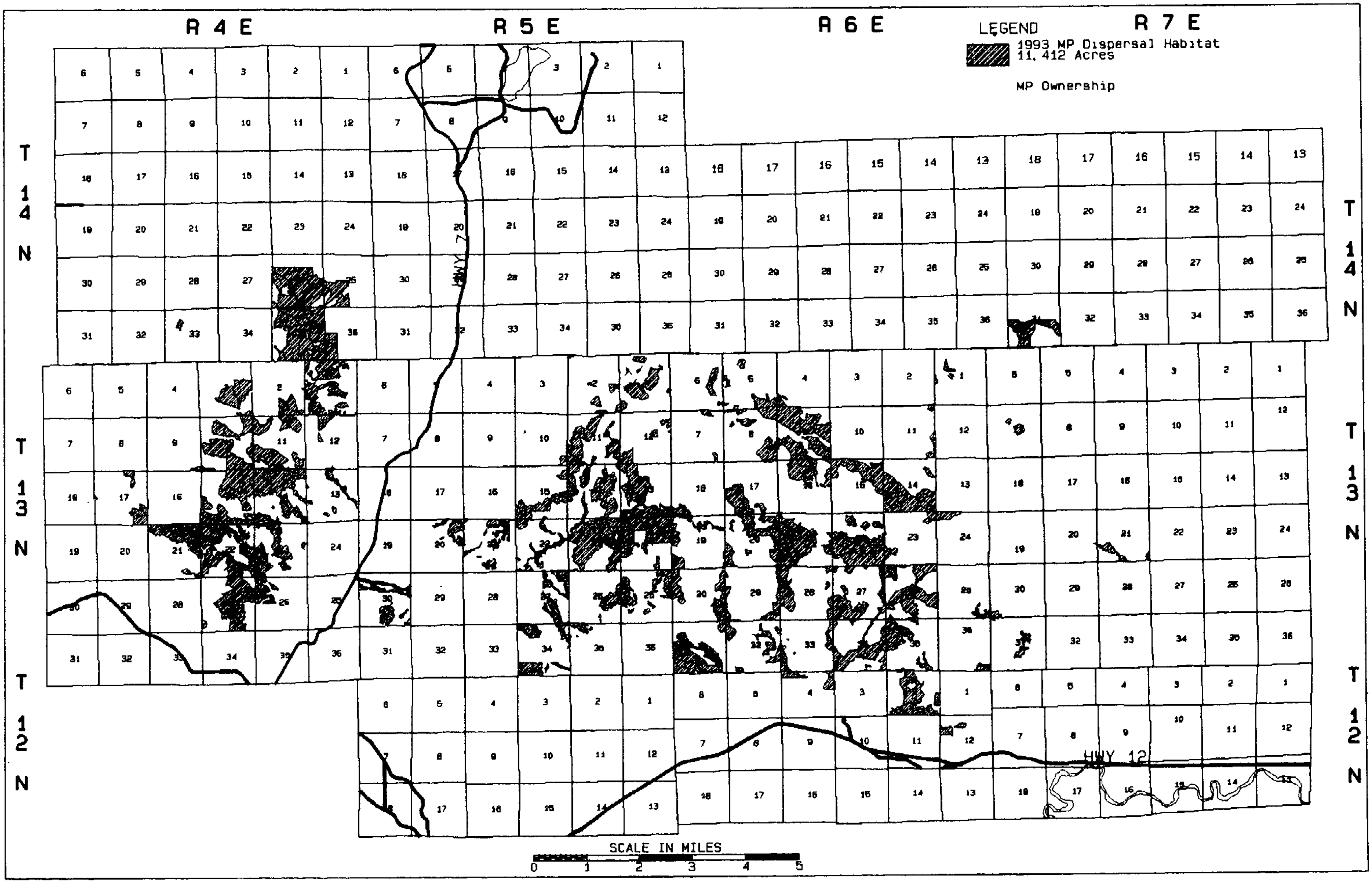


Figure 2-4. Spotted owl dispersal habitat on the Murray Pacific ownership as of 1993.

considered suitable will become suitable in the model when they attain an average dbh of 9.2 inches and a minimum age of 27 to 53 years (depending on Site Class). This is a conservative estimate because many stands will meet the dispersal habitat definition in subsection 2.3.3 before they reach an average dbh of 9.2 inches, but this limit was used to avoid the risk of assuming a stand to be suitable dispersal habitat before it actually is. Future refinements to the model may increase the estimate of actual dispersal habitat.

According to the Murray model, the total area of foraging and roosting habitat for dispersing owls will increase from 11,412 acres in 1993 to 23,233 acres by 2043 (Figures 2-5 and 2-6), and will average approximately 23,000 acres from 2043 to 2093. Fluctuations in the total area of habitat will occur due to the uneven distribution of forest age classes that currently exists on the Murray ownership (Figure 1-2). The uneven distribution of age classes will gradually be corrected by harvesting on a sustained area basis rather than harvesting all stands as they reach economic harvest age, and the total area of dispersal habitat will eventually stabilize. Murray will harvest a maximum of 20 percent of the commercial timberland on the ownership in any 10-year period, and no more than 5 percent in any 1 year. In many years they will harvest less, but at no time will they harvest more than these amounts. This equates to a maximum of approximately 10,000 of 50,000 acres in a 10-year period and 2,500 acres in 1 year. This will result in some stands being harvested several years later than Murray's current economic rotation, but it will eventually lead to a more even and sustainable rate of harvest. The use of a 10-year averaging period will allow Murray to remain flexible to market conditions, but the 1-year and 10-year maximums will prevent the perpetuation of a skewed age-class distribution. In the absence of the HCP, Murray estimates the maximum rates of harvest in the future could be 5,000 acres in a single year and 18,000 acres over 10 years.

From the standpoint of spotted owls dispersal habitat, the sustained harvest rate will help eliminate temporal and spatial gaps in the dispersal landscape in the future. The current acreage of gap in the landscape (i.e., areas more than 1/8 mile from a stand of dispersal foraging and roosting habitat) is 26,556 acres (Figure 2-6). This will decrease to 8,720 acres by 2043.

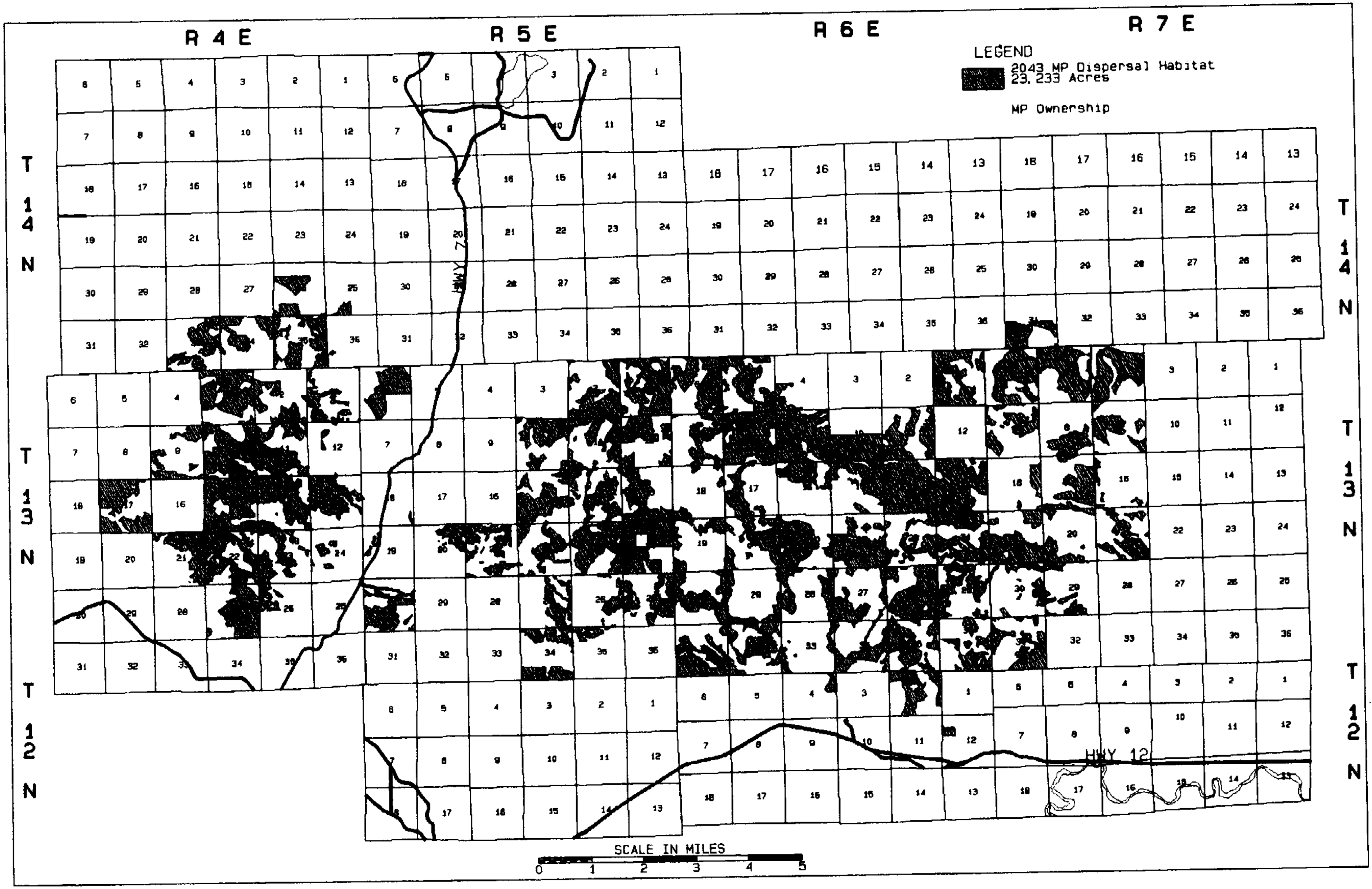


Figure 2-5. Projected spotted owl dispersal habitat on the Murray Pacific ownership in 2043.

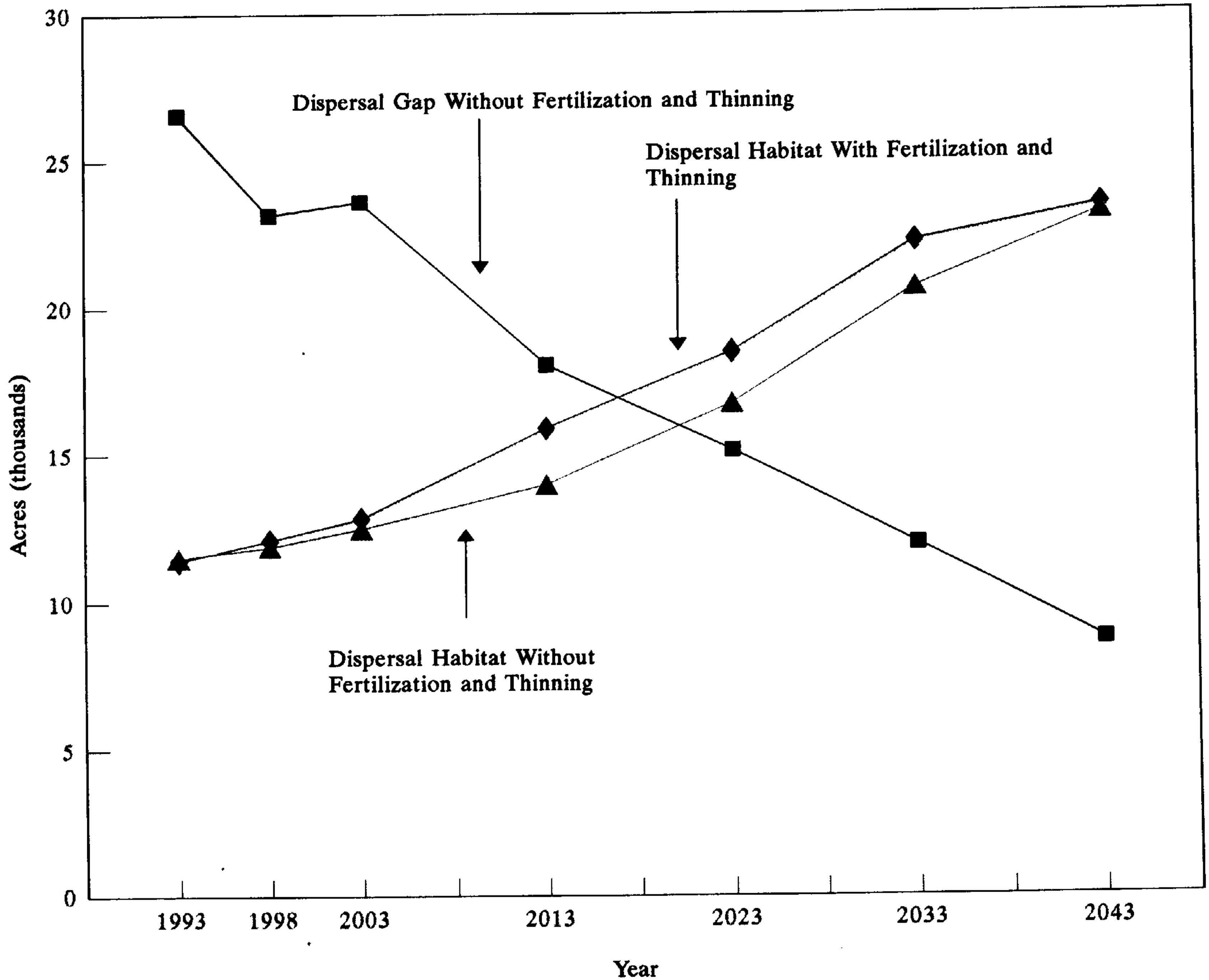


Figure 2-6. Projected trends in spotted owl dispersal habitat and gap under the Murray HCP.

In addition to the measures described in subsection 2.3.3, Murray will initiate tests of fertilization and pruning to accelerate the development of owl dispersal habitat conditions in managed forest stands. These tests will be based on recommendations in Appendix G of the Draft Recovery Plan (Lujan et al. 1992), with specific adaptation to the Murray ownership. Recent investigations by Murray suggest that fertilization of young stands at least once during the first 5 years after planting significantly accelerates stand development. The soils on the ownership are characterized by a deep surface layer of volcanic ash that provides a poor growth medium. Once tree roots reach below the ash layer, growth is similar to high quality sites elsewhere. Prior to that, however, growth is slow. Murray believes fertilization at this early stage could be the most effective use of fertilizer in growing dispersal habitat (and commercial timber) and tests are underway. If the tests are successful at increasing timber production and improving habitat conditions, Murray will continue a program of fertilizing up to 1,000 acres per year.

Pruning is considered a possible tool for accelerating the development of both wildlife habitat and high-value timber. Murray will conduct a test of the effectiveness of pruning on the ownership by pruning 1,000 acres between 1993 and 1998 and monitoring the results. If pruning is found effective, it too will be incorporated into Murray's management. Preliminary results of the effectiveness of pruning may be available by 2003, but continued monitoring will be conducted if necessary to adequately evaluate it as a management tool.

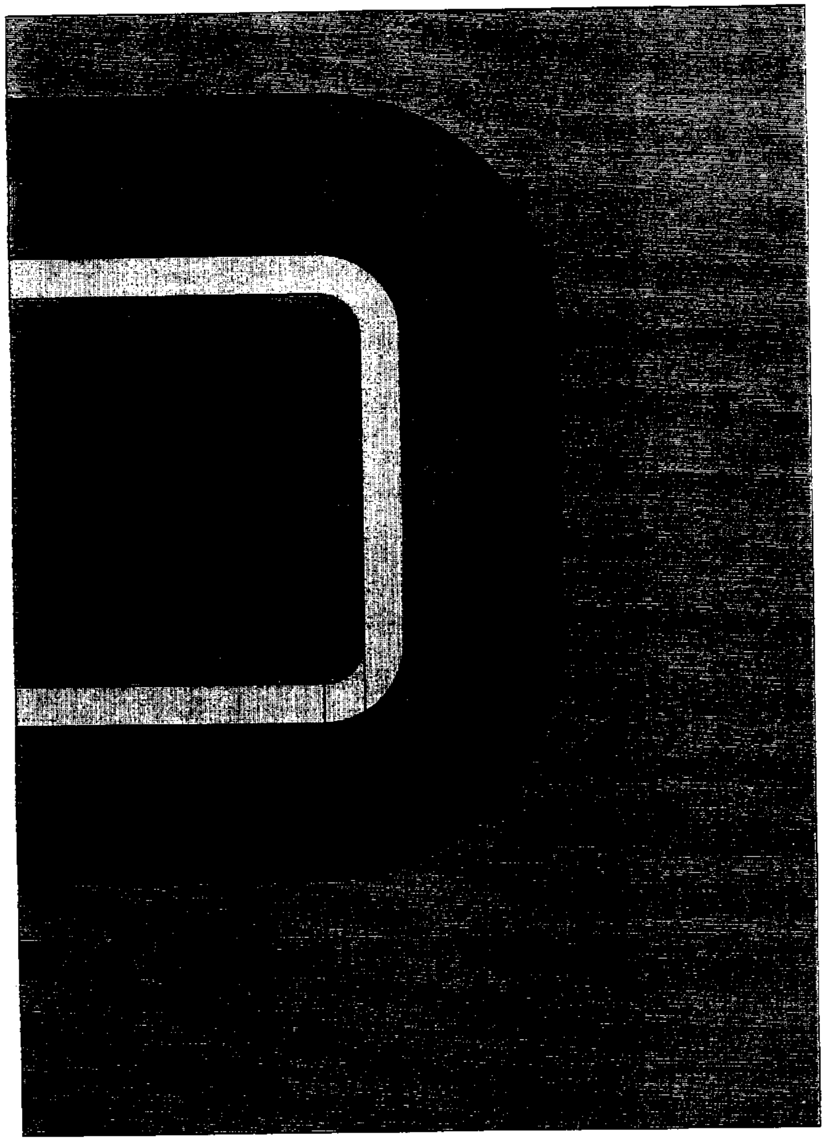
Precommercial thinning is a tool that has commonly been used to accelerate stand development in the past in the Pacific Northwest. It is believed that lower planting densities, fertilization and pruning may take the place of precommercial thinning in the future, but Murray still owns approximately 5,000 acres in need of precommercial thinning as a result of intensive planting and/or heavy invasion by natural seedlings. Murray will conduct the precommercial thinning of approximately 5,000 acres between 1993 and 1998, and additional acres after that if necessary to control stocking density.

The anticipated effects of fertilization, pruning and thinning will be improved conditions for dispersing spotted owls within the managed landscape of the Murray ownership. The combination of fertilization and thinning is expected to accelerate the development of dispersal habitat by approximately 5 years, so that the creation of an overall landscape for dispersal will be achieved at least 5 years sooner (Figure 2-6). The results of these tests will be reviewed during regularly scheduled meetings on the HCP, or more often if necessary. Validation that thinning, pruning and fertilization produce habitat for dispersing owls and their prey will be conducted as part of the overall HCP validation described in subsection 2.5.3.

2.4.2 Landscape Management

As noted in subsection 2.3.3, the spatial arrangement of forest stands is as important as the total area of forest in determining habitat for dispersing spotted owls. By definition, a landscape managed simultaneously for timber production and owl dispersal should be made up of stands 5 to 120 acres in size (with an optimum of 40 acres) spaced no more than 1/4 mile apart. To evaluate and monitor dispersal habitat at the landscape level, a geographic-based dispersal landscape model was developed using ArcInfo GIS. In the model, all areas within the ownership are given a numerical Dispersal Habitat Value (DHV) between 0 and 10, depending on proximity to stands of suitable dispersal habitat. This is accomplished by creating a series of concentric buffers around stands of suitable habitat, and assigning progressively lower values to buffers more distant from the stands (Figure 2-7). Interior portions of stands meeting the definition of roosting and foraging habitat (beyond 200 feet from a clearcut edge) receive the highest DHV of 10. The edge areas of those same stands are rated 8. Buffers then proceed out from the edge in increments until a DHV of 0 is reached at 3/4 mile. The total score for all acres of the landscape is termed the Dispersal Landscape Index (DLI). The net effect of the scoring is to give higher DLI values to landscapes with greater total dispersal habitat and more uniform distribution of the habitat. Two landscapes with comparable amounts of habitat can have different DLI scores depending on clumping and spacing of the habitat. Greater clumping does not increase the score of the stands, because values do not increase beyond 200 feet from the edge, but the overall DLI will decrease because of greater amounts of gap in the landscape.

For comparative purposes, the optimum DLI value was calculated to represent perfect implementation of the prescription provided in subsection 2.3.3 (40-acre blocks of habitat spaced 1/4 mile apart). This scenario produces a DLI of 7.50, which becomes the reference point for evaluating future management of the ownership. It is not the theoretical maximum DLI for the ownership, because it assumes regular harvest of commercial stands. The maximum DLI would be 10 if the entire ownership was forest that met the definition of dispersal habitat in subsection 2.3.3, but such a DLI could not be sustained because



LEGEND

- Dispersal Habitat Value - 10
- Dispersal Habitat Value - 8
- Dispersal Habitat Value - 7
- Dispersal Habitat Value - 5
- Dispersal Habitat Value - 3
- Dispersal Habitat Value - 1
- Dispersal Habitat Value - 0

Figure 2-7. Habitat Value Rating System used in the Spotted Owl Dispersal Landscape Index.

economic harvest would eventually lead to equally broad areas of gap. The highest DLI that can be sustained on this managed landscape is 7.50. The existing DLI for the Murray ownership is 5.34 (Figure 2-8). The projected DLI after the first 50 years implementation of the HCP is 7.47 (Figure 2-9). It will remain at or above this level the remaining 50 years. Key aspects of the DLI plots to note are the total area of roosting/foraging dispersal habitat, the interspersion of habitat and the size and total amount of gaps in the dispersal landscape. Future management of the Murray ownership will be guided not only by the numerical values of the total area of habitat and the DLI, but also the location and size of individual blocks of habitat and gaps. It is also important to note that the total acreage of habitat or the DLI at one point in time is not as important as average values over time or trends over the life of the HCP. Obviously, an ownership composed entirely of dispersal habitat at one point in time would have a high DLI, but this would eventually lead to a very low DLI if harvest occurred over similarly large areas. The overall goal of this HCP is to show a sustainable increase in total acreage of dispersal habitat and DLI (Figure 2-10). The projection of habitat conditions on the Murray ownership presented in Figures 2-5 and 2-9 is the result of a computer simulation based on the criteria in Section 2.3. The resulting distribution of habitats is not perfect relative to the definition of suitable dispersal habitat in Section 2.2, because a number of large stands and wide gaps still remain. It is not possible to eliminate these gaps from the projection without assigning specific harvest dates and boundaries for the future, and that is considered a speculative and possible misleading process. Nevertheless, the large gaps are inconsistent with the objectives of the HCP and should be eliminated in the future. For this reason Murray will make specific adjustments to harvest timing and spacing in the future to reduce the area of gap below that shown in Figure 2-9. Gaps cannot be eliminated altogether, but Murray will eliminate all areas with a DHV of 1 or 0 and reduce the area with a DHV of 3 to 1,000 acres by 2043.

2.4.3 Summary of HCP Implementation

The primary objective of the Murray HCP is to manage the ownership for spotted owl dispersal, as stated in Section 2.1. The scientific basis for dispersal habitat management is summarized in Section 2.2 and incorporated into management measures in Section 2.3. The implementation of management for dispersal habitat is described in detail in subsections 2.1.1 and 2.4.2, and summarized in Table 2-2.

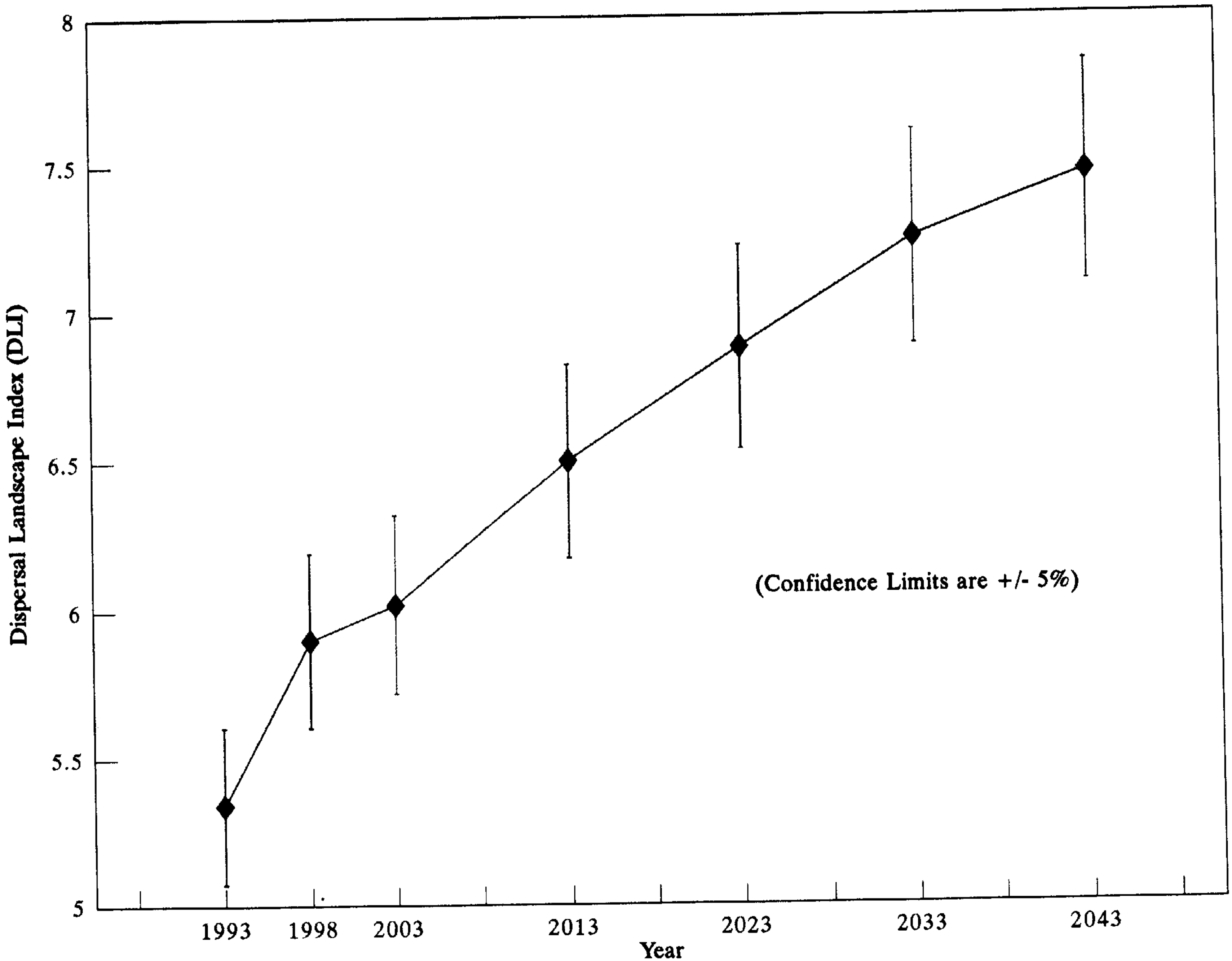


Figure 2-10. Projected trend in the spotted owl Dispersal Landscape Index (DLI) under the Murray HCP.

Table 2-2. Measures to be implemented for spotted owls under the Murray HCP.

- Known spotted owl activity centers and other areas likely to support nesting will be monitored annually and nests will be protected from disturbance (i.e., road building or timber harvest) from 1 March through 30 September in years of active reproduction;
- A minimum of 1,222 acres of the ownership will be permanently protected from future harvest and retained as mature forest habitat as shown in Figure 2-2 (State Forest Practices Rules and Regulations do not require full protection of these areas);
- No more than 20 percent (10,000) acres of the commercial timberland on the ownership will be clearcut harvested in any 10-year period and no more than 5 percent (2,500 acres) will be harvested in any 1 year (actual harvest rates may be considerably less in many years);
- Clearcut harvest size will range from 5 acres to 120 acres and average 40 acres over any 10-year period;
- A minimum of two residual live trees from the dominant or codominant size classes and three snags will be retained for every acre of clearcut harvest (as required by State Forest Practices Rules and Regulations);
- A minimum of two logs measuring at least 12 inches in diameter and 20 feet in length will be left for each acre of clearcut harvest (as required by State Forest Practices Rules and Regulations);
- All clearcut sites will be replanted with native coniferous seedlings within 2 years of harvest (consistent with standard forest practices in the region);
- Precommercial thinning will be conducted on approximately 5,000 acres currently in need of stocking control, and any future stands with similarly high densities of trees, to accelerate stand development and individual tree size to facilitate owl use;
- Fertilization will be tested as a means of accelerating stand development at the seedling/sapling stage, and up to 1,000 acres will be fertilized annually during the life of the HCP if results are positive;
- Pruning will be tested as a means of accelerating the development of dispersal habitat by pruning 1,000 acres between 1993 and 1998 and monitoring results;
- Total acreages of dispersal habitat and gap on the ownership will improve as shown in Figure 2-6 by 2043, and will remain at approximately those levels through 2093;
- The Dispersal Landscape Index (DLI) for the ownership will increase to 7.47 by 2043 as shown in Figure 2-10, and remain at or above that level through 2093;
- All areas of the ownership greater than 1/2 mile from a stand of dispersal habitat (i.e., areas with DHVs of 1 or 0) will be eliminated by 2043 and
- The total area of the ownership lying 1/4 to 1/2 mile from the nearest stand of dispersal habitat (i.e., areas with a DHV of 3) will be reduced to 1,000 acres or less by 2043.

2.5 MONITORING

Monitoring of the HCP will serve two purposes; verification and validation. Verification will be used to demonstrate that commitments made as to the quantity, quality and location of wildlife habitats are met. Validation will be conducted to test some of the basic assumptions of the plan concerning the relationships between wildlife and their habitats and determine if the HCP is providing mitigation as planned. Both types of monitoring are discussed in detail below.

2.5.1 Habitat Verification

Habitat conditions on the Murray ownership will be monitored on a regular basis as an addition to Murray's routine management. Murray's GIS-based forest inventory will contain maps of the entire ownership showing the age, size and species composition (among other site parameters) of every forest stand on the ownership. These maps will be updated at least annually to reflect changes brought about by timber harvest, tree growth and perturbation (e.g., fire or insect infestation) and refinements to the data base from field data collection. Based on the definition of suitable spotted owl dispersal habitat provided in Section 2.3, Murray also will maintain in its GIS a current map of dispersal habitat on the ownership. Murray will use this information not only as a record of past and current compliance with the HCP, but also as a planning tool to guide management in a way that will ensure future consistency with the HCP. Future harvests and silvicultural operations will be simulated in the GIS and their effect on owl habitat projected to aid Murray in choosing options that best meet the dual objectives of sustainable timber harvest and spotted owl dispersal.

Maintenance of the GIS data base will involve two primary activities on the part of Murray. The first will be the updating of stand conditions as they change over time. The second will be improvement of the data base through incorporation of site-specific information on each stand. The rapid evolution of computer based inventory and modeling systems such as the GIS has enabled land managers to monitor and predict forest conditions with greater speed and precision than ever before. Unfortunately, most inventory data bases now lag behind the analytical capabilities of the models. Murray's data base is typical of this situation. Much of the stand information in the GIS is based on interpretation of aerial photographs, generalized soils maps and projections from growth and yield models. All assumptions and predictions as to habitat condition used in this HCP have therefore been conservative to avoid overestimating actual conditions. Over the next 10 to 20 years, as Murray enters most of its stands for silvicultural treatment or harvest, site-specific information will be gathered and incorporated into the data base. Parameters to be measured on a site-specific basis will include stand age, species composition, stocking, site index, snag density and decay stage, log species, size and decay class, canopy height and depth and understory condition. Over the life of the HCP, Murray will gradually develop a detailed data base of these variables as they exist on the ownership. This will improve their ability to verify compliance with the HCP, as well as predict future habitat conditions on the ownership.

In addition to maintaining the GIS maps and data base in current (annual) condition, Murray also will update maps of the spotted owl DLI described in subsection 2.4.2 in 1998, 2003 and every 10 years thereafter. Again, this will enable Murray and the USFWS to track compliance with the HCP and make adjustments as needed to maintain adequate dispersal habitat.

2.5.2 Owl Population Monitoring

The Murray ownership is currently known to support one resident, non-breeding pair of spotted owls and one resident single spotted owl. As noted in subsection 2.7.1, harvest of suitable spotted owl habitat under the HCP will most likely render the two known home ranges unsuitable for occupancy by spotted owls by 2003. In the meantime, owls can be expected to persist for an indeterminate number of years. Owl population monitoring under the HCP will consist of annual surveys to determine the status of the two occupied home ranges. Monitoring will continue in each home range until it is determined to be vacant of spotted owls according to current USFWS protocol, or until such time that the USFWS considers it no longer necessary to monitor spotted owl populations to avoid the risk of take.

Four other resident spotted owl home ranges and four "status unknown" sites have been reported within 2.5 miles of the Murray ownership. These sites will not be surveyed under the HCP because they are historic and unlikely to be occupied (Site Nos. 219 and 233) or the bulk of the suitable habitat within each is on non-Murray land that is under the control of other owners (Site Nos. 217, 220, 307, 701, 941 and 944). Murray's actions on the resident owls will be insignificant relative to those of the primary landowners. Murray lands currently support a total of only 65 acres of suitable spotted owl habitat in all six of the home ranges centered off the ownership.

Approximately 2,178 acres of suitable spotted owl habitat on the Murray ownership are beyond 1.8 miles from the known activity centers, mostly in isolated stands too small to support owls. Nevertheless, there exists a slight potential that nesting could occur in these areas in the future, particularly if habitat in the surrounding younger forest improves under the HCP. Murray will therefore survey for spotted owls prior to any harvest of suitable nesting habitat on the ownership. Surveys will involve three visits to all suitable nesting habitat within 1/4 mile of proposed harvests, in the spring (March-June) prior to harvest. Nesting owls will be protected as described in subsection 2.3.1.

2.5.3 HCP Validation

Murray will conduct monitoring/research during implementation of the HCP to test the model of dispersal habitat upon which the HCP is based. Spotted owl use of dispersal habitat occurs at the level of the stand (i.e., species composition and structure) and the landscape (i.e., interspersion of stands). Validation of assumptions in the model as to spotted owl use of dispersal habitat would require extensive monitoring of dispersing owls (through radio telemetry and/or banding) and would be beyond the scope of Murray's HCP. It would also be intrusive on the local population of owls and is not considered appropriate considering the concerns that currently exist for reproduction and dispersal in the Mineral Block. Instead, Murray will focus model validation efforts on the prey populations in stands of dispersal habitat. Murray will assess prey populations by conducting small mammal sampling in selected stands within the ownership at two key times in the implementation of the HCP; immediately after implementation and in 2023 when the first generation of stands grown under the HCP reaches dispersal habitat condition. During each sampling period, Murray will sample for three consecutive years. Murray will sample two stands of suitable roosting, nesting and foraging habitat (i.e., old-growth) for baseline comparison and up to four stands of dispersal habitat (two replicates each of two conditions) in each of the two sampling periods. Sampling methods will be designed to target the principal prey of spotted owls (flying squirrels, deer mice and voles).

2.5.4 Monitoring of Other Species

The Murray ownership will be surveyed to determine if marbled murrelets are occupying potential harvest areas. Surveys will be done in accordance with survey protocol approved by the USFWS. Surveying of individual stands of potential habitat will continue until there is a reasonable level of assurance that murrelets are not occupying the stands, or until murrelets are located, whichever occurs first. If murrelets are found occupying the ownership, Murray will avoid taking murrelets or prepare an HCP and seek a permit for the incidental take of murrelets.

2.5.5 Reporting, Review and Modifications to the HCP

Murray will submit reports on the progress of the HCP to the USFWS annually. Each report will include:

a) a map and tabular summary of existing dispersal habitat on the ownership,

b) a summary of harvest activities that occurred over the preceding year (number and location of harvests and total acres harvested),

c) a summary of owl population monitoring results,

d) a summary of any validation monitoring conducted over the preceding year and discussion of progress and status toward meeting HCP mitigation requirements,

e) an updated projection of future dispersal habitat conditions and

f) a discussion of any problems that have arisen and/or changes that may be suggested by Murray.

Meetings will be held annually between Murray and the USFWS for the first five years of HCP implementation (1993 through 1997) to discuss the progress of the HCP and review any needed refinements or revisions including those that may be suggested by pertinent research other than Murray's. Amendments to the HCP, including any in response to unforeseen events, will be made in accordance with the Implementation Agreement between Murray and the USFWS and 50 CFR 13.27-13.29.

The USFWS will be responsible for monitoring compliance with the permit and HCP, and coordinating HCP implementation with the WDW and DNR to cooperate with these agencies' responsibilities for endangered species and forest management.

Subsequent meetings will be held every 10 years during the life of the HCP, beginning in 2003. Meetings may be held more frequently if both Murray and the USFWS find it necessary. Amendments to the plan during this time period will also be made in accordance with the Implementation Agreement.

Murray is currently in the process of negotiating land exchanges with the USFS and DNR in the Mineral area. If the exchanges are completed, some lands described in this HCP will be transferred to the respective public agency and other lands will be acquired by Murray (Table 2-3). Any forestlands acquired by Murray in the future through purchase or trade within the overall boundary of the HCP area will be incorporated into the HCP and managed accordingly.

2.6 COSTS AND FUNDING

This HCP requires Murray to engage in silvicultural activities like thinning, fertilization, and pruning to accelerate growth of the dispersal habitat. Murray must also incur substantial opportunity costs such as deferring timber harvest beyond the best economic rotation age of the trees. All of these costs must be paid by Murray as an additional charge to operating expenses. All opportunity costs cannot be responsibly estimated, but can be identified in categories like more land area devoted to set asides, adjusted rotation periods for various stands, lack of flexibility in responding to market conditions due to HCP harvest limitations and the risk of product obsolescence. Funding for the costs will come from Murray's continued commercial operations on the ownership, operations which have proven successful for more than eight decades. In addition, the HCP will be binding not only upon Murray but on any successor should Murray fail. In short, the value of the land itself stands behind the funding obligations of this HCP.

Table 2-3. Timberlands under consideration for exchange in or near the Murray HCP area.

MURRAY - U.S. FOREST SERVICE EXCHANGE

Lands to Murray Legal Location	Acres	Lands to U.S. Forest Service Legal Location	Acres
SW1/4 and W1/2 of NW1/4, Section 12, T13N,R4E	240	Section 31, T13N, R7E	652.35
SE1/4 of NE1/4 Section 26, T13,R4E	40		
Total	**280**	**Total**	**652.35**

MURRAY - DNR EXCHANGE

Lands to Murray Legal Location	Acres	Lands to DNR Legal Location	Acres
E1/2 of SW1/4 and W1/2 of SE1/4, Section 12, T13N,R5E	160	S1/2 of SW1/4, Section 22, T13N, R5E	80
SE1/4 of NW1/4, SE1/4 of SE1/4, Section 24, T13N,R5E	160	W1/2, Section 26, T13N,R5E	320
E1/2 of E1/2 of NE1/4 and NE1/4 of SE1/2, Section 21, T13N,R5E	80	W1/2, Section 27 T13N, R5E	320
Total	**400**	N1/2 of N1/2, S1/2 of NE1/4, NE1/4 of SE1/2 and S1/2 of S1/2, Section 34, T13N,R5E	440
		N1/2 of NW1/4 and NW1/4 of NE1/4 Section 35, T13N,R5E	120
		Total	**1,280**

2.7 EFFECTS OF THE HCP ON PLANTS AND WILDLIFE

2.7.1 Spotted Owls

Incidental Take: The total number of incidental takes of owls (if any) which might occur under this HCP is unknown. It is possible that up to 20 adult spotted owls and their offspring could be subject to incidental "take" (according to USFWS interpretation of take) during the first 10 years of the HCP, and up to 10 adults and their offspring could be subject to incidental take during each 10-year period over the remaining 90 years of the HCP. Although this many takes is improbable, as explained below, the incidental take permit covers this possibility. The incidental take permit authorizes Murray to continue to manage its forests in accordance with the terms of the HCP through its 100-year life.

The Murray ownership currently contains 4,678 acres of coniferous forest considered suitable for nesting, roosting and/or foraging by spotted owls. Surveys of the suitable habitat for the presence of spotted owls in 1991 and 1992 identified one non-breeding pair (WDW Site No. 749) and one resident single (WDW Site No. 837). The potential for a second resident single owl exists near the first, but surveys conducted according to USFWS protocol have failed to consistently detect the second owl. Within the home ranges of the known pair and single (where a home range is defined by a circle with a radius of 1.8 miles centered on the site center of the owl), there currently exist 1,206 acres (for the pair) and 1,991 acres (for the single) of suitable habitat (Table 1-2). According to guidelines suggested by the USFWS (see subsection 1.5.1), both home ranges contain less than the recommended minimum amount of suitable habitat to sustain spotted owls. In the opinion of the USFWS, the risk of taking (as defined by the ESA) will occur when commercial timber harvest resumes in either home range. Under the HCP, Murray will resume timber harvest of its lands in both home ranges by mid-1993. Harvest of mature and old-growth stands will continue until most commercial timber owned by Murray is harvested and replanted with seedlings (1,181 acres for the pair and 712 acres for the single). Murray estimates this will occur by 2003. Stands considered non-commercial, either because of low timber value, inaccessibility or dedication as riparian buffers and other protective set-asides, will remain in the home ranges. It is estimated that 25 acres of non-commercial mature and old-growth timber will remain as RMZs in the home range now occupied by the pair and 25 acres will remain in the current home range of the single.

Continued harvest in the home ranges of Sites 749 and 837, as described above, may eventually render those home ranges insufficient to support resident spotted owls. The USFWS has indicated this may constitute a taking of the three (and possibly a fourth) resident owls and their offspring (if they should ever reproduce). The date on which taking will occur in the opinion of the USFWS is difficult to determine because of variations in the responses of individual owls to habitat alterations and ambiguities in USFWS policy concerning take. The USFWS may consider that a taking has occurred as soon as harvest of suitable habitat resumes in either home range (i.e., 1993) or as late as the date at which harvest of mature and old-growth forest is completed in the two known home ranges (i.e., 2003).

A number of other spotted owl site centers lie on or near the Murray ownership and could be affected by future timber harvest. Two of these (WDW Site Nos. 219 and 233) are "single, status unknown" sites based on detection of owls 8 or more years ago. While neither site is believed to be occupied, there exists the remote potential for occupancy in the future. The harvest of suitable habitat within 1.8 miles of either site center could result in the take of up to four adult owls and their offspring.

Eight acres of the suitable habitat planned for harvest within the home range of the resident single Site No. 837 also lie within 1.8 miles of Site No. 944, which is a "single, status unknown" site. Harvest of the 8 acres could result in the risk of a take of Site No. 944, according to USFWS definitions, if: a) Site No. 944 is occupied by one or more resident spotted owls in the future and b) the home range of Site No. 944 does not contain a sufficient amount of suitable habitat at the time of Murray's harvest. The potential take resulting from Murray's harvest near Site No. 944 is therefore estimated to be two owls and potentially their offspring, although the likelihood of take is expected to be very low.

Murray also plans to harvest 37 acres of suitable spotted owl habitat within 1.8 miles of Site No. 220, which is a pair site centered roughly 1 mile from the ownership. There is currently less than 40 percent suitable habitat within 1.8 miles of the site center (Behan, pers. comm. 1993), and the harvest of these 37 acres also could be considered a taking of two adult spotted owls and their offspring.

Four other spotted owl site centers are known to exist within 2.5 miles of the Murray ownership. Murray holds no suitable habitat within 1.8 miles of any of the site centers, but future shifts in those site centers could bring them closer to the Murray ownership and within 1.8 miles of suitable habitat. If such shifts occurred, and there existed less than enough suitable habitat within 1.8 miles of the new site centers, Murray's harvest of suitable habitat could be considered a take. While the likelihood of such an occurrence is very low, the maximum estimated level of take would be eight adult owls (assuming one pair per site center), and their offspring.

Finally, the potential exists that spotted owls could establish and defend territories on or near the Murray ownership in areas not presently known to support owls. The potential for this is considered to be low, given the overall absence of suitable habitat, but it should be acknowledged that the harvest of timber on the Murray ownership will create at least some risk, however small, of take at any time in the future. For purposes of the permit, it is assumed Murray's activities could result in the take of up to five pairs of owls (and their offspring) in each decade of the HCP.

Management for Dispersal Habitat: The primary result of the HCP will be to create a landscape conducive to dispersal by juvenile spotted owls within the Murray ownership. The quality of dispersal habitat can be described in three ways: a) the total area of forest stands suitable for roosting and foraging by juvenile owls (i.e., dispersal stands), b) the total area of gaps in the dispersal landscape represented by forest stands of trees too small to provide roosting and foraging and c) the general landscape condition as estimated by the DLI. Over the 100 years of the HCP (1993 to 2093), the total area of dispersal stands will increase (Figure 2-6), the area of gaps will decrease and the DLI will increase (Figure 2-10). All three trends signify overall improvement in conditions conducive to juvenile spotted owl dispersal. Total area of dispersal stands will increase from an existing 11,412 acres to an estimated 23,233 acres in 2043, while the amount of gap (areas beyond 1/4 mile from dispersal stands) will decrease from 26,556 to 8,720 acres. The most significant trend in gap acreage will be the decline of large gaps (spaces between dispersal stands of more than 1 mile) from 9,476 acres in 1993 to 0 acres by 2043. In effect, dispersing juvenile owls will have to cross no opening greater than 1 mile on the Murray ownership in 2043. The DLI will increase from 5.34 to 7.47 by 2043.

The values presented in Figures 2-6 and 2-10 are future estimates based on projections of forest growth and yield and anticipated levels of harvest. All values are subject to variation due to refinements in the prediction models or adjustments in harvest plans within the limits specified in subsection 2.4.1. Also shown in Figure 2-10 are confidence limits +or- 5% for DLIs). These are considered to be the maximum ranges of variation for the projected values, and all actual values under the HCP can be expected to lie within these limits. A summary of the effects of the HCP on spotted owls is presented in Table 2-4.

Table 2-4. Summary of the effects of the Murray HCP on spotted owls.

- Harvest of 2,430 acres of suitable nesting, roosting and foraging habitat within 1.8 miles of known activity centers and up to 2,048 acres of suitable habitat beyond 1.8 miles from known activity centers over 10 years (the remaining 70 acres of suitable habitat within known circles and 130 acres outside known circles on the ownership will be left in reserve areas).

- Possible displacement (i.e., taking) of up to 10 pairs of spotted owls and their offspring over the first 10 years and up 5 pairs and their offspring per decade for the remaining 90 years.

- Increase in the area of dispersal habitat from 11,412 acres in 1993 to 23,233 acres by 2043, and maintenance of an average of 23,000 acres from 2043 to 2093.

- Decrease in the total gap area from 26,556 acres to 8,720 acres by 2043, and continued gradual decrease thereafter. Gaps larger than 1 mile will be eliminated.

- Increase in the Dispersal Landscape Index from 5.34 in 1993 to 7.47 by 2043, and maintenance at 7.40 or above from 2043 to 2093.

- Long-term validation monitoring of the dispersal landscape to improve the overall understanding of spotted owl ecology.

2.7.2 Marbled Murrelets

The marbled murrelet is known to exist in the vicinity of the Murray ownership and could potentially occupy old-growth stands on the ownership. The harvest of suitable murrelet nesting habitat within the regulatory home ranges of known spotted owls, as proposed in this HCP, would potentially impact murrelets. The marbled murrelet is protected under the ESA as a threatened species, however, and the permit for take of spotted owls requested by Murray will not permit the take of murrelets. Murray will continue to conduct surveys and/or take other appropriate measures to avoid the risk of take of marbled murrelets on the ownership. If murrelets are found to be occupying the ownership and conflicting with Murray's proposed management, Murray may request an amendment to the HCP and the permit for take.

2.7.3 Other Animals

No measures will be taken under the HCP specifically to benefit other wildlife species other than the prey of spotted owls. The primary effects of the HCP on other species of wildlife will be incidental to management for spotted owls and will involve a change in the types and distribution of habitats on the Murray ownership over the next 100 years (Figures 2-11 and 2-12). The ownership will experience an increase in the amount of sapling, pole and small sawtimber coniferous forest and a decrease in the amount of seedling, large sawtimber, old-growth, mixed and hardwood forest. The total areas of wetland, brush and rock habitat will remain the same (Figure 2-11). Those species associated with aquatic, riparian and wetland habitats will be affected little by the HCP, since these habitats are at least partially protected by existing state and federal law and will be treated no differently under the HCP. These species include the Columbia pebblesnail, Fender's soliperlan stonefly, bull trout, mountain sucker, pygmy whitefish, Van Dyke's salamander, tailed frog, northern red-legged frog, spotted frog, northwestern pond turtle and harlequin duck.

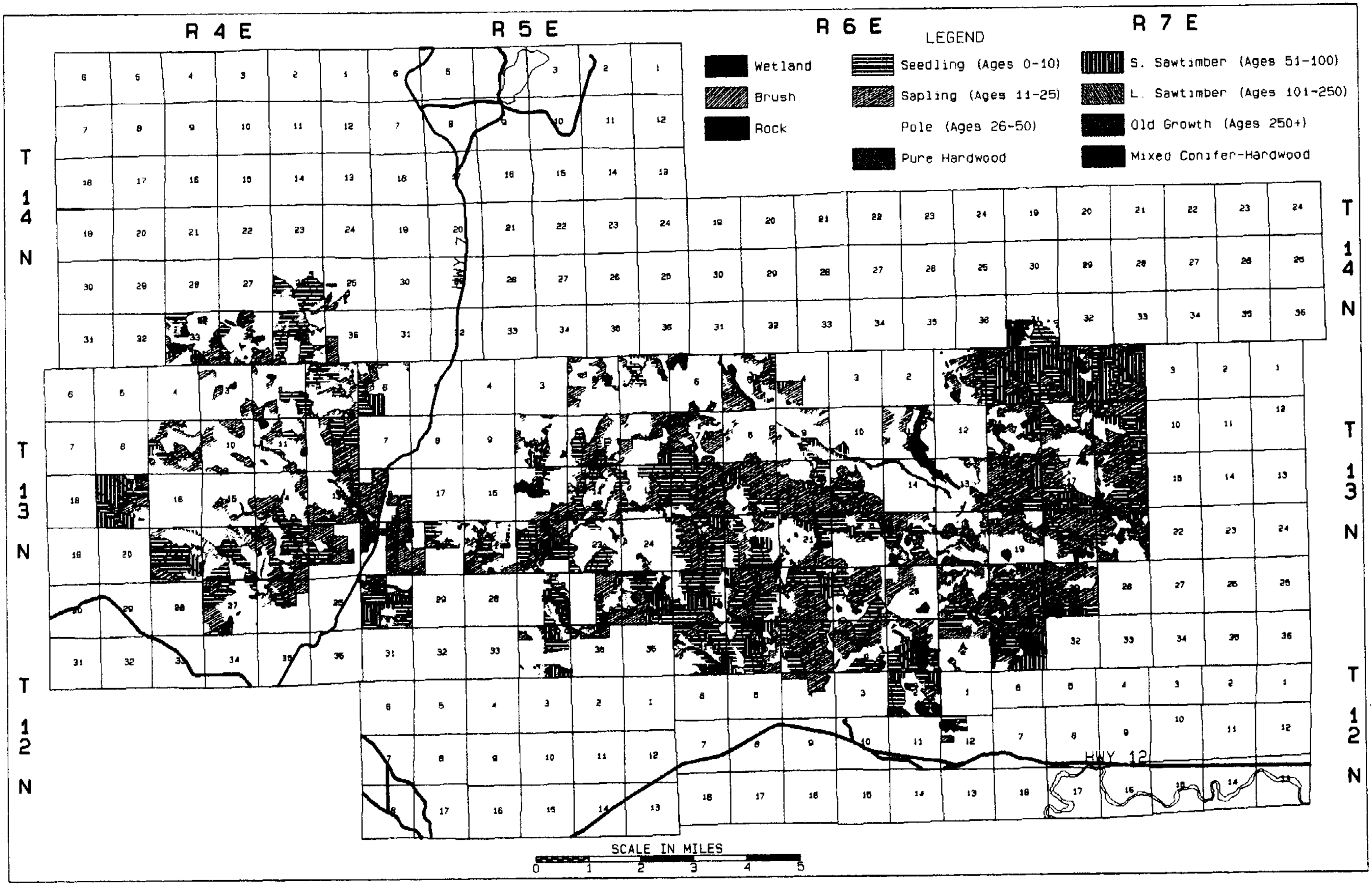


Figure 2-11. Projected distribution of wildlife habitats on the Murray Pacific ownership in 2043 under the HCP.

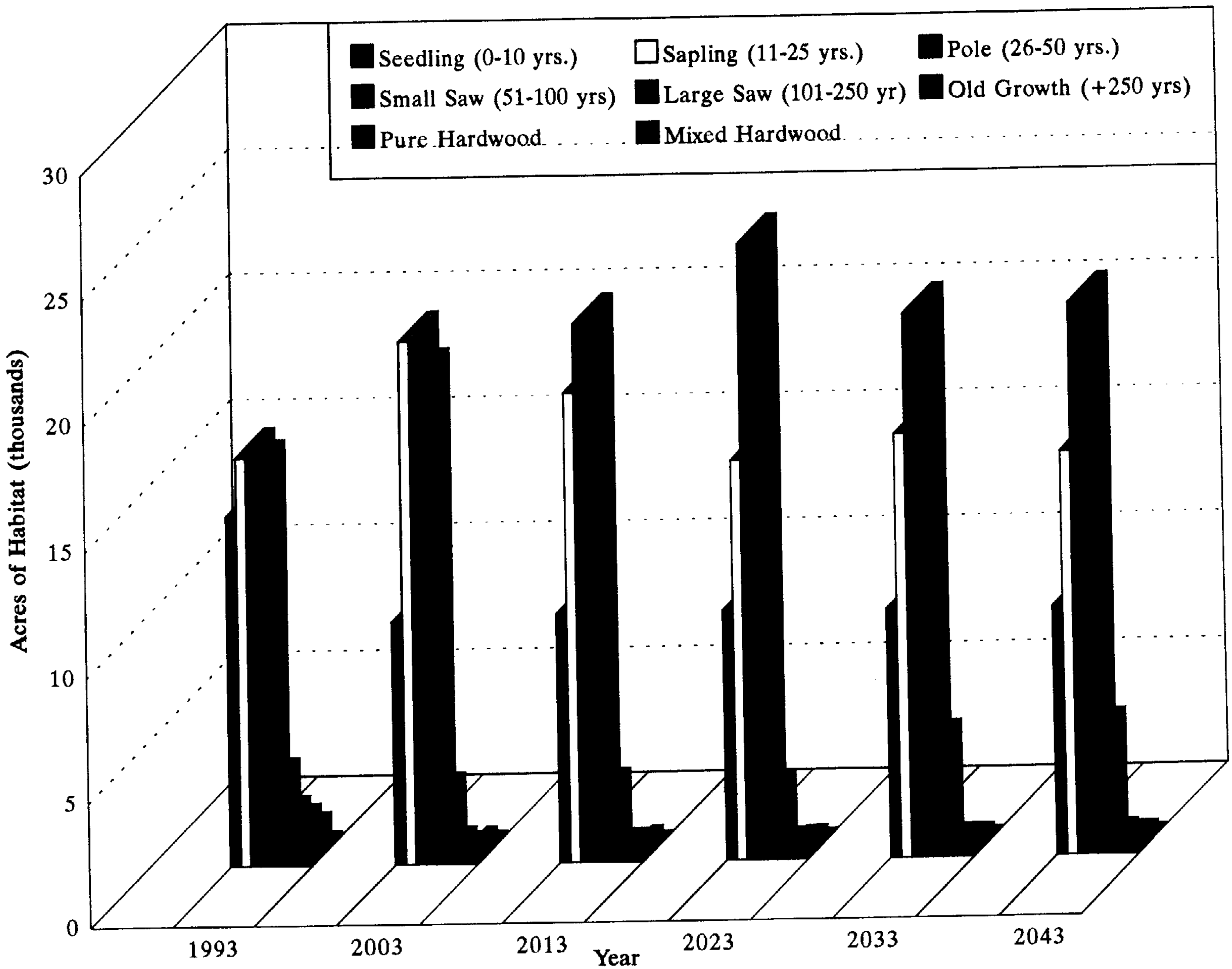


Figure 2-12. Projected trends in forest habitat types on the Murray Pacific ownership through 2043 under the HCP.

Species associated with particular successional stages of coniferous forest will be affected by the change in the distribution of habitats under the HCP. Some species, such as the pileated woodpecker, Vaux's swift and goshawk, reach highest densities in mature and old-growth forest. Retention of large snags and logs may provide some necessary habitat components for these species in pole stage and small sawtimber stands, but population numbers are expected to be lower in the younger habitats than in mature or old-growth forest. While total numbers will be lower under the HCP, none of these species is expected to be extirpated from the ownership.

Species that presently occur at very low densities on the Murray ownership (or are absent altogether), such as the great blue heron, golden eagle, bald eagle, osprey, California wolverine, gray wolf, grizzly bear and Pacific fisher, are not likely to be effected by the HCP. A change in the distribution of forest age classes should have little impact on these species. No take of federally-listed species other than the spotted owl is anticipated as a result of Murray's activities under the HCP.

2.7.4 Plants

The HCP will have no effect on federally-listed plants, as none occur in the State of Washington. The State Sensitive species listed in Table 1-3 will be affected if they are present and their habitats are altered through timber harvest or road building. Most of the species are associated with unique habitats that are protected and/or limited in their distribution on the Murray ownership; effects on these will be minor. The rest are associated with more common habitat types, such as moist coniferous forest, and may be effected by forestry operations.

3.0 ALTERNATIVES TO THE PROPOSED HCP

3.0 ALTERNATIVES TO THE PROPOSED HCP

3.1 PROTECTION AND MAINTENANCE OF EXISTING SUITABLE SPOTTED OWL HABITAT WITHIN 1.8 MILES OF EACH KNOWN ACTIVITY CENTER

The now-rescinded USFWS guidelines of July 1990 (revised August 1990) suggested that the risk of taking resident spotted owls in the Washington Cascades could be avoided by maintaining 2,523 acres of suitable spotted owl habitat within 1.8 miles of each owl activity center. The guidelines further suggested that 500 acres of the 2,523 should lie within 0.7 mile of the activity center and include the best 70 acres of suitable spotted owl habitat directly surrounding the activity center. Even though rescinded, the former guidelines can serve as biological parameters for an alternative approach to owl habitat management. The two known spotted owl home ranges centered on the Murray ownership contain 1,206 and 1,991 acres of suitable spotted owl habitat as of 1993, so harvest of suitable habitat in both home ranges would have to be curtailed. Murray would continue to harvest merchantable, non-suitable habitat within the home ranges, as well as all merchantable habitat outside the circles, and they would monitor the owls to verify their continued presence.

Murray also owns approximately 45 acres of suitable habitat in circles centered on adjacent ownerships. None of the circles meets the threshold of 40 percent suitable habitat, so harvest of those 45 acres also would be curtailed under this alternative. Suitable habitat beyond 1.8 miles form known activity centers would be harvested when economical for Murray, unless new owls were discovered. This alternative would be the existing condition or "No-Action" if Murray followed the now-rescinded USFWS guidelines.

The net effect of this alternative over the next 100 years would be to maintain existing habitat suitable for resident owls within the known home ranges, while adding little additional habitat for foraging and roosting by dispersing owls. Most of the suitable habitat (both resident and dispersal) would be in large blocks concentrated in the known home ranges. The overall DLI for the ownership after 50 years would be 6.80 (Figure 3-1), and the total area of dispersal habitat would be 16,978 acres. This alternative was not chosen by Murray because it would reduce Murray's current harvestable area by 41 percent (from

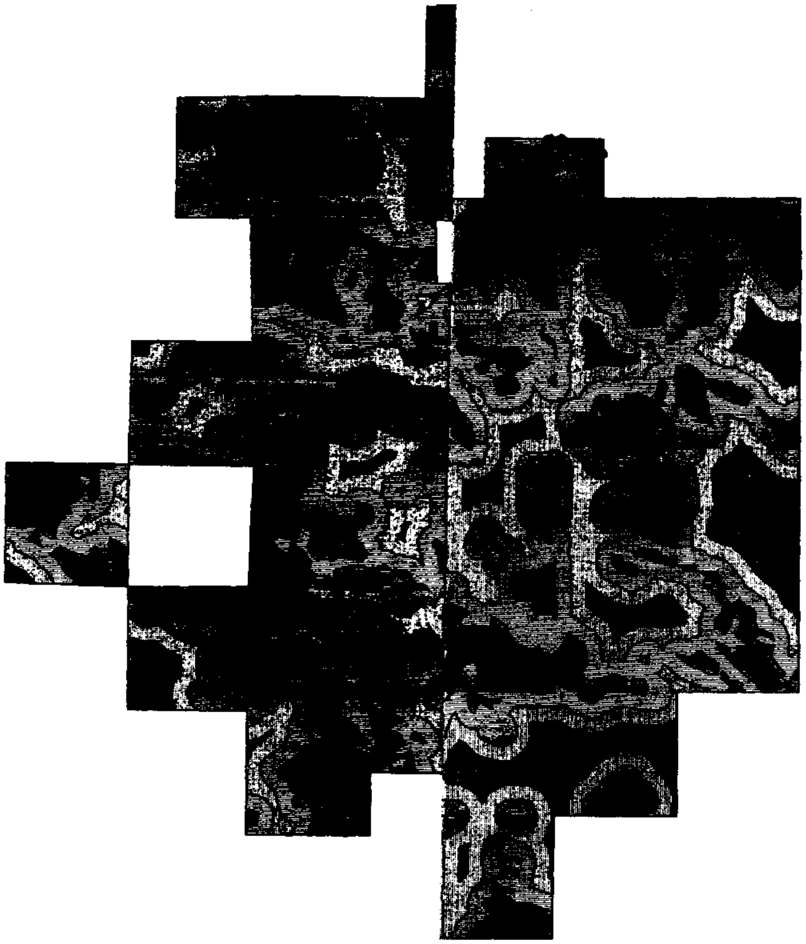


Figure 3-1. Spotted Owl
2043 with p

5,950 acres to 3,520 acres). This loss of commercial timber would significantly reduce Murray's operating income over the next decade, and is not an economically viable option for the company.

A variation of the 1.8-mile management scenario could occur if the known spotted owls on the ownership abandon their home ranges and are not replaced. Under such a scenario, Murray would resume commercial harvest on all its lands, subject only to other state and federal regulations governing forestland management (principally the Washington Forest Practices Rules and Regulations). The result would be that far less habitat would be provided over the long term for resident or dispersing spotted owls than with any of the other alternatives. The potential for such a scenario is real because of the small amount and fragmented nature of the habitat currently on the ownership. This situation is further complicated by the state and federal practice of moving regulatory activity centers for resident owls to reflect the detection of highest status, which can change as often as each year. When an activity center is moved, suitable habitat within 1.8 miles of the old activity center can be more than 1.8 miles from the new activity center and harvestable without the risk of incidental take. If shifting occurs several times for the same activity center, the total area of suitable habitat can eventually be reduced to a very low level. This scenario is considered a potential outcome of the 1.8-mile management alternative and the 500-acre alternative described in Section 3.2.

3.2 PROTECTION OF 500 ACRES OF SUITABLE SPOTTED OWL HABITAT AROUND EACH KNOWN ACTIVITY CENTER

This alternative is similar to the previous alternative, except the area of protected habitat would be reduced to 500 acres within 0.5 mile of the activity center in each home range. The best 70 acres of habitat surrounding each activity center also would be protected as part of the 500 acres. This alternative would be consistent with a recent memo issued on 24 August 1992 by the Assistant Secretary of the Interior for Fish, Wildlife and Parks and would be the No-Action Alternative if Murray followed only the August 1992 memo. Like the previous alternative, it would result in the retention of suitable habitat for resident spotted owls within the known home ranges and the development of dispersal habitat also concentrated within the home ranges. The total area of dispersal habitat could increase to 15,310 by 2043 and the DLI would reach 6.59 (Figure 3-2). Harvest of mature and old-growth forest stands would continue in the known home ranges (but perhaps only outside the 500 acres), as well as outside the known home ranges. This alternative was not selected by Murray because it could still restrict harvest of up to 750 acres of forest for several decades, if not longer, if resident owls persist within the ownership. That result is not an economically viable option for the company.

3.3 COMPARISON OF THE HCP AND ALTERNATIVES

As noted above, the two alternatives to the HCP are variations on Murray's current forestland management, adjusted to avoid the risk of taking spotted owls. They would result in the protection of differing amounts of suitable nesting, roosting and foraging habitat, but in other respects they are essentially identical. Murray would protect the existing suitable habitat within the respective circular areas and pursue timber management and harvest on an economic basis in non-suitable habitat within the circles and all habitat outside the circles. If either circle was abandoned by owls in the future (according to USFWS criteria), harvest would resume in the circle(s) as well. In all harvesting, Murray would comply with existing state and federal regulations concerning forest and wildlife management, but there would not necessarily be any concerted effort to correct the uneven distribution of forest age classes that currently exists. When compared to the HCP, the alternatives ultimately would result in less total area of dispersal habitat (Figure 3-3), more area in gap (Figure 3-4) and lower overall quality of dispersal habitat on the ownership, as measured by the Dispersal Landscape Index (DLI) (Figure 3-5; Table 3-1). The 500-acre alternative would provide a poorer quality dispersal landscape than the HCP by 2003, and this would continue over the life of the HCP. The 1.8-mile circle alternative would provide slightly more dispersal habitat than the HCP in the short term, but the HCP will provide a better landscape from approximately 2023 on, as the younger stands being managed for dispersal habitat develop the necessary structural characteristics. Abandonment of one or both of the known activity centers would result in considerably less dispersal habitat under both alternatives.

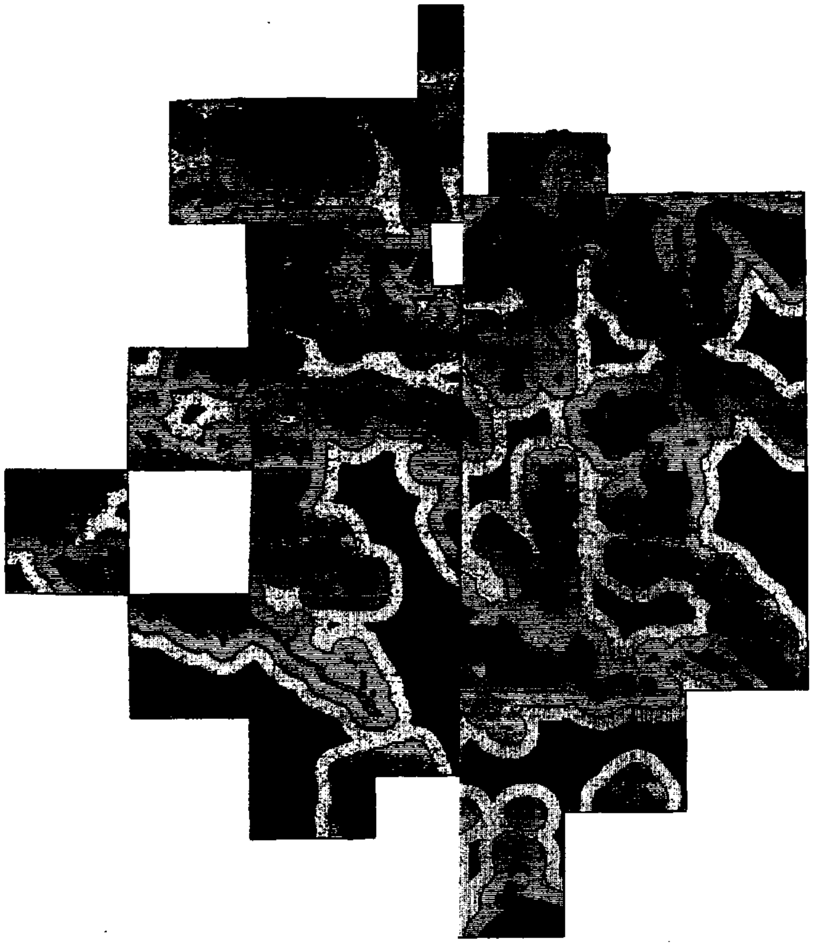


Figure 3-2. Spotted Owl
2043 with pı

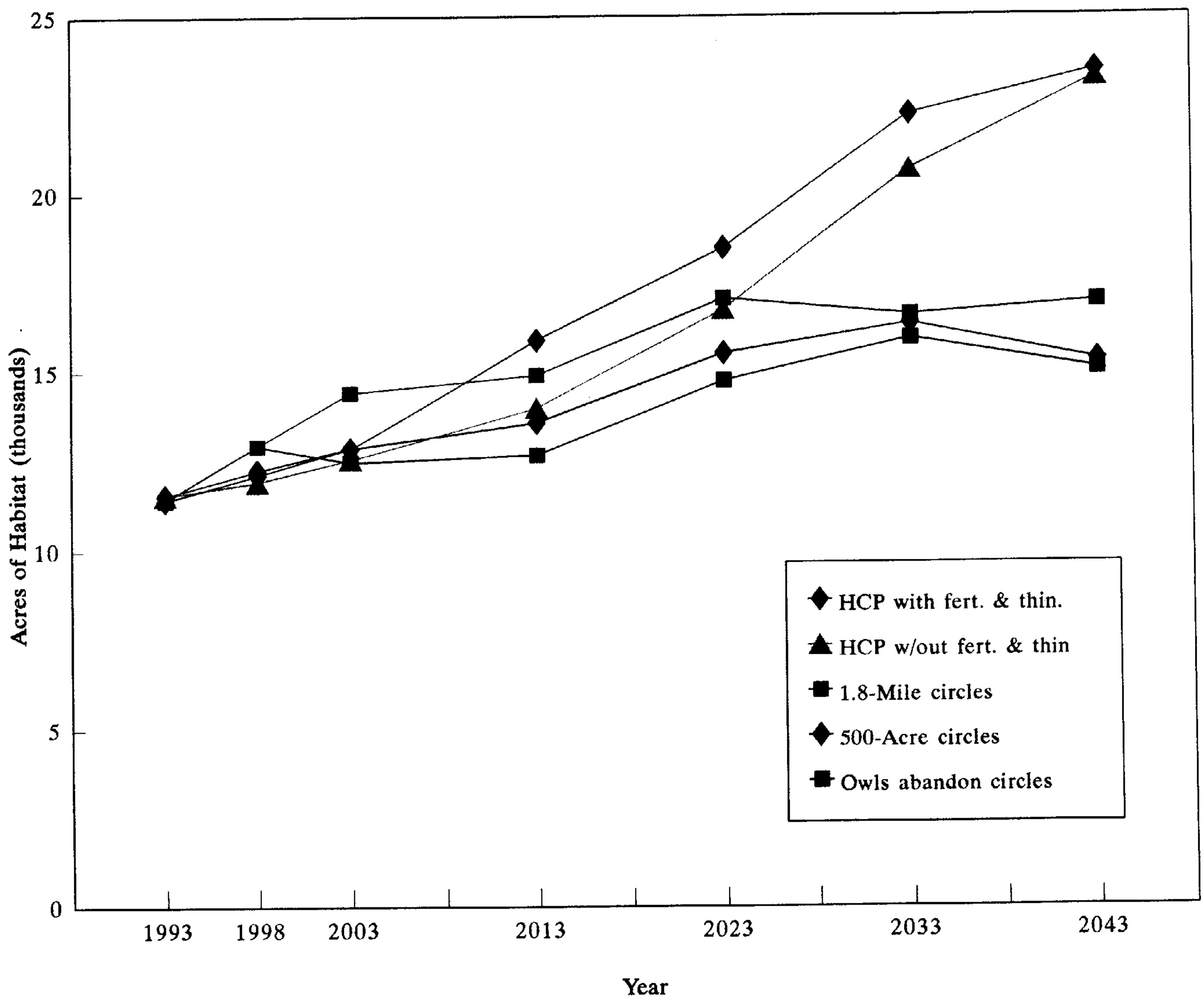


Figure 3-3. Projected trends in spotted owl dispersal habitat under the Murray HCP and alternatives.

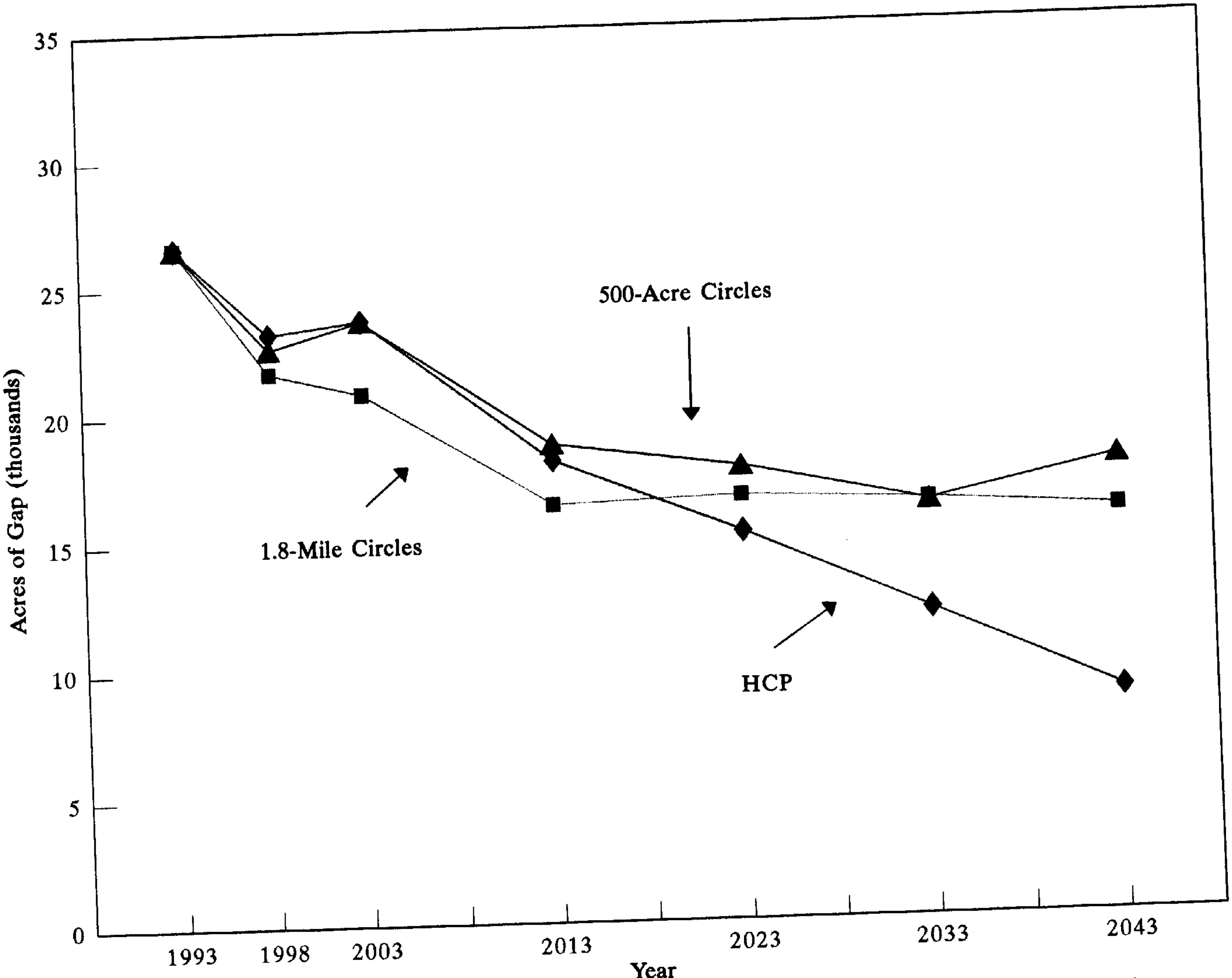


Figure 3-4. Projected trends in gap in the spotted owl dispersal landscape under the Murray HCP and alternatives (gap includes all areas in the ownership more than 1/8 mile from the nearest dispersal stand).

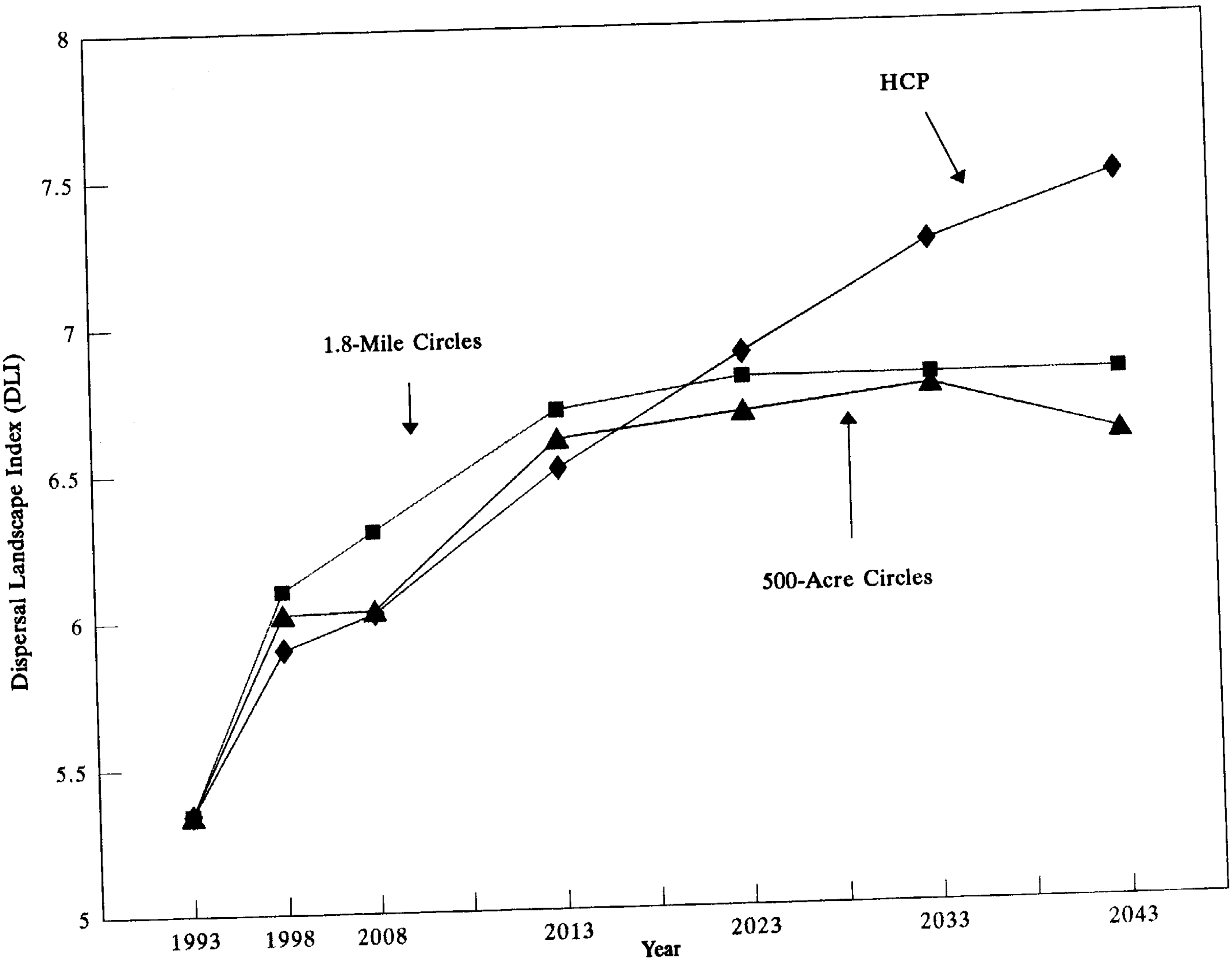


Figure 3.5. Projected trends in the spotted owl Dispersal Landscape Index (DLI) under the Murray HCP and alternatives.

Table 3-1. Comparison of the Murray HCP and alternatives over the 50 years between 1993 and 2043.

	ALTERNATIVES			
	Existing Condition	HCP	1.8 - Mile[1]	500 - Acre[1]
Acreage of Dispersal Habitat	11,412 ac.	Increase to 23,233 ac.	Increase to 16,978 ac.	Increase to 15,310 ac.
Acreage of Total Dispersal Gap	26,556 ac.	Decrease to 8,720 ac.	Decrease to 15,785 ac.	Decrease to 17,739 ac.
Acreage of Dispersal Gaps > 1 mile	9,476 ac.	Eliminated	Decrease to 813 ac.	Decrease to 1,247 ac.
Dispersal Landscape Index	5.34	Increase to 7.47	Increase to 6.80	Increase to 6.59
Merchantable Timber Available for Harvest in 1993	3,520 ac.	5,950 ac.	3,520 ac.	5,200 ac.

1 Assumes owls persist on the ownership

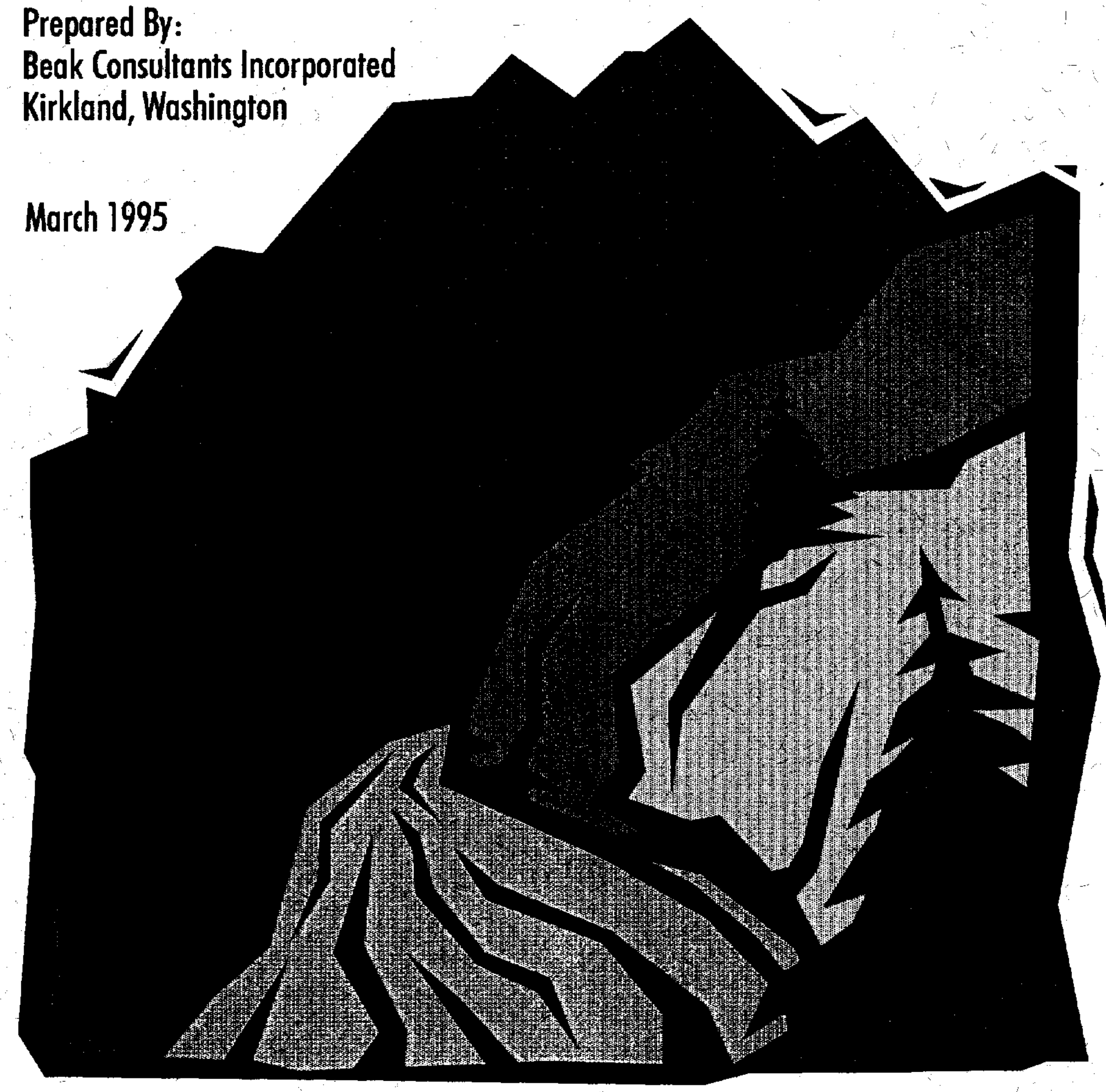
By design, the Murray HCP will provide a consistently large acreage and favorable distribution of habitat through 2093. The current distribution and acreage of habitats on the ownership are unfavorable to spotted owls because they result in a landscape dominated by large areas of very young forest. Both the spatial and chronological distributions of the habitat are skewed away from conditions suitable for spotted owl dispersal. This situation will take several decades to correct through the redistribution of forest age classes across the landscape, but once it is corrected it will remain relatively constant. The rate of harvest, which is the primary determinant of the distribution of forest age classes on the ownership, will be regulated between 1993 and 2093, with the specific objective of correcting the uneven distribution that currently exists. Once the distribution is corrected, the situation will reverse somewhat and the rate of harvest will be controlled by the distribution. Murray will be able to harvest only what is merchantable, and the amount that is merchantable will be a function of the distribution of forest age classes that will be created under the HCP. The potential for large clearcuts and extensive areas of harvest over short periods of time, as occurred in the past, will be very low after 2093. While the term of the HCP will last only until 2093, the beneficial effects of the HCP on owls will likely last for several rotations, and even indefinitely.

AMENDMENT TO THE HABITAT CONSERVATION PLAN AND INCIDENTAL TAKE PERMIT PRT-777837 FOR THE NORTHERN SPOTTED OWL

ON TIMBERLANDS OWNED BY THE MURRAY PACIFIC CORPORATION LEWIS COUNTY, WASHINGTON

Prepared By:
Beak Consultants Incorporated
Kirkland, Washington

March 1995



AMENDMENT TO THE

HABITAT CONSERVATION PLAN

AND INCIDENTAL TAKE PERMIT PR-777837

FOR THE NORTHERN SPOTTED OWL

ON TIMBERLANDS OWNED BY

THE MURRAY PACIFIC CORPORATION

LEWIS COUNTY, WASHINGTON

Prepared For:
The Murray Pacific Corporation
Tacoma, Washington

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Kirkland, Washington

30 March 1995
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1.0 INTRODUCTION

This Amended Habitat Conservation Plan (HCP Amendment) supplements and amends Murray Pacific Corporation's (Murray's) Habitat Conservation Plan for the Northern Spotted Owl *(Strix occidentalis caurina)* approved in 1993. This is a multiple-species HCP Amendment which addresses both listed and unlisted species. This HCP Amendment is intended, to the maximum extent practicable for Murray, to minimize and mitigate the impacts to all species which currently are listed or may be listed in the future as threatened or endangered under 16 U.S.C. §1531-1544, the federal Endangered Species Act of 1973 (ESA), as amended, during the 100-year term of this HCP Amendment.

There are at least four important concepts involved in this HCP Amendment that provide key reasons for the parties to agree to the plan. The first concept involves the element of risk, and the courage to move forward despite the risk. Only mutual willingness on the part of each party to accept some moderate risk can move the raging controversy over threatened and endangered species from the courts and meeting rooms, from the endless theoretical and emotional arguments, to creative programs carried out on the ground. Over time such programs can help lead to scientifically-based cooperative and adaptive protection of species.

Second is the concept of certainty. Risk cannot be unlimited for any party, nor for the species involved. Reasonable certainty for each provides considerable incentive to finally agree to an HCP. Because one of the primary concerns about the survival of species is the continuing loss of habitat, it is important to know that at least 10 percent of the Mineral Tree Farm owned by Murray will be available as forested reserve wildlife habitat for the next 100 years. This is in addition to a commitment to perform formal Watershed Analyses throughout virtually all of the tree farm, provide expanded riparian management zones, increase the amount of woody debris and number of trees left standing across the landscape after harvest and greatly improve habitat distribution throughout the tree farm through adherence to the dispersal landscape index of the previously approved spotted owl HCP. The quality of the reserve habitat is high, being primarily riparian, and will improve as the years pass and the forest matures. This may seem an insignificant contribution considering the state of Washington or the world as a whole. However, it is significant to Murray, and to the agencies. If everyone made similar commitments, including dedicating 10 percent of his or her ownership to wildlife habitat, the concern about loss of habitat would be substantially diminished. It is unlikely all landowners will make these commitments. Therefore, for Murray to do so is an important precedent.

For Murray to agree to the habitat management and financial commitments of the HCP Amendment, it must have reasonable certainty that it can absorb the costs and yet remain economically viable over the term of the Amendment. Some degree of certainty and predictability in business ventures is essential and very fundamental, whether planning for production or attempting to borrow money. This need was recently addressed by Secretary of Interior Bruce Babbitt in announcing a policy providing reasonable certainty for parties to HCPs. The essential provisions of this policy are embodied in the HCP Amendment and Implementation Agreement. The venture is not risk free for anyone, but the risks are reasonable.

Third is the concept of adaptive management. The key elements of adaptive management include experimentation, monitoring and analysis and synthesis of results, followed by adaptive management in response to the scientific results of those efforts. Due to the current lack of definitive scientific information, the opportunity for learning and responsive adjustment provided by adaptive management is an important incentive for the agencies to agree to the terms of this HCP Amendment. This HCP Amendment is a straightforward habitat plan. Although the effects on individual species have been considered as though all were listed, this HCP Amendment is a true shift away from the current but unworkable "species-by-species" approach to protection of wildlife. The hypothesis, backed by the scientific rationale set out in this document, is that this habitat plan will work well in this setting. There is good reason to believe it will work well in this location. Through the continuing scientific information provided to the agencies by Murray scientists, and additional information the agencies may gain through their own efforts, the agencies have the opportunity to learn from this plan, and to adjust both this plan and plans for other areas, including the U.S. Forest Service (USFS) Late-Successional Reserves (LSRs) surrounding these Murray lands. The Implementation Agreement for this plan provides for consultation between the agencies and Murray in the event unforeseen circumstances arise. In such an event, the agencies can seek adjustments to the HCP. If the cost to Murray can be minimized, Murray may agree to the adjustments. Otherwise, the agreement does not constrain the agencies from taking additional action at their own cost. In extraordinary circumstances, as defined in the agreement, some further mitigation can be required of Murray. Although further costs which can be imposed on Murray are constrained under this HCP Amendment, it does not limit the opportunities for adaptive management, within this HCP area or elsewhere.

The fourth and final important concept is mutuality of concerns. It is not helpful to view the certainty concept as solely a Murray concern, nor adaptive management solely as a concern of the agencies. Each of the above concepts is important to all of the parties, because each concept is essential to reaching this agreement. Each concept is of mutual concern. The parties will share a mutual incentive to make this HCP Amendment function well, both as a specific plan for this plan area and, in the larger sense, as a small step along the path to finding appropriate and effective alternatives for fish and wildlife management. Through this HCP Amendment the parties are free to support each other in that effort, without unreasonable fear of future negative repercussions.

2.0 BACKGROUND

This HCP Amendment has been prepared by Murray as an expansion of their HCP for the management of the northern spotted owl, which was approved by the U.S. Fish and Wildlife Service (USFWS) in 1993. The original spotted owl HCP is incorporated herein by reference, and remains in effect to the extent it is not contradictory to the terms of this Amendment, in which case this HCP Amendment will control.

Murray owns and operates the Mineral Tree Farm in eastern Lewis County, Washington. Murray applied to the USFWS and obtained a permit for the incidental take of spotted owls on the Mineral Tree Farm in 1993. The permit was necessary because, in the opinion of the USFWS, continued harvest of mature forest habitat presented the risk of incidental take of resident spotted owls, a species listed as threatened under the ESA. To minimize and mitigate the effects of any incidental take, Murray agreed to manage the tree farm under the terms and conditions of the HCP for 100 years (through 2094). The permit provides Murray with the assurance that it can continue to operate the tree farm without the risk of prosecution for the take of owls. Continued operation of the tree farm provides the means whereby Murray can undertake the conservation and management requirements of the HCP. The HCP provides the USFWS with assurance that the tree farm will be managed in a manner consistent with the long-term management and recovery of the species.

Murray's permit covers any incidental take of spotted owls that might occur during the management and harvest of timber on the tree farm. Other threatened and endangered species are protected under Section 9 of the ESA, and Murray must also avoid the incidental take of these species. The marbled murrelet (*Brachyramphus marmoratus*) is a threatened species that is known to exist in the vicinity of the tree farm. A number of other listed species are rare, but present, in the southern Washington Cascades, and could possibly occur on the Mineral Tree Farm at some time over the next 100 years. In addition, a number of species that currently are candidates for federal listing are known to occur on or near the tree farm. Future listings of these and other species could impose additional restrictions on Murray and seriously impede efforts to manage for spotted owls under the HCP. Murray is therefore amending the original spotted owl HCP to include habitat management for multiple species, while doing so in a manner consistent with the original spotted owl HCP objective of providing a dispersal landscape for spotted owls. The HCP Amendment supports Murray's application for incidental take permits to cover all currently listed species for 100 years. This HCP Amendment and the associated Implementation Agreement also include provisions for the issuance of incidental take permits for currently-unlisted species on the tree farm if they are listed in the future. All fish and wildlife species with the potential to occur on or near the Mineral Tree Farm are considered as though they are listed under the ESA for the purposes of this HCP Amendment.

The objective of this HCP Amendment is to provide for the management of the tree farm in a manner that maintains and enhances fish and wildlife habitat while permitting the continued harvest of commercial timber. Habitat management on the tree farm will focus on: a) the protection of water quality and fish habitat, b) the growth and maintenance of mature forest habitat in designated reserve areas (primarily along streams) and c) enhancement of wildlife habitats in managed commercial stands across the tree farm. These contributions on the part of Murray will complement ongoing efforts on adjacent public lands and contribute to the overall maintenance of fish and wildlife populations across the regional landscape. Federal lands administered by the USFS to the east and west of the Mineral Tree Farm are managed as LSRs under the President's Northwest Forest Plan (U.S. Forest Service and Bureau of Land Management 1994). Among the primary management objectives in LSRs are the maintenance of wildlife and their late-successional habitats and the protection of fish habitat (U.S. Forest Service and Bureau of Land Management 1994). Murray's efforts on the Mineral Tree Farm will supplement federal efforts in the LSRs. Late-successional habitat on the adjacent federal lands will be interconnected across the tree farm through a series of habitat reserves, while habitat for early- and mid-successional wildlife species will be provided on the remainder of the tree farm. Fish habitat protection will occur through protection of streamside areas along all fish-bearing streams on the tree farm and reduction in sediment delivery to streams that could occur through landslides and erosion.

Considered as a whole, this HCP Amendment substantially exhausts the biological measures available to Murray, given the resources of the company, the location and condition of the habitat on the tree farm and the needs of all species which might reasonably be expected to occur on the tree farm over the next 100 years. In short, by this HCP Amendment Murray is making a commitment to do what it can for wildlife and still survive as a company.

This HCP Amendment is designed to help reverse the general decline of fish and wildlife habitat, while simultaneously enabling productive use of timber resources by Murray. There are no guarantees that the HCP Amendment will be universally successful. There will always be scientific and economic uncertainties. Difficult decisions are required whenever wildlife requirements are weighed against the reality of the economic constraints on the ability of the owner to satisfy such requirements. However, given all the circumstances, this HCP Amendment represents the best the owners, management and employees of Murray, combined with independent scientific and technical skills, can provide for fish and wildlife resources across the tree farm for a significant period of time. Murray believes that, despite the uncertainties involved, biologic and economic sustainability can be achieved under this HCP Amendment, given the determination of its owners and management to succeed, and given the cooperation and responsiveness of the USFWS, National Marine Fisheries Service (NMFS) and the Washington Department of Fish and Wildlife (WDFW).

This HCP Amendment is demonstrable evidence that habitat values can be preserved and enhanced on a commercial tree farm for the benefit of both a wide variety of fish and wildlife species and for the business owners and employees of Murray. The long-term health of fish and wildlife and the commercial success of the business are interdependent. This HCP Amendment integrates the objectives of both.

3.0 PURPOSE AND NEED FOR THE AMENDMENT TO THE HCP

3.1 Permit for Incidental Take

Murray has applied to the USFWS and NMFS for permits under Section 10 of the ESA which will allow the incidental take of currently listed species on the Mineral Tree Farm. The associated Implementation Agreement also includes provisions for the issuance of incidental take permits for currently-unlisted species on the tree farm if they are listed in the future. The permit and the Implementation Agreement, including the unlisted species provisions, will be in effect through the year 2094, and will cover any take that occurs incidental to routine commercial timber management and harvest. This HCP Amendment has been prepared to minimize and mitigate the effects of any incidental take that might occur under the permit.

3.2 Biological Objectives

The primary biological objective of this HCP Amendment is to assure that the effects of any future incidental takings, as defined in the ESA, are minimized and mitigated to the maximum extent practicable, and that such takings will not appreciably reduce the likelihood of the survival and recovery of the affected species in the wild. Unlisted species are addressed in this HCP Amendment as if the species were listed pursuant to the ESA. Management for wildlife has historically occurred on a species-by-species basis, and has typically been focused on species of economic concern (i.e., game species) and species threatened with local extirpation or extinction. Such reactive wildlife management is costly to landowners and it is much less effective than proactive management of healthy populations of animals. Murray recognizes the opportunity provided under the ESA to take a proactive approach to wildlife habitat management to protect wildlife now and avoid additional listings in the future.

As overall guidance for the management of the tree farm, Murray will follow the recommendations developed during a 1993 workshop at the University of Washington's Pack Forest. The workshop was attended by a wide variety of representatives of the forest products industry, academia and natural resource agencies within the state of Washington. The attendees identified the following roles as appropriate for private forest landowners in Washington:

- protection of riparian areas and wetlands, and the habitats they provide;
- provision of habitat for early- and mid-successional wildlife species in managed upland forests;
- assistance to public land managers in meeting their responsibilities for late-successional ecosystems; and
- maintaining site productivity to ensure sustainable forestry.

3.3 Long-term Economic Objective

The long-term economic objective of the HCP Amendment is to provide certainty for the future management of the Mineral Tree Farm. The recent federal listings of the spotted owl and marbled murrelet have seriously constrained management of the tree farm and reduced its economic return in ways that were not anticipated just 5 years ago. The potential for additional listings in the future further threatens the economic viability of the tree farm. Commercial timber production is a long-term venture, requiring investments that are not returned for decades, but investments are difficult if not impossible to justify when future returns (i.e., from timber harvests) are uncertain or even unlikely. The long-term economic objective of this HCP Amendment is to provide a measure of regulatory certainty for the management of the tree farm that will enable and even encourage

Murray to continue commercial forestry as a viable endeavor, while supporting meaningful habitat management.

3.4 Short-term Economic Objective

A second economic objective of the HCP Amendment is to provide for the continued harvest of commercial timber on the tree farm in the short term in a manner consistent with the management of listed and unlisted species. Approximately 2,834 acres of the Mineral Tree Farm support mature coniferous forest (over 100 years old). Some of this forest will be retained indefinitely to protect steep and unstable slopes and address other environmental concerns, but most of this acreage is scheduled for harvest over the next decade. Survival of the tree farm as a business in the near term is contingent upon the continued harvest and sale of this timber. Murray's existing permit for the incidental take of spotted owls already allows the harvest of the timber, but the potential for nesting marbled murrelets on the tree farm caused Murray to voluntarily delay some timber harvest while habitat was surveyed. No murrelet occupancy was indicated during 3 years of surveys, but the potential for the presence of additional species has prompted Murray to pursue a proactive approach. Potential federal listings of species, such as the northern goshawk (*Accipiter gentilis)*, could pose similar constraints on commercial timber harvest and render all existing habitat management measures meaningless. This HCP Amendment is intended to provide a workable framework for the rational management of wildlife habitats on the Mineral Tree Farm in a manner that does not destroy the commercial enterprise.

4.0 BACKGROUND INFORMATION ON THE RESOURCES OF THE HCP AREA

The following chapter summarizes, supplements and updates background information on the location, management history and resource conditions of the Mineral Tree Farm as originally presented in Murray Pacific's HCP for the Northern Spotted Owl prepared in 1993.

4.1 Environmental Setting

The Mineral Tree Farm encompasses 53,527 acres of commercial timberland in eastern Lewis County, Washington (Figure 4-1). The total area of the tree farm decreased from the 54,610 acres reported in the original spotted owl HCP due to land exchanges with the state of Washington and USFS (see page 2-43 of the original spotted owl HCP).

The tree farm lies on the west slope of the Cascade Mountains, and is characterized by steep terrain, abundant precipitation and dense coniferous forest. The entire tree farm is managed for commercial timber production, and most of it has been clearcut or partially harvested at least once since 1913. Approximately 479 acres of the tree farm currently are considered to be old-growth coniferous forest that has never been harvested. The remainder of the tree farm is selectively-harvested old-growth forest, second-growth forest, non-forested wetland, rock, stream, lake and road.

The tree farm is surrounded by private, state and federal timberlands and a small amount of agricultural land. State and private timberlands are managed for commercial timber production, much like the tree farm. Federal lands managed by the USFS Gifford Pinchot National Forest abut the tree farm on the east and west. The federal lands are managed as LSRs under the Northwest Forest Plan (U.S. Forest Service and Bureau of Land Management 1994). The primary emphasis for these reserves is the maintenance of mature and old-growth forest habitats.

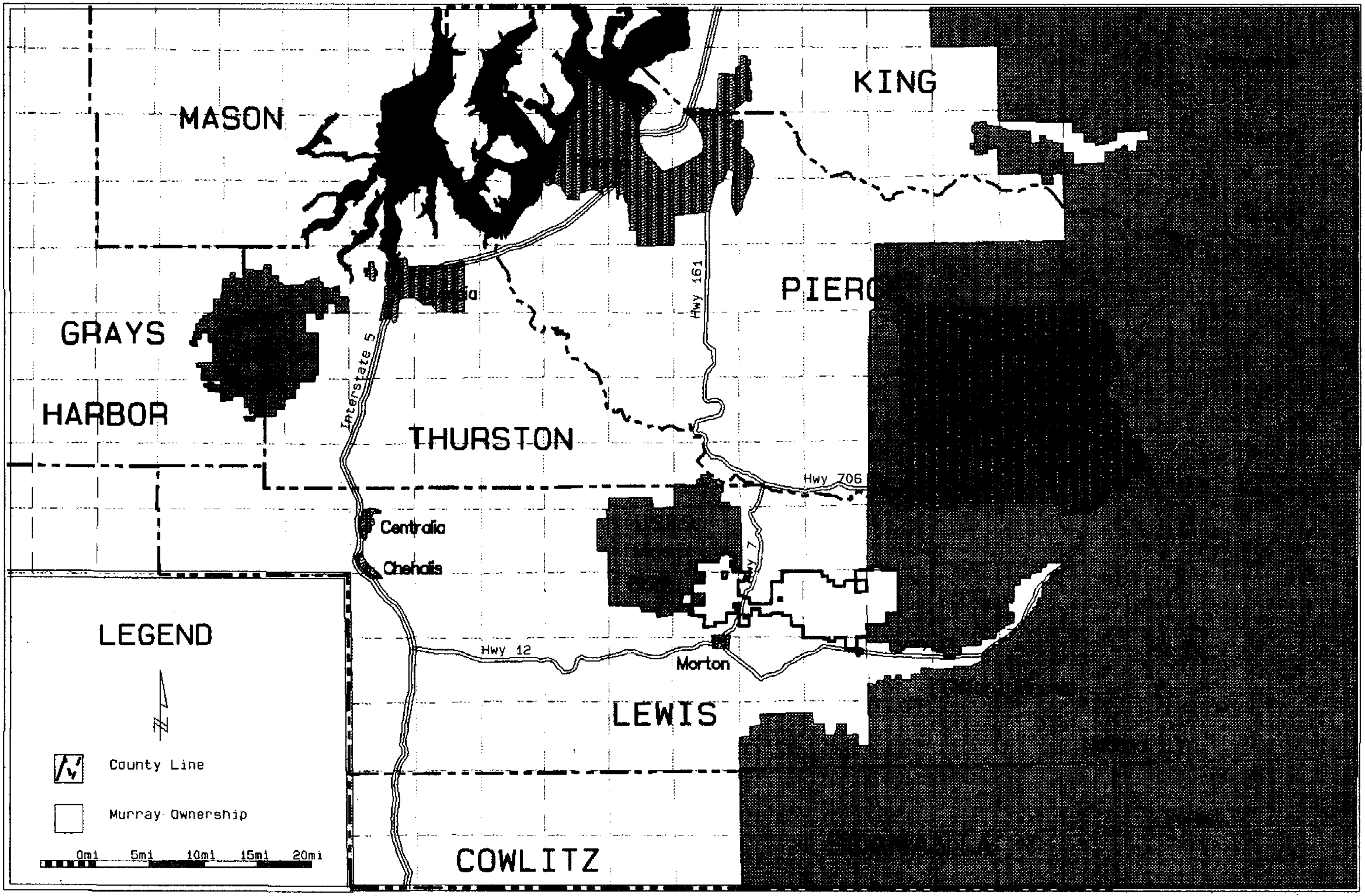

Figure 4-1. Location map.

Local climate is marine, with dry summers and mild wet winters (Phillips 1964). Daily temperatures in the area average around 30° F (-1° C) during winter and 61° F (16° C) during summer, based on records from Longmire, Washington at elevation 2,762 feet. Precipitation occurs in all months, but about two-thirds of the annual total falls between mid-October and late February when the heaviest rainstorms occur. Annual precipitation increases with elevation from approximately 60 inches in the lower elevations to 120 inches in the upper elevations (Cummans et al. 1975). Above 4,000 feet in elevation the winter precipitation falls mainly as snow, and persistent winter snowpacks are common. Between 1,200 feet and 3,000 feet in elevation winter temperatures fluctuate around 32° F (0° C), and precipitation can fall as rain or snow. Roughly one-third of the tree farm lies within this transient snow zone, where rain-on-snow events can result in major runoff events. Peak streamflows on the tree farm typically occur during these brief winter rain-on-snow events.

4.2 Geology and Soils

The HCP Amendment area falls within the Southwestern Washington physiographic province (Franklin and Dyrness 1984). The area is characterized by tall, steep ridges of volcanic origin, ranging in elevation from approximately 1,000 feet to 5,380 feet. A range of slope aspects are present on the tree farm, but southerly aspects predominate.

The HCP Amendment area can be divided into two geologic categories along a dominant north-south geological contact immediately east of State Route 7. To the east of the contact is a combination of andesitic and basaltic volcanic rock units originating from Mt. Rainier (Schasse 1987). To the west are continental marine sandstones and faulted and folded basalts. Glacial sediments and Holocene alluvium cover the valley floors.

Soils on the tree farm are typically composed of deep deposits of volcanic ash. Soil stability varies within the land holdings and is influenced by the composition and strength of the soil and fractured bedrock, hydrologic characteristics of soils, soil thickness, slope angle and local vegetation root strength. Mass wasting has occurred both naturally and in association with some past road construction and timber harvest on steep slopes. Mass wasting has taken the form of shallow landslides, deep-seated landslides, debris flows and dam-break floods (debris torrents), as identified from aerial photographs. The Washington State Department of Natural Resources (DNR) has classified the soils on the ownership according to surface erosion potential and estimates that there are equal proportions of areas with low, medium and high erosion potential. Soil fertility is generally moderate to low due to coarse textures and high slope angles in most areas.

4.3 Air Quality

The area in which the tree farm is located is subject to the highest primary and secondary air quality designations under the federal Clean Air Act. The area currently meets federal air quality standards for all pollutants. No air quality monitoring has taken place in the area for several years (Brown, pers. comm., 26 October 1994).

There are three potential sources of particulate air pollution associated with forest management activities; slash burning, wildfire and road use. The DNR regulates burning of forest slash and other wood debris, and helps to protect air quality through regional smoke management plans. A written permit is required for burning of slash piles greater than 10 feet in diameter in the winter (October through mid-March), and over 4 feet in diameter in other months. If burning of over 100 tons of material at one time is proposed, the applicant must work with the DNR to develop a smoke management plan for the burn site (Escober, pers. comm., 26 October 1994). Murray uses burning on a very limited basis to reduce slash accumulations on the tree farm, and then only where necessary and consistent with relevant environmental and management considerations.

4.4 Surface Water Resources

4.4.1 Stream Systems

The Mineral Tree Farm is drained by roughly 476 miles of streams and supports 317 acres of ponds and open-water wetlands (Figure 4-2). Major river systems draining the tree farm are the Tilton River, Cowlitz River and Nisqually River. Water draining the Mineral Tree Farm to the south (including the Tilton drainage) empties into the Cowlitz River, which flows into the Columbia River at River Mile (RM) 68 near Kelso, Washington. Streams draining to the north empty into the Nisqually River near RM 54.3, just upstream from Alder Lake. The Nisqually River flows to the northwest into Puget Sound near Olympia, Washington.

The DNR classifies surface waters according to size, flow, fish use and domestic use (Table 4-1). More than 88 percent of the total stream length on the tree farm is made up of un-named, intermittent streams (DNR Types 4 and 5) with individual stream lengths of 1 mile or less (Table 4-2). Most of these Type 4 and 5 streams are steep, confined channels in cascading, plunge pool configurations. The density of stream drainages on the tree farm averages 5.7 stream miles per square mile.

4.4.2 Surface Water Quality

Surface water quality on the Mineral Tree Farm is generally very good. Most streams are classified by the Washington Department of Ecology (Ecology) as Class AA (extraordinary) or Class A (excellent), which are the categories of highest water quality (WAC 173-201A-045). These stream classes are characterized by generally low temperatures, low turbidity, moderate pH (6.5 to 8.5), low fecal coliform counts and dissolved oxygen concentrations of greater than 8 mg/l. Seasonal variations in water quality result from fluctuations in streamflow and temperature. Locally, water quality may be slightly degraded due to natural erosion, slope failure or past removal of protective streamside cover due to windthrow, fire or logging.

Figure 4-2. Surface waters on the Mineral Tree Farm.

Table 4-1. Surface water typing system employed by the Washington DNR.

Type 1 Waters:	All waters, within their ordinary high water mark, inventoried as "Shorelines of the State," excluding wetlands.
Type 2 Waters:	Segments of natural waters, including wetlands, not classified as Type 1 waters that have a high fish, wildlife or human use. Includes waters diverted for domestic use by more than 100 residential, camping or accommodation units (for 1,500 feet upstream from diversion point), waters used by substantial numbers of anadromous or resident game fish for spawning, rearing or migration and waters used by salmonids for off-channel habitat.
Type 3 Waters:	Segments of natural waters including wetlands, not classified as Type 1 or 2 that have moderate to slight fish, wildlife and human use. Includes waters diverted for domestic use by more than 100 residential, camping or accommodation units (for 1,500 feet upstream of diversion point), waters used by significant numbers of fish for spawning, rearing or migration, waters used by significant numbers of resident game fish and waters highly significant for protecting downstream water quality.
Type 4 Waters:	Segments of natural perennial or intermittent waters not classified as Type 1, 2 or 3 waters, upstream until the channel width becomes less than 2 feet. These waters are generally considered non fish-bearing streams. The value of Type 4 waters lies in the influence they have on water quality downstream in Type 1, 2 and 3 waters.
	Differed
Type 5 Waters:	Segments of natural perennial or intermittent waters not classified as Type 1, 2, 3 or 4 waters, including streams with or without well-defined channels, areas of perennial or intermittent seepage, ponds, natural sinks and drainage ways with a short period of spring or storm runoff.

Source: WAC 222-16-030.

Table 4-2. Lengths and proportions of stream types within the Mineral Tree Farm.

DNR Stream Type	Length (miles)	Percent of Total
Type 1	11.4	2.4
Type 2	7.3	1.5
Type 3	34.1	7.2
Type 4	131.1	27.6
Type 5	291.9	61.3
Total	**475.8**	**100.0**

A search of the U.S. Environmental Protection Agency (EPA) STORET database was conducted during the spring of 1994 through the EPA Region 10 Office located in Seattle, Washington. Historic water quality data were found for the Tilton River, East Fork Tilton River and Peters Creek.

Water quality data of various parameters were collected over two sample periods in 1968 in the Tilton and East Fork Tilton Rivers. Peters Creek water quality samples were collected between 1983 and 1985 and included only turbidity and total suspended solids (residue). Based on STORET database information, Tilton and East Fork Tilton waters were soft, slightly basic in pH, with moderate conductivities and low nitrate-nitrogen concentrations in 1968. Peters Creek, located in the Kiona Creek Watershed, had low to moderate total suspended solids concentration and turbidity.

As part of the Watershed Analysis process, Murray initiated water quality sampling during the summer of 1992 in various creeks located within watersheds intersecting the tree farm. Sampling continued through the summer of 1993, and continues to date. Water quality samples were collected in the Connelly, East Fork Tilton (including the South Fork), Kiona (including Peters and Oliver) and Kosmos (including Rainey and Stiltner Creek) watersheds. *In-situ* water quality parameters collected at each station included pH, water temperature, conductivity (μmhos/cm), dissolved oxygen (mg/l) and percent saturation. Total suspended solids and turbidity were collected during the 1992 monitoring season. Sampling occurred during July and September. The results of water quality sampling are presented by WAU in a detailed report to Murray (Beak 1995c) and summarized in Table 4-3 and Figure 4-3.

During the summer of 1992, waters on the Mineral Tree Farm were well oxygenated, clear, low in total suspended solids and moderate in pH. One *in-situ* pH value was below the water quality standard of 6.5 during the July 1992 sampling. During the summer of 1993, creek waters were well oxygenated with low to moderate conductivities. The pH in the creeks ranged from slightly basic to slightly acidic. A few Class AA water quality violations were recorded for pH and dissolved oxygen.

Table 4-3. Summary of water quality data collected on the Mineral Tree Farm from 1992 through 1994.

		Dissolved Oxygen				pH				Stream Temperature					
WAU	Period of Record	Range (mg/l)	Obs. (N)	Criteria Excursions (<9.5 mg/l)		Range (pH units)	Obs. (N)	Criteria Excursions (<6.5 or >8.5)		Range (°C)	Obs. (N)	Criteria Excursions (>16.0 °C)		Criteria Excursions (>19.0 °C)	
Connelly	92-94	10.00-11.13	14	0	0%	6.5-7.3	15	0	0%	12.2-22.2	12	6	50%	2	17%
Kiona	92-94	7.29-14.24	36	7	19%	6.0-8.7	36	3	8%	14.3-22.4	21	13	62%	5	24%
Kosmos	91-94	8.40-11.00	22	7	32%	6.3-7.2	22	2	10%	10.8-19.4	16	6	38%	1	6%
E.F. Tilton	93-94	8.73-11.29	29	4	14%	5.9-7.2	29	5	17%	13.0-24.5	30	15	50%	3	10%
W.F. Tilton	94	8.30-10.85	18	5	28%	5.7-7.2	18	3	17%	16.0-21.1	9	8	89%	2	22%
Nineteen	94	9.00-11.20	9	2	22%	6.2-7.2	9	2	22%	14.8-22.0	7	4	57%	2	29%
Mineral	94	8.50-11.80	17	1	6%	6.5-7.2	17	0	0%	14.0-21.0	12	10	83%	3	25%
N.F. Mineral	94	8.57-10.91	9	2	20%	6.3-7.2	9	1	11%	15.5-19.8	6	4	66%	2	33%
Silver	94	8.12-11.60	24	9	38%	5.7-7.8	24	6	25%	9.0-25.0	15	7	47%	3	20%
TREE FARM		7.29-14.24	178	37	21%	5.7-8.7	179	22	12%	9.0-25.0	128	73	57%	23	18%

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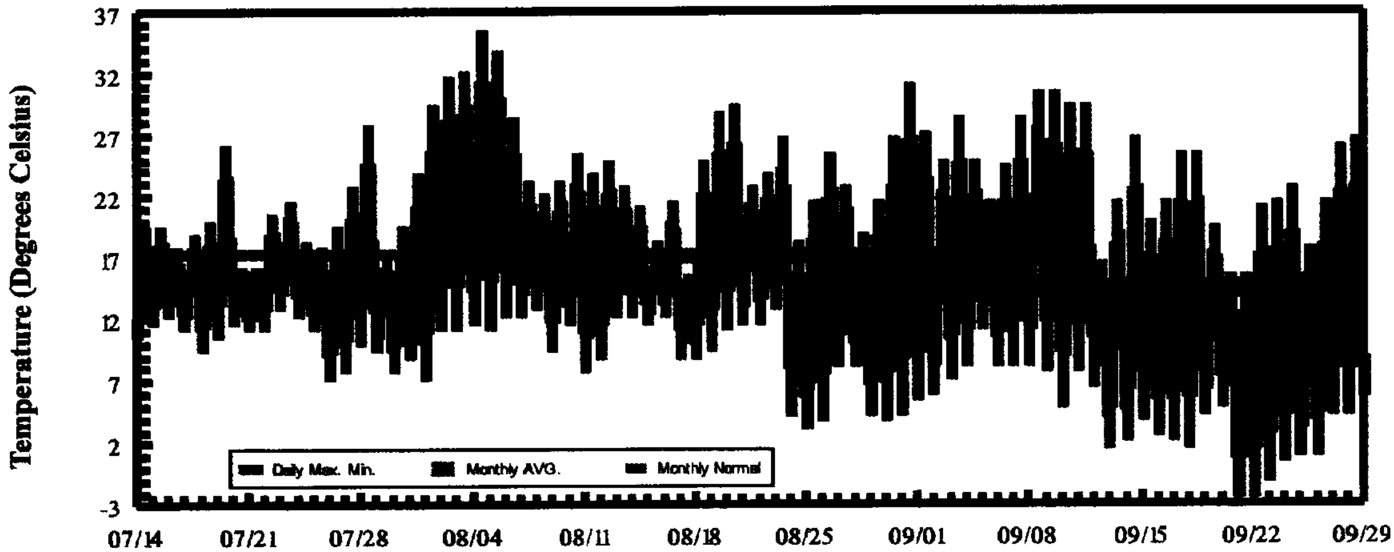
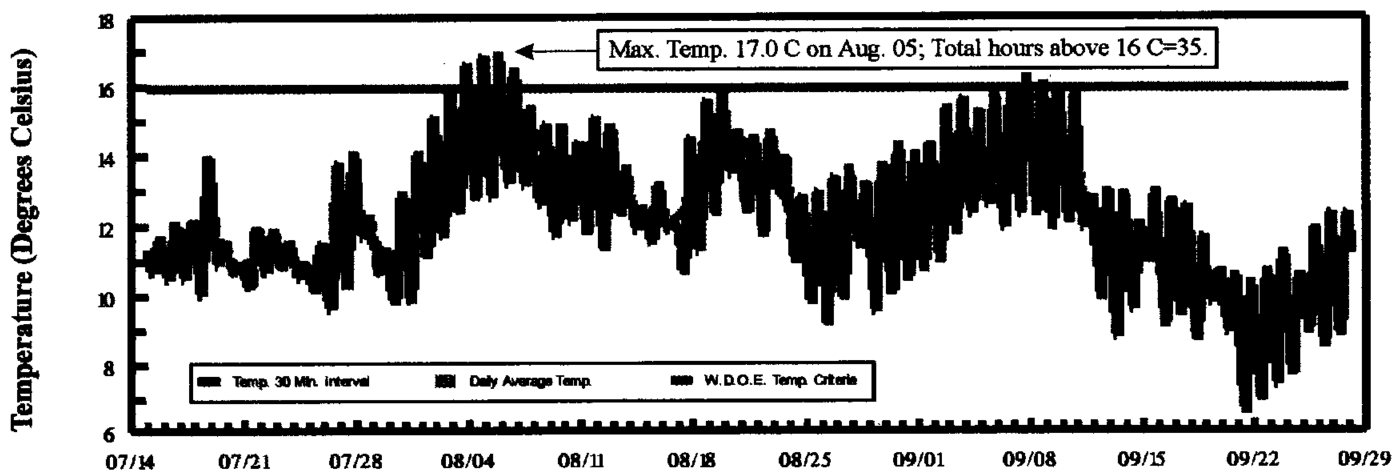


Glenoma Air Temperature (Elevation 289m [950 ft]) - 1993



East Fork Tilton WAU 337m [1105 ft]) - 1993

Figure 4-3. Instantaneous and daily average air temperatures at Glenoma, Washington and stream temperatures in the East Fork Tilton watershed in 1993.

Water temperature gauging was initiated in a number of creeks during the summer of 1992 as part of the riparian function module of Watershed Analysis. Continuous temperature recorders were installed in July and removed in September to record maximum summer water temperatures and to determine the hours water temperature exceeded the applicable temperature standards. Thermometers also were distributed throughout various stream networks to record annual maximum water temperatures. Placement of gauges and maximum thermometers was based on: a) riparian shade condition, b) creek flow, c) upstream shade condition, d) downstream shade condition, e) tributary flow, f) land use and g) other contributing human activities or natural processes. During the 1992 and 1993 period of record, various creeks exceeded the Class AA temperature standard of 61°F (16.0° C) for drinking water in the afternoon hours in August and September during periods of peak air temperatures. Maximum stream temperatures rarely exceeded 64°F (18.0°C) and then only for short periods of an hour or so. No mainstem temperatures have been recorded which exceed 75°F (24.0°C), the level at which salmonid mortalities may start to occur.

4.5 Vegetation

4.5.1 Plant Communities

The Mineral Tree Farm falls within both the *Tsuga heterophylla* and the *Abies amabilis* Forest Zones (Franklin and Dyrness 1984). The *Tsuga heterophylla* Zone lies between sea level and 3,000 feet in elevation and is dominated by western hemlock (*Tsuga heterophylla*), Douglas-fir (*Pseudotsuga menziesii*) and western redcedar (*Thuja plicata*). The *Abies amabilis* zone occurs above 3,000 feet in elevation, where growing conditions are cooler and a greater proportion of the annual precipitation occurs as snow. Dominant tree species include Pacific silver fir (*Abies amabilis*), noble fir (*Abies procera*), Douglas-fir, western hemlock, western redcedar and western white pine (*Pinus monticola*). Natural stands in these forest zones eventually develop what have been called "old-growth" characteristics. These include dominant trees in excess of 3 feet in diameter at breast height (dbh) and 200 feet in height, multiple ages and size classes of trees ranging from large dominants to seedlings, large standing dead trees (snags) and heavy accumulations of logs on the forest floor (Franklin et al. 1981). Such stands can reach several hundred years of age, subject only to infrequent but catastrophic disturbances such as fire or windthrow. Under commercial timber management, old-growth stands are harvested, typically by clearcutting, and converted to plantations of one or more early-successional species that are then cultivated and harvested at intervals of 40 to 60 years.

The Mineral Tree Farm is currently a mosaic of coniferous forest stands of varying ages (Figure 4-4). Approximately 1,144 acres are classified as old-growth (stand ages of 250+ years), but only 479 acres have never been entered for logging and retain all or most of the old-growth characteristics described by Franklin et al. (1981). The remaining 665 acres of old-growth were harvested up to 80 years ago, but only had up to 50 percent of the dominant overstory removed. Roughly 2,910 acres are natural stands that have never been harvested, but regenerated after natural disturbance (probably fire) between 80 and 120 years ago and have not yet developed the size and structure typically considered old-growth. An additional 44,936 acres (90 percent of the ownership) have been partially or completely harvested at least once in the past 80 years. The remaining 4,537 acres of the ownership are non-forested (e.g., road, rock, creek, wetland, etc.).

4.5.2 Sensitive, Threatened and Endangered Plant Species

No federally-listed threatened or endangered plant species are known to exist on the tree farm. Four of the 47 candidates for federal listing in Washington State occur in Lewis County (Table 4-4). Only one of these four candidate species, tall bugbane (*Cimicifuga elata*), could possibly occur on the Mineral Tree Farm. Tall bugbane, recently elevated to state status of threatened, favors moist, shady forests at lower elevations. It could be found on the tree farm in riparian forest with a well-developed overstory canopy. The remaining federal candidate species occur in habitat not supported on the tree farm and/or their known geographic ranges do not include the tree farm. Pale larkspur (*Delphinium leucophaeum*) is known to inhabit dry cliffs and ledges along the lower

Table 4-4. Plant species with special state or federal status that could occur on or near the Mineral Tree Farm.

Common Name	Scientific Name	Federal Candidate	State Status[1]	USFS Status[2]	Chance of Occurrence	Habitat
Pale larkspur	*Delphinium leucophaeum*	Yes	SE		Low	Dry cliffs and ledges along lower Columbia River; fencelines in open agricultural areas
Kincaid's sulfur lupine	*Lupinus sulphureus var. Kincaidii*	Yes	SE		Low	Low elevation meadows; disjunct from Willamette Valley population
Hairy-stemmed checker mallow	*Sidalcea hirtipes*	No	SE		Low	Coastal mountains and bluffs; fencelines in open areas in valley bottoms
Tall bugbane	*Cimicifuga elata*	Yes	ST	K Endemic	Moderate	Moist, shady forests at lower elevations
Thin-leaved peavine	*Lathyrus holochlorus*	No	ST		Low	Partially cleared land/fence rows, low elevation; disjunct from Willamette Valley population
White meconella	*Meconella oregana*	Yes	ST		Low (no recent verifiable sightings in Lewis County)	Open ground, grassy fields wet in spring
Great polemonium	*Polemonium careum*	No	ST		Low (no recent verifiable sightings in Lewis County)	Forest openings, woodlands, roadsides; lowlands west of Cascade

[1] State Status Codes:
SE = State Endangered
ST = State Threatened
SS = State Sensitive
SM = State Monitor

[2] USFS Status Codes:
K = Known to occur on the Randle Ranger District
S = Suspected to occur on the Randle Ranger District

Table 4-4. Continued.

Common Name	Scientific Name	Federal Candidate	State Status[1]	USFS Status[2]	Chance of Occurrence	Habitat
Tall agoseris	*Agoseris elata*	No	SS	S	Moderate, not listed in Lewis County, but known to occur in Pierce and Yakima Counties	Meadows, open woods up to mid-elevations
Lanced leaved grape-fern	*Botrychium lanceolatum*	No	SS	K	Moderate	Wet habitat, montane to high montane
Moonwort	*Botrychium lunaria*	No	SS	K	Moderate	Wet habitat, relatively open places at mid to high elevations
Victoria's grape fern	*Botrychium minganense*	No		S	Moderate	Shade form of *B. lunaria*
Mountain moonwort	*Botrychium montanum*	No	SS	S	Moderate	Not known, observed on wet bench with old-growth western redcedar and in rocky creek drainage with mixed forest
St. John's moonwort	*Botrychium pinnatum*	No	SS	K	Moderate	Moist or wet places, sometimes in open places, montane
Green-fruited sedge	*Carex interrupta*	No		S	Moderate	Sandy, gravelly riverbanks and other wet, low places
Saw-leaved sedge	*Carex scopulorum*	No		S	Moderate	Wet or moist meadows and shores of streams and lakes at mid-elevations

1 State Status Codes:
SE = State Endangered
ST = State Threatened
SS = State Sensitive
SM = State Monitor

2 USFS Status Codes:
K = Known to occur on the Randle Ranger District
S = Suspected to occur on the Randle Ranger District

Table 4-4. Continued.

Common Name	Scientific Name	Federal Candidate	State Status[1]	USFS Status[2]	Chance of Occurrence	Habitat
Giant helleborine	*Epipactis gigantea*	No	SS	S	Low	Stream banks, lake margins, springs and seeps, especially near thermal waters, often in desert regions
Common blue-cup	*Githopsis specularioides*	No	SS	K	Moderate	Dry, open places in valleys and foothills
Curved woodrush	*Luzula arcuata*	No	SS	S	Moderate	Rocky or gravelly soil, generally on moraines or above timberlines
Northern microseris	*Microseris borealis*	No	SS	K	Low (Skamania County, not documented in Lewis County)	Sphagnum bogs and wet meadows in the western Cascades
Branching montia	*Montia diffusa*	No	SS	S	Low (Known to occur in Skamania County but not recently documented in Lewis County)	Moist woods, primarily at low elevations
Pine broomrape	*Orobanche pinorum*	No	SS	K	Moderate	Coniferous forests, parasitic on various conifers
Mt. Rainier lousewort	*Pedicularis rainierensis*	No	SS	S	Moderate	Moist, alpine meadows and open coniferous forest from 4,000 to 7,000 feet; local endemic in the immediate vicinity of Mt. Rainier
Fringed pinesap	*Pleuricospora fimbriolata*	No	SS	K	Moderate	Deep coniferous forest, mostly just emerging from duff. Saprophytic. Often associated with Douglas-fir at low-mid elevations. Only species of the Pacific coast. Apparently does not tolerate disturbances in understory or opening of canopy resulting from logging.

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2 USFS Status Codes:
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Table 4-4. Continued.

Common Name	Scientific Name	Federal Candidate	State Status[1]	USFS Status[2]	Chance of Occurrence	Habitat
Wheeler's bluegrass	*Poa nervosa*	No	SS	S	Low	Basalt cliffs, often with Nuttall's larkspur; exposed ridges and talus slopes to open woods, montane to alpine
California sword-fern	*Polystichum californicum*	No	SS	S	Low (not known to occur in Lewis County)	Generally shady cliff crevices below 1,500 ft.; woods and open rocky places; or streambanks, mid-montane
Brewer's cinquefoil	*Potentilla diversifolia*	No	SS	S	Low (not known to occur in Lewis County)	Rocky alpine slopes in Washington; found at elevation 7,800 ft.. (montane to alpine)
Pygmy saxifrage	*Saxifraga debilis*	No	SS	S	Low (not known to occur in Lewis County)	Damp cliffs, rock crevices and talus near snowbanks; alpine, ephemeral streams
Small-flowered trillium	*Trillium parviflorum*	No	SS		Moderate	Moist woods and along streams at lower elevations, west Cascades
Puget balsamroot	*Balsamorhiza deltoidea*	No	SM		Moderate	Open places

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Columbia River and has been found along a fenceline at one location in Lewis County west of Chehalis. Kincaid's sulfur lupine (*Lupinus sulphureus var. Kincaidii*) is considered to be a disjunct species (widely separated from the main population known to occur in the Willamette Valley of Oregon) which inhabits low elevation meadows. The fourth federal candidate species, white meconella (*Meconella oregana*), is known to inhabit open grassy areas which are typically wet in the spring, but it is not likely to occur on Murray ownership since no recent verifiable sightings have been documented in Lewis County.

Lewis County supports several state-listed threatened or endangered species which have no federal status. The hairy-stemmed checker mallow (*Sidalcea hirtipes*) is a state endangered species which is found on coastal mountains and bluffs and in open valley bottomlands. This species has been observed in silty valley bottom soils in Lewis County. Although a sighting of the hairy-stemmed checker mallow was documented in 1970 in a field adjacent to the Mayfield Reservoir parking lot, it has not been observed during subsequent surveys at this site (Gamon,pers. comm., 3 November 1994). Suitable soil conditions for the hairy-stemmed checker mallow are not expected to occur in the Mineral Block, and this species is not expected to occur on the tree farm (Gamon, pers. comm., 3 November 1994). Thin-leaved peavine (*Lathyrus holochlorus*), a state threatened species, is found at low elevations on partially cleared land. This species is also disjunct from its main Willamette Valley population and is not expected to be found on the tree farm. Great polemonium (*Polemonium careum*), a west Cascade lowland plant known to occur in forest openings, woodlands and roadside ditches, also has been elevated from state sensitive to state threatened status. However, no recent verifiable sightings are reported in Lewis County, and as such, is not likely to be found on the Mineral Block.

Thirteen state sensitive species are listed for Lewis County. Of the 13 species, 10 have a moderate chance of occurring on the Mineral Tree Farm (Table 4-4). Three of these species, common blue-cup (*Githopsis specularioides*), fringed pinesap (*Pleuricospora fimbriolata*) and pine broomrape (*Orobanche pinorum*) have been documented on lands immediately adjacent to the tree farm (Norwood, pers. comm., 21 April 1994). Common blue-cup is known to inhabit dry, open places in valleys and on foothills. Surveys for common blue-cup were conducted in August 1992 along the southern boundary of the tree farm because of earlier sightings on adjacent non-Murray lands reported by the Washington Natural Heritage Program (WNHP). No evidence of common blue-cup was found in the area. However, the survey was performed after the peak flowering period. Extremely dry conditions and heavy livestock trampling within the suitable habitat (on the non-Murray lands) made positive identification of common blue-cup difficult. Fringed pinesap and pine broomrape are sensitive saprophytic species found in mature coniferous forests at low to mid-elevations. The fringed pinesap is reportedly sensitive to disturbance in the understory and large canopy openings. No surveys have been conducted for fringed pinesap or pine broomrape on the tree farm. These species could possibly occur in mature coniferous stands 60 years or older.

Five state sensitive species are listed as occurring in adjacent counties, and are suspected to occur on the Gifford Pinchot National Forest's Randle District in extreme eastern Lewis County. Only one of these species, tall agoseris (*Agoseris elata*), could possibly occur on the Mineral Tree Farm, in meadow or open forest habitat up to mid-elevations. The USFS also lists three additional species as sensitive which are suspected to occur on the Randle District but are not listed by the state. These are Victoria's grape-fern (*Botrychium minganense*), green-fruited sedge (*Carex interrupta)* and saw-leaved sedge (*Cares scopulorum*). These species are considered likely to occur on the tree farm, and would be associated primarily with wet habitat from low to mid-elevations. The WNHP lists the presence of a high quality, mid-elevation wetland on the tree farm. A survey of this wetland was conducted in August 1992; no sensitive species were observed during the survey. A total of 324 acres of wetland habitat exist on the tree farm, all of which could potentially support seven of the state-listed sensitive species (Table 4-4).

4.6 Fish

4.6.1 Fish Habitat

Approximately 53 miles of fish-bearing waters have been mapped on the Mineral Tree Farm. As part of the Watershed Analysis process, routine stream surveys are conducted to examine local fish populations and check water typing for accuracy. Representative stream reaches are walked to measure channel characteristics associated with fish habitat quality. Pools are examined for fish presence or absence and any fish present are identified to species, it possible. When discrepancies with the DNR water type reference maps are noted, it is Murray's policy to notify local resource agencies including the WDFW, Ecology and DNR, although Murray does not have legal power to affect water type changes. To date, three Watershed Analyses have been or are in the process of being conducted. Stream reaches have been identified in two watersheds for which water type changes have been recommended.

Channel conditions are typical of those found along steep western slopes of the Cascade Mountains in Washington State. Gradients of fish-bearing waters range from less than 1 percent on the floodplains and local pools and lakes to over 15 percent in the headwaters (Table 4-5). The majority of the stream gradients on the tree farm range between 2 and 15 percent.

Water quality in streams on the tree farm is generally very good (see subsection 4.4.2, Water Quality and Quantity). Fish habitat surveys conducted for Watershed Analyses have found relatively low pool percentages and infrequent large woody debris (LWD) (Beak 1993, Beak 1994). A representative sample of habitat measurements collected during Watershed Analysis is provided in Table 4-6. Mass-wasting events have significantly altered fish habitat in many of the basins by contributing large quantities of coarse and fine sediment. Vegetative bank cover is typically fair, with overhanging brush and rootwads predominating. Side channels are rare in the high-gradient reaches but become more frequent as the streams reach the floodplains of the Cowlitz, Tilton and Nisqually Rivers. Adequate spawning substrates are typically found in low-gradient reaches and

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Table 4-5. Channel characteristics and potential sensitive species use of fish-bearing waters occurring on the Mineral Tree Farm.

Channel Characteristic	**Species Use[1]**	**Length (miles)**	**Percent of Total**
0-2% gradient, unconfined channel	B,O,M,P,S	6.2	11.7
0-2% gradient, confined channel	B,O,M,P,S	2.9	5.5
2-8% gradient, unconfined channel	B,M,P	2.7	5.1
2-8% gradient, confined channel	B,M,P	30.4	57.6
8-15% gradient, unconfined channel	B,M,P	0	0
8-15% gradient, confined channel	B,M,P	8.1	15.4
>15% gradient	B,M,P	2.5	4.7
Total		**52.8**	**100**

[1] Sensitive species likely found in this channel type:
B = Bull trout
O = Olympic mudminnow
M = Mountain sucker
P = Pygmy whitefish
S = Sandroller

Table 4-6. Sample of field data results and default habitat diagnostic calls from Watershed Analysis on the Mineral Tree Farm.

WAU (Seg. #)	Percent Pool		Pool Frequency (CW/Pool)		LWD (Pieces/CW)		Pool Depth (m)			Dominant Substrate	Spawning Gravel Quality	
	Value	Rating	Value	Rating	Value	Rating	Average	Max.	%>1m	Type	%<0.85 mm	Rating
Kiona (1)	19	Poor	15	Poor	0.5	Poor	0.8	1.2	25	Sand	ND	ND
Kiona (2)	15	Poor	14	Poor	6.6	Good	0.4	0.6	0	Cobble	ND	ND
Kiona (3)	1	Poor	337	Poor	0.2	Poor	0.6	0.6	0	Cobble	14.4	Fair
Kiona (4)	14	Poor	13	Poor	6.2	Good	0.7	2.0	15	Cobble	5.4	Good
Kiona (5)	49	Good	4	Fair	1.2	Fair	0.6	2.0	11	Boulder	ND	ND
Kiona (6)	14	Poor	11	Poor	ND	ND	0.9	1.3	21	Bedrock	ND	ND
Kiona (7)	18	Poor	10	Poor	0.7	Poor	0.8	2.5	18	Boulder	ND	ND
Oliver (11)	8	Poor	29	Poor	0.4	Poor	0.6	0.9	0	Gravel	ND	ND
Oliver (12)	17	Poor	12	Poor	0.6	Poor	0.7	1.3	11	Cobble	6.0	Good
Peters (13)	100	Good	211	Poor	0.1	Poor	ND	ND	ND	Silt	ND	ND
Peters (14)	16	Poor	18	Poor	0.1	Poor	0.4	0.8	0	Cobble	7.3	Good
Peters (15)	7	Poor	31	Poor	1.7	Fair	0.5	0.7	0	Cobble	ND	ND
EF Tilton (1)	24	Poor	3	Fair	1.4	Fair	0.9	1.3	41	Boulder	3.1	Good
EF Tilton (2)	11	Poor	3	Fair	0.4	Poor	1.0	2.5	42	Boulder	4.3	Good
EF Tilton (3)	14	Poor	4	Fair	1.1	Fair	0.7	1.3	14	Cobble	2.1	Good
EF Tilton (4)	15	Poor	2	Fair	3.0	Good	0.6	1.7	8	Cobble	3.0	Good
SF Tilton (8)	18	Poor	9	Poor	0.5	Poor	0.6	1.1	1	Cobble	5.9	Good

CW=Channel width
ND=No data collected

where woody debris has slowed the stream's movement through steep areas. Sediment sampling results show low fine sediment proportions in spawning gravels (Table 4-6). Most fine sediments are transported downstream to the lower-gradient reaches of the floodplains. Fish habitat conditions are typical of basins in western Washington where logging has occurred over approximately the last 100 years.

Streams on the Mineral Tree Farm currently do not support naturally reproducing runs of anadromous fish. Three hydroelectric projects and a barrier dam impact fish migration along the Cowlitz River downstream from the tree farm. Mayfield Dam completed in 1962 at RM 52 and Mossyrock Dam completed in 1968 near RM 65.5, are currently impassable to fish. Although Mayfield Dam was built with fish passage facilities for upstream and downstream migration, the upstream passage system is no longer operable. Attempts to maintain self-sustaining runs of anadromous fish were abandoned in the 1980s. High predation on juveniles in the Mayfield Reservoir, juvenile passage mortality at dams and concerns over the introduction of fish diseases into the hatcheries through the water supply led to this decision.

The Cowlitz Salmon Hatchery Barrier Dam was built near RM 50.5 in 1968 as partial mitigation for the dams. All natural upstream migration is blocked at this point to facilitate capture of fish for the hatchery, and to reduce the risk of Infectious Hematopoietic Necrosis virus contamination of the hatchery water supply. In the past, excess broodstock have been periodically transported (via truck) from the hatchery to locations above the dams. These fish were mainly intended to provide sport fishing opportunities. With completion of the Cowlitz Falls Dam located near RM 89 in 1994, a mitigation program was introduced which will attempt to reintroduce runs of spring chinook, coho and winter steelhead to the upper basin. Downstream migrants would be collected at the Cowlitz Falls Dam and transported downstream past all four dams. Restoration of anadromous fish to the Tilton River system remains a long-term goal of WDFW and local interest groups such as the Friends of the Cowlitz (Hunter, pers. comm., 14 September 1994). A more complete description of the dams and their respective histories was prepared by the Bonneville Power Administration (BPA) with assistance from the Cowlitz Technical Advisory Committee (Bonneville Power Administration 1993).

Anadromous fish migration in the Nisqually River also is blocked downstream from the Mineral Tree Farm by two dams operated by the City of Tacoma. Neither of the dams (LaGrande, finished in 1912 at RM 42.7; or Alder, built in 1945 at RM 44.2) are passable by migrating fish. The presence of a natural fish barrier near RM 43 has been conjectured, but no practical method exists to make an absolute determination. The barrier would be located at the bottom of LaGrande Reservoir and is likely buried in silt. Although various fish passage options have been studied for these dams (Stober and Bell 1986), no agreement among the various participants has been reached. Fish enhancement efforts to date have concentrated on hatchery production for release below the dams.

4.6.2 Status of Anadromous Fish

This HCP Amendment covers all species and runs of anadromous fish which potentially could occupy the Mineral Tree Farm. Although three hydropower dams currently block anadromous fish passage downstream of the tree farm, this situation could change during the 100-year term of the HCP Amendment and anadromous fish could again be present on the tree farm.

Cowlitz River Basin

The Cowlitz River Basin at one time supported large salmon and steelhead runs. Over-fishing, hydropower development and habitat degradation have been identified as the three major causes of a severe decline in the overall fish population since the turn of the century (Bonneville Power Administration 1993). Commercial fishing pressure in the Columbia River and Pacific Ocean has drastically reduced escapement to the area. Installation of three hydroelectric dams and the fish barrier dam have significantly contributed to the decline. Although mitigation in the form of the Cowlitz salmon and trout hatcheries and various upstream and downstream fish transportation projects have been initiated, a completely satisfactory and permanent solution has not been achieved to date. Increased urbanization and other land use changes downstream of the tree farm have altered natural runoff characteristics of the rivers and degraded water quality. Habitat attributes important to salmonids, including LWD and streambank shading, have been reduced by past logging practices and the proliferation of agriculture along the rivers.

With construction of the Cowlitz Falls Dam and Skineeva Reservoir upstream of Riffe Lake, the issue of re-establishing anadromous fish runs in the upper basin was reviewed. Thirty-one reintroduction alternatives for seeding the upper basin were examined. Five options were eventually selected for implementation. Four of the options require spawning anadromous fish at the hatcheries and introducing the progeny (eggs through smolts) into the upper river. The fifth option includes releasing adult salmon and sea-run trout into the Cowlitz Falls reservoir for natural reproduction in the upper Cowlitz and Cispus Rivers. All five options would require smolts to be trapped at the Cowlitz Falls Dam and trucked downstream to below the barrier dam. Species/runs to be introduced initially include all runs of coho, spring chinook and late winter run steelhead. Fish stocking began in fall 1994 with introductions of coho salmon. The project will be funded by the BPA until 2032 and managed by a full-time project biologist. Reintroduction of anadromous species into the upper Cowlitz River basin could affect three drainages in which Murray has landholdings. Kiona Creek, Silver Creek and Oliver Creek flow into the Cowlitz River upstream of the Cowlitz Falls Reservoir.

Coho (*Oncorhynchus kisutch*), spring and fall chinook (*Oncorhynchus tshawystcha*), winter and summer steelhead (*Oncorhynchus mykiss*) and sea-run cutthroat (*Oncorhynchus clarki*) are all known historically to have spawned in the upper Cowlitz River basin. Surveys of the Cowlitz River basin by the U.S. Department of the Interior in 1936 to 1937 noted one or more of these species in many of the rivers surveyed (U.S. Department of the Interior 1949). Prior to 1981, and again in 1993, a number of surplus hatchery steelhead trout were released into the Tilton River by the Washington Department of Wildlife (WDW; now part of the Washington Department of Fish and Wildlife) for the sport fishery (Bruce, pers. comm., 2 November 1993). The state of Washington also transports surplus adult coho and chinook from the salmon hatchery to streams above Mayfield Dam for recreational harvest purposes (Lucas, pers. comm., 15 January 1993; Peterson, pers. comm., 17 June 1993). Since 1979, chinook salmon have only been released above

Mossyrock Dam and not into the Tilton River basin. Anadromous fish have been denied access to the upper basin in the past due to hatchery-related disease concerns.

Anadromous fish populations currently found downstream of the Mineral Tree Farm in the Cowlitz River system come from two sources; hatchery plants and residualized wild stock. The first are excess broodstock planted to supply the sport fishery. Fish not caught by anglers may spawn, and their resultant progeny residualize in the upper basin or reservoirs. Fish trapped upstream by the construction of Mossyrock Dam have probably also residualized and developed a landlocked life history (Bonneville Power Administration 1993).

Current salmonid management practices for the area focus on supplying hatchery adults for sport harvest (Bruce, pers. comm., 2 November 1993). Planting of surplus adults into the Tilton and Cowlitz Rivers provides fish access to the tree farm. Restoration of anadromous runs in the upper Cowlitz River basin has begun with development of the Cowlitz Falls Hydroelectric Project. The Cowlitz Falls Technical Advisory Committee has also been working to develop a master plan for fish resources in the region (Bonneville Power Administration 1993). Recommendations include continuing the trap and haul program at the barrier dam, initiating various habitat restoration programs and introducing a first generation of spawning adult salmon and steelhead to the upper basin, upstream of Cowlitz Falls.

Nisqually River Basin

The Nisqually River basin below the Nisqually Hydroelectric Project supports runs of chum, coho, fall chinook, pink and sockeye salmon, steelhead and sea-run cutthroat trout. The Nisqually River supported a run of spring chinook until about 1950. This run is currently believed to be nonexistent. None of these species are able to proceed above the hydroelectric project at RM 42.7. Fish surveys in Alder Lake and its tributaries reported relatively good sized populations of landlocked sockeye salmon, also known as kokanee (*Oncorhynchus nerka*). Fish planting above the hydroelectric projects has been conducted by the WDW (and WDFW) for a number of years.

Records dating back to 1945 show plants of rainbow trout, cutthroat trout, kokanee, winter and summer steelhead and black crappie (Harza Northwest Incorporated 1991). Kokanee are currently being considered for enhancing the fishery in Alder Lake (Harza Northwest Incorporated 1991). Annual stocking of kokanee fry from the Lake Cushman hatchery facility is proposed as further mitigation for the hydroelectric project.

Fish habitat surveys of Mineral Creek upstream to the anadromous fish barrier at RM 7.3 found good to excellent habitat and moderate numbers of rainbow and cutthroat trout (Stober and Bell 1986). Murray property in this basin begins at RM 9.4 and continues upstream to the headwaters. Although kokanee reportedly spawn in Mineral Creek (Harza Northwest Incorporated 1991), spawning surveys in 1989 failed to locate any dead or live fish or redds (Harza Northwest Incorporated 1991). No anadromous species occur on or have access to the Mineral Tree Farm from the Nisqually River.

4.6.3 Genetic Integrity of Anadromous Fish

The Washington State Salmon and Steelhead Stock Inventory (SASSI) is part of a statewide effort to identify distinct salmon and steelhead stocks and determine their relative status (Washington Department of Fisheries et al. 1992). Stocks identified as depressed or critical are close to or below the population size where there is a risk of permanent loss of distinct genetic material. The SASSI report defines a stock by: a) distinct spawning distribution, b) distinct spawning and/or run-timing distribution and c) distinct biological characteristics (e.g. genetics, size, age structure, etc.). A review of the SASSI report was made to determine whether or not genetically distinct stocks were present on or immediately downstream of watersheds being managed by Murray. The species listed in the SASSI report for the Cowlitz and Nisqually River Basins are described below. Included is an assessment of each stocks' behavioral and genetic isolation as well as their population status.

Activities on the Mineral Tree Farm are unlikely to have any effect on distinct salmon and steelhead stocks described as depressed or critical. Of the four stocks identified on the Cowlitz River side, all are considered of mixed origin, and all except winter steelhead are of composite production. Salmon and steelhead stocks on the Nisqually River side are currently limited to the river below LaGrande Dam, while the Mineral Tree Farm begins 20 river miles upstream of the upper reservoir.

Spring Chinook Salmon

Spring chinook are historically native to the entire Cowlitz River, but are now limited mainly to below the Cowlitz salmon hatchery barrier dam. The current population is primarily of hatchery origin. The stock is considered healthy based on the escapement trend.

The Nisqually River supported a run of spring chinook until about 1950. It is currently believed to be extinct.

Fall Chinook Salmon

The Cowlitz River fall chinook was designated as a distinct stock on the basis of spawning time and geographic distribution (Washington Department of Fisheries et al. 1992). No unique biological characteristics were found to separate the stock from other lower Columbia River stocks. Cowlitz River fall chinook were historically native to the Cowlitz River sub-basin. Genetic characteristics indicated the fall stock was different from all other chinook stocks examined. The stock is considered healthy based on natural spawning escapements from 1967 through 1991.

The Nisqually River summer/fall chinook stock is mixed with composite production. Hatchery influence from Green River stock has occurred. Escapement from 1977 through 1991 averaged about 1,000 fish. The stock status is healthy.

Coho Salmon

Although coho were historically abundant in the Cowlitz River basin and may have been unique, hatchery coho plants starting in 1915 near Morton have produced a stock currently considered mixed and of composite production. In 1985, an estimated 100 percent of naturally spawning fish in the lower Cowlitz River basin were believed to be from hatchery releases. Excess hatchery broodstock are also released into the upper Cowlitz River basin on a periodic basis.

The Nisqually River coho stock is mixed with composite production. Hatchery influence on the stock is undetermined. Escapement from 1967 through 1991 ranged from 600 to 13,000 fish. The stock status is healthy.

Steelhead

Cowlitz River winter steelhead were designated a separate stock on the basis of the geographical isolation of the spawning population. With the introduction of hatchery fish starting in 1957, the stock has been considered mixed. Current biological characteristics are unknown, but not considered distinct. Because of their propensity for spawning in steep headwater streams, the steelhead population was impacted more than most salmon stocks by construction of the hydroelectric projects. An estimated 80 percent of the historic spawning and rearing area is no longer available (Washington Department of Fisheries et al. 1992). The stock status is currently considered depressed. Restoration of adult spawners above Cowlitz Falls Dam is expected to improve the run size. The Nisqually River winter steelhead stock was designated on the basis of geographical isolation of the spawning population. The stock is thought to be native and wild. The current stock status is healthy.

Chum Salmon

The Nisqually River chum stock is native with wild production. Escapement from 1968 through 1991 ranged from 10,000 to 70,000 fish. The stock status is healthy.

Pink Salmon

The Nisqually River pink stock is native with wild production. Escapement from 1959 through 1967 ranged from 500 to 12,300 fish. The stock status is healthy.

4.6.4 Status of Resident Fish

Resident fish species potentially inhabit all perennial streams on the Mineral Tree Farm. Little is known regarding site-specific species abundance and distribution. Resident rainbow and cutthroat trout are abundant throughout the upper Cowlitz and Nisqually River basins. Naturally spawning populations are reinforced with WDFW outplanting to help mitigate for migratory and habitat losses as a result of the dams. Other non-anadromous species inhabiting the area include eastern brook trout (*Salvelinus fontinalis*), mountain whitefish (*Prosopium williamsoni*), largescale, bridgelip and mountain suckers (*Catostomus sp.*), sculpin (*Cottus sp.*), longnose and speckled dace (*Rhinichthys sp.*), western brook lamprey (*Lampetera richardsoni*), northern squawfish (*Ptychocheilus orgonensis*), largemouth bass (*Micropterus salmoides*), black crappie (*Pomoxis nigromaculatus*), brown bullhead (*Ictalurus nebulosus*) and pumpkinseed (*Lepomis gibbosus*).

4.6.5 Fish Species With Special Status

Among the species potentially occurring on the Mineral Tree Farm, two are considered candidates for listing as threatened or endangered by the USFWS, and four are considered candidates for listing or are monitored by the state of Washington (Table 4-7).

Bull trout (*Salvelinus confluentus*)
The taxonomic status of the bull trout is connected with that of Dolly Varden (*Salvelinus malma*), and the two are often confused (Cavender 1978). The bull trout is considered to be primarily an inland, non-anadromous species, while Dolly Varden is mainly a coastal and anadromous species (Cavender 1978). Bull trout are opportunistic feeders on aquatic insects, snails, amphibians, leeches, salmon eggs and fish (Wydoski and Whitney 1979). Spawning occurs in the upper reaches of mountain streams, with juvenile and adult rearing typically downstream in third- and fourth-order creeks. Although suitable bull trout habitat exists on and near the Mineral Tree Farm, no reports were found of bull trout ever being observed in the Cowlitz River basin (Washington Department of Wildlife 1992). Although bull trout may occur in larger streams and rivers on the tree farm, the chance of occurrence on or near the tree farm is considered low.

Table 4-7. Fish species with special state or federal status that may currently be present on or near the Mineral Tree Farm.

Common Name	**Scientific Name**	**Federal Status**[1]	**State Status**[1]	**Chance of Occurrence**	**Habitat**
Bull trout	*Salvelinus confluentus*	C1	G	Low	streams
Olympic mudminnow	*Novumbra hubbsi*	C2	SC	Low	streams
Mountain sucker	*Catostomus platyrhynchus*	none	SM	Low	streams
Pygmy whitefish	*Prosopium coulteri*	none	SM	Low	streams
Sandroller	*Percopsis transmontana*	none	SM	Moderate	streams

[1]Status Codes:

- SC = State Candidate (for Endangered, Threatened, or Sensitive)
- G = State Game Species
- C1 = Federal Candidate for Listing, Category 1
- C2 = Federal Candidate for Listing, Category 2
- SM = State Monitor

Olympic mudminnow (*Novumbra hubbsi*)

The Olympic mudminnow is on both the state and federal special status lists. This relatively small fish is found only within portions of the Olympic Peninsula and central western Washington, including Lewis County. Recent surveys in the upper Chehalis River basin discovered the presence of Olympic mudminnow. Although the Cowlitz River also flows through Lewis County, the fish would have been required to migrate a considerable distance. No mudminnow has ever been reported in the Cowlitz River basin, and the likelihood of occurrence is low. Olympic mudminnows inhabit slow moving waters, ponds and wetlands with silty substrates high in organic material. Areas with dense aquatic vegetation are preferred.

Mountain sucker (*Catostomus platyrhynchus*)

The mountain sucker is found in the Great Basin and in the upper Missouri, upper Colorado, Fraser and Columbia River systems (Wydoski and Whitney 1979). In Washington, it is found only in the upper Columbia River and its tributaries east of the Cascade Range (Rodrick and Milner 1991). It is less abundant in Washington than in other portions of its range.

Wydoski and Whitney (1979) state that it prefers the clear, cold water of mountain streams with bottoms of sand, gravel or boulders. Abundant overhanging vegetation and gravel or cobbled substrate are also preferred. The food of the mountain sucker, which has a specialized lower jaw, consists of algae scraped off of rocks. The mountain sucker is listed as a state monitor species. Four specimens of the mountain sucker were collected in 1980 in the Cowlitz River near the Mineral Tree Farm. It is possible the mountain sucker could occur in the rivers and streams on the tree farm.

Pygmy whitefish (*Prosopium coulteri*)

The pygmy whitefish is found in the Columbia River system in Washington, Montana and British Columbia (Scott and Crossman 1973). Rodrick and Milner (1991) state that in Washington, persistent populations are found in lakes and cold streams associated with the Columbia River system and have been reported in Diamond Lake near Spokane, Crescent Lake on the Olympic

Peninsula and Lake Chester Morse near Seattle. Pygmy whitefish inhabit lakes deeper than 20 feet and swift-moving, cold mountain stream reaches. They spawn in stream riffles or along lake shores in the fall and winter months and feed on bottom organisms including aquatic insects, crustaceans and small molluscs (Wydoski and Whitney 1979). The pygmy whitefish is found in various scattered locations throughout Washington, but no observations have been reported on or near the Mineral Tree Farm. Their presence on the tree farm is unlikely. Pygmy whitefish are listed as a state monitored species.

Sandroller (*Percopsis transmontana*)

The sandroller is a small resident fish (usually less than 5 inches) found primarily in the Columbia River and its tributaries. Individuals have been reported in southwestern Washington. The fish inhabit low-gradient backwater areas of streams among roots and near undercut banks. At night sandrollers move out from cover into sandy areas along stream bottoms. Spawning occurs during late spring and early summer. The fish is listed as a state monitor species. Although not reported in the upper Cowlitz River basin, the sandroller is thought to occur in the lower Cowlitz River reaches and may have spread throughout the basin. The likelihood of occurrence on or near the tree farm is moderate.

4.7 Wildlife

An estimated 638 species of vertebrates inhabit western Washington (Brown 1985). Of these, 241 species are associated with coniferous forest ecosystems on the west slope of the Cascade Range and could potentially occur on the Mineral Tree Farm for all or part of the year. The USFWS, under authority of the ESA, has identified species considered threatened or endangered due to low population numbers or other significant threats to their survival (U.S. Fish and Wildlife Service 1990), as well as candidate species under consideration for formal listing proposals (U.S. Fish and Wildlife Service 1991). Among the list of species native to the western Cascade Range and potentially present on the tree farm, 23 species of vertebrate and invertebrate wildlife (excluding fish) are currently listed as threatened or endangered, or are candidates for listing (Table 4-8) (U.S. Fish and Wildlife Service 1994a). In addition to species with federal status under the ESA, a number of species have been identified by the WDFW as having special status within the State of Washington because they are locally rare or threatened with extinction within the state (Washington Department of Wildlife 1991b). Seven such species could occur on the tree farm, bringing the total number of non-fish species of special interest potentially on the tree farm to 30 (Table 4-8). This list includes the northern spotted owl, which was the focus of Murray's original spotted owl HCP.

A detailed discussion of the spotted owl and its status is contained in the original spotted owl HCP (Murray Pacific Corporation 1993). The remaining 29 species are the primary focus of this HCP Amendment. A discussion of each species is provided below. The benefits of the HCP Amendment, however, extend to all species potentially present on the tree farm.

Columbia pebblesnail *(Fluminicola columbianus)*

The Columbia pebblesnail (or giant Columbia River spire snail) is a fresh water snail of the family *Hydrobiidae* found in Idaho, Oregon and Washington (U.S. Fish and Wildlife Service 1991). Habitat requirements of this species are not well known, but it is believed they require cold, well-oxygenated, permanently-flowing streams with cobble and boulder substrate. While earlier researchers associated them primarily with major rivers such as the Columbia, they have been found in streams as narrow as 100 feet (Taylor 1982). Burch (1989) listed the Columbia pebblesnail as occurring in the middle portions of the Columbia River in Washington and the lower Snake River in Washington and Idaho. Prior to the preliminary phase of a survey for *F. columbianus* by Neitzel and Frest (1989), the mollusc had been collected only in the Columbia River (between Portland and the Wenatchee River) and the Black Canyon of the Payette River in Idaho. Neitzel and Frest (1989) found these molluscs at 15 sites in six different streams (the Columbia, Okanogan, Wenatchee and Methow Rivers in Washington; the Deschutes River in Oregon; and the Snake River in Idaho). Additional sites were targeted for continuing surveys based on habitat considerations found in the surveys, including the Cowlitz River below Mayfield Lake. The Columbia pebblesnail has not been reported in streams on the Murray ownership, but there is the potential for its occurrence in the larger tributaries to the Cowlitz River that drain the tree farm.

Table 4-8. Wildlife species with special state or federal status that may be present on or near the Mineral Tree Farm.

Common Name	Scientific Name	Federal Status[1]	State Status[1]	Chance of Occurrence	Habitat
INVERTEBRATES					
Columbia pebblesnail	*Fluminicola columbianus*	C2	SC	Moderate	streams
Fender's soliperlan stonefly	*Soliperla fenderi*	C2	—	Moderate	streams
AMPHIBIANS					
Van Dyke's salamander	*Plethodon vandykei*	—	SC	Present	riparian, seeps, closed-canopy forest
Larch Mountain salamander	*Plethodon larselli*	C2	SS	Moderate	steep, semi-wet talus, closed-canopy coniferous forest
Tailed frog	*Ascaphus truei*	C2	SM	Present	streams, mature mixed forest
Northern red-legged frog	*Rana aurora aurora*	C2	—	Present	ponds, wetlands, closed-canopy forest
Cascades frog	*Rana cascadae*	C2	—	Present	riparian-wetland, closed-canopy forest

[1] Status Codes:

SE-State Endangered
ST-State Threatened
SS-State Sensitive
FT-Federal Threatened
FE-Federal Endangered

SC-State Candidate (for Endangered, Threatened or Sensitive)
SM-State Monitor
G-State game species
C2-Federal Candidate for listing, Category 2
C1-Federal Candidate for listing, Category 1

Table 4-8. Continued.

Common Name	Scientific Name	Federal Status[1]	State Status[1]	Chance of Occurrence	Habitat
AMPHIBIANS Continued					
Spotted frog	*Rana pretiosa*	C1	SC	Low	riparian-wetland, closed-canopy forest
REPTILES					
Northwestern pond turtle	*Clemmys marmorata marmorata*	C2	SE	Low	ponds, lakes, wetlands
BIRDS					
Great blue heron	*Ardea herodias*	---	P	Moderate	riparian-wetland, mature-forest edge
Harlequin duck	*Histrionicus histrionicus*	C2	G	Moderate	rivers, closed-canopy forest
Marbled murrelet	*Brachyramphus marmoratus*	FT	ST	Present[2]	old-growth forest, riparian and upland
Golden eagle	*Aquila chrysaetos*	---	SC	Present	cliff-talus, tundra, open forest, grass
Bald eagle	*Haliaeetus leucocephalus*	FT	ST	Moderate	riparian mature forest
Northern goshawk	*Accipiter gentilis*	C2	SC	Present	mature and old-growth forest
Osprey	*Pandion haliaetus*	---	P	Moderate	riparian-wetland and mature forest

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G-State game species
C2-Federal Candidate for listing, Category 2
C1-Federal Candidate for listing, Category 1
P-Species not listed, but breeding areas are protected under state regulation

2 According to PSG Survey Protocol, presence but not occupancy has been determined for the marbled murrelet.

Table 4-8. Continued.

Common Name	Scientific Name	Federal Status[1]	State Status[1]	Chance of Occurrence	Habitat
BIRDS Continued					
Northern spotted owl	*Strix occidentalis*	FT	SE	Present	mature and old-growth forest
Vaux's swift	*Chaetura vauxi*	—	SC	Present	riparian, young and old-growth forest
Pileated woodpecker	*Dryocopus pileatus*	—	SC	Present	mature and old-growth forest
Western bluebird	*Sialia mexicana*	—	SC	Moderate	large forest openings
Olive-sided flycatcher	Contopus borealis	C2	—	Moderate	old-growth forest
Little willow flycatcher	Empidonax trailli brewsteri	C2	—	Low	willow and alder thickets in riparian areas
MAMMALS					
Gray wolf	*Canis lupus*	FE	SE	Low	wilderness areas, open tundra and forest
Grizzly bear	*Ursus arctos*	FT	SE	Low	wilderness areas, alpine meadows and subalpine forest
California wolverine	*Gulo gulo luteus*	C2	SM	Low	wilderness areas, coniferous forest
Pacific fisher	*Martes pennanti*	C2	SC	Moderate	mature and old-growth coniferous forest
Townsend's big-eared bat	*Plecotus townsendii*	C2	SC	Moderate	caves, open young forest
Fringed myotis	*Myotis thysanodes*	C2	—	Low	caves/cliffs in riparian, grass-shrubland
Long-eared myotis	*Myotis evotis*	C2	—	Moderate	snags, caves and cliffs in riparian old-growth forest
Long-legged myotis	*Myotis volans*	C2	—	Moderate	snags, caves and cliffs in mature and old-growth riparian forest

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Fender's soliperlan stonefly (*Soliperla fenderi*)

Fender's soliperlan stonefly is found only in Washington State. Stoneflies have aquatic larvae and are mostly found associated with streams (Thorp and Covich 1991). The greatest number of species are found associated with fast, cold mountain streams. Jewett (1955) describes *S. fenderi* as a new species, with the holotype from St. Andrew's Creek in Mount Rainier National Park. Stark (1983) describes specimens of this species from seeps along St. Andrew's Creek, a small unnamed stream near the Reflection Lakes and from seeps along the Puyallup River and Christina Falls, all in Mount Rainier National Park. He states that a specimen from near Snoqualmie Pass may be this species as well. St. Andrew's Creek in Mount Rainier National Park is at elevations ranging from 2,750 feet (park boundary) to 5,886 feet (St. Andrew's Lake), and flows into the South Fork of the Puyallup River outside the Park. Reflection Lakes are at an elevation of 4,854 feet, and the two forks of the Puyallup River range from approximately 2,600 feet (boundary) to as high as 7,200 feet (glaciers). Christine Falls is at an elevation of 3,680 feet. Snoqualmie Pass is at an elevation of 3,022 feet. The Fender's soliperlan stonefly may be associated with the larger permanent streams and rivers on the Mineral Tree Farm.

Van Dyke's salamander (*Plethodon vandykei*)

The Van Dyke's salamander is found only in western Washington (Leonard et al. 1993). It has been collected in Thurston, Clallam, Jefferson, Mason, Grays Harbor, Pierce, Lewis, Skamania, Pacific and Wahkiakum Counties. The Van Dyke's salamander has no federal status at this time, but is a candidate for listing by the WDFW.

The Van Dyke's salamander is usually associated with seepages or streams, but may also be found away from water on north-facing slopes with thick moss cover (Leonard et al. 1993). Typically it can be found in the splash zone of creeks and waterfalls under rocks, woody debris and bark on logs near water from sea level to 5,000 feet. Little is known about the breeding habits of this species. Of the two nests that have been found, one was under a moss-covered stone and the other inside a large Douglas-fir log near a creek (Leonard et al. 1993).

In August 1994, a one-week amphibian survey was conducted on the Mineral Tree Farm (Beak Consultants Incorporated 1995a). The survey included 1 hour, time-constrained searches (Corn and Bury 1991) on 19 streams distributed throughout the ownership. Survey efforts involved searching stream reaches and their adjacent banks, and a combination of aquatic and terrestrial survey techniques were used (Corn and Bury 1990, 1991). A survey crew of three biologists worked upstream searching shallow water, splash zones, streamside rubble and adjacent stream banks (up to 25 feet from the stream), as well as recording data and taking photographs. During surveys, biologists overturned large (> 4 inches) rocks, logs and bark piles with potato rakes (Corn and Bury 1990), particularly if the site was moist. Amphibians were observed or captured by hand, and some were photographed for positive identification.

The 1994 amphibian survey revealed the presence of Van Dyke's salamander in four streams; two tributaries in the Connelly Creek drainage and two in the West Fork Tilton River drainage (Table 4-9). While a range of sites were sampled, the species was found to only inhabit lower elevation streams (DNR Type 3 and 4 waters) that were in drainages containing mature and old-growth forest cover.

Larch Mountain salamander (*Plethodon larselli*)

The Larch Mountain salamander is one of the rarest amphibians in the Pacific Northwest (Leonard et al. 1993). It was formerly believed to be limited to the Columbia River gorge until specimens were found near Mt. St. Helens and Mt. Rainier. A new record has been obtained for just east of Snoqualmie Pass (Washington Department of Fish and Wildlife 1994a). The range of this species, as delineated by Leonard et al. (1993), shows that it occurs relatively close to the eastern border of the Mineral Tree farm, therefore, it is possible that it may be present on the tree farm.

This species is truly terrestrial and is rarely associated with streams or open water habitats (Nussbaum et al. 1983). Most populations of this salamander are located on steep talus kept moist by a covering of mosses and a dense overstory of coniferous trees at elevations up to 3,400 feet, although it also may occur in lava tubes and caves (Leonard et al. 1993). It appears to be more

Table 4-9. Summary of the 1994 amphibian surveys on the Mineral Tree Farm.

DRAINAGE SYSTEM	**CC**	**WT**	**ET**	**MC**	**GC**	**KC**	**RC**	**TOTALS**
NUMBER OF STREAMS	**5**	**5**	**4**	**1**	**1**	**2**	**1**	**19**
Van Dyke's salamander	5(2)	3(2)	0	0	0	0	0	8(4)
Tailed frog	2(1)	1(1)	8(3)	0	2(1)	1(1)	9(1)	23(8)
Red-legged frog	1*(1)	0	2*(1)	0	0	0	0	3(2)
Cascades frog	0	0	2(2)	0	0	5(1)	1(1)	8(4)

CC = Connelly Creek
WT = W. Fork Tilton River
ET = E. Fork Tilton River
MC = Mineral Creek
GC = Gallup Creek
KC = Kiona Creek
RC = Rainey Creek
* Indicates incidental capture after 1-hour search period was over
(n) numbers in parentheses indicate the number of streams where amphibian occurred, only one stream reach was sampled per stream

common in talus slopes that are not perpetually wet throughout the year (Nussbaum et al. 1983). Bury and Corn (1989) only found them inhabiting old-growth forest, even though all seral stages were sampled.

Tailed frog (*Ascaphus truei*)

The tailed frog is found in British Columbia, Washington, Oregon, Idaho, northern California and western Montana (Nussbaum et al. 1983). It has been reported throughout western Washington in Chelan , Okanogan, Kittitas, Yakima and Lewis Counties, and in the southeastern corner of the state. The tailed frog is a candidate for federal listing. The tailed frog is found from sea level to near timberline, occurring in or near fast-flowing, permanent streams within forested areas (Nussbaum et al. 1983; Leonard et al. 1993). Adults forage nocturnally in the vicinity of streams and find refuge during the day and throughout the winter under rocks in streams. Tailed frog adults feed on insects and other invertebrates. The larval period for tailed frogs is usually 2 years, but can vary between 1 and 4 years, presumably depending on water temperature and food availability during the growing season.

Surveys of the Mineral Tree Farm in 1994 revealed tailed frogs in the Connelly Creek, West Fork Tilton River, East Fork Tilton River, Gallup Creek, Kiona Creek and Rainey Creek drainages (Table 4-9). Tailed frogs were absent or poorly represented in streams lacking mature forest cover.

Northern red-legged frog (*Rana aurora aurora*)

The northern red-legged frog is found in southern British Columbia, through western Washington (including Lewis County) and Oregon into northern California (Leonard et al. 1993). They are found throughout western Washington from sea level to 4,680 feet. The northern red-legged frog is a candidate for listing by the USFWS. The WDFW has not assigned any specific status for this species.

Adult red-legged frogs are highly terrestrial and are frequently encountered in damp woodlands adjacent to streams (Leonard et al. 1993). They are attracted to places where cattails, sedges and other plants provide good cover. Breeding habitat includes cold marshes, swamps, ponds, lakes and slow-moving streams. The red-legged frog was found in the Connelly Creek and East Fork Tilton River drainages during 1994 surveys (Table 4-9).

Cascades frog (*Rana cascadae*)

The Cascades frog ranges throughout the Cascade Range from Washington to northern California, and in the Olympic Mountains of Washington. Its distribution is confined to higher elevations, generally occurring from 2,000 feet to timberline. This species is generally considered to be a mountain frog which is always in close association with water. It is most common in pools along streams in alpine meadows and forests, but also inhabits ponds, lakes, swamps and marshes (Leonard et al. 1993).

Amphibian surveys of the Mineral Tree Farm in 1994 revealed Cascades frogs at four of 19 streams sampled, including two in the East Fork Tilton River and one each in the Kiona Creek and Rainey Creek drainages (Table 4-9). These frogs were only found in streams (DNR Type 1-4 waters), usually at higher elevations with mature and old-growth forest cover.

Spotted frog (*Rana pretiosa*)

The spotted frog is the most aquatic of the native frogs. It is found from southeast Alaska through British Columbia to northeast California, and eastward through Idaho and northern Nevada. In Washington, this species is known to occur at several locations east of the Cascade Range (McAllister and Leonard 1991; Rodrick and Milner 1991). Historically there were populations west of the Cascades in Washington and in the Willamette Valley in Oregon, but it is believed the non-native bullfrog (*Rana catesbeiana*) and other aquatic predators have significantly reduced these populations. Searches of several locations in western Washington known to have historically supported spotted frogs in 1989 and 1990 resulted in no detections, but a single spotted frog was found by the same researchers in a tributary to the Black River in Thurston County (McAllister and Leonard 1991). This is the only recent sighting of a spotted frog in western Washington. The spotted frog is a candidate species for listing by the USFWS and WDFW.

Adult spotted frogs are found in or near perennial water bodies such as springs, ponds, lakes or slow-moving streams and are often associated with emergent non-woody vegetation (Leonard et al. 1993). They feed on invertebrates, and adults can eat other small frogs. Spotted frogs may occur in association with the small lakes and beaver ponds on the Mineral Tree Farm, although none were found during stream amphibian surveys in 1994.

Northwestern pond turtle (*Clemmys marmorata marmorata*)

The Northwestern pond turtle is found in California, Nevada, Oregon and Washington, where its status trend is listed as declining (U.S. Fish and Wildlife Service 1991). They have been found from sea level to approximately 6,700 feet, but the majority of the population is found below 4,500 feet. Rodrick and Milner (1991) state the only confirmed populations are in Klickitat and Skamania Counties in Washington. A recent record has been obtained for Lewis County (Washington Department of Fish and Wildlife 1994a). Historically they were also found in King, Pierce, Thurston and Clark Counties with a few recent sightings in King and Pierce Counties. Northwestern pond turtles inhabit marshes, ponds, sloughs and small lakes. They require abundant aquatic vegetation, protected shallows for juveniles and logs and banks or floating vegetation for basking adults (Rodrick and Milner 1991). They are opportunistic feeders on aquatic vegetation and small animals. Western pond turtles occurring in a pond environment may move as much as 800 feet into adjacent habitats to overwinter (Holland 1991b). Pond turtles also leave the water to nest. Nest sites have been found from 55 feet from water (Holland 1991a) to as much as approximately 1,300 feet (Storer 1930). It is not expected that pond turtles occur on the Mineral Tree Farm, but bodies of water do exist that could potentially support pond turtles.

Great blue heron *(Ardea herodias)*

The great blue heron is found throughout most of North America. In western North America, it breeds from southeast Alaska to Mexico, and winters from British Columbia to northern South America (Peterson 1990). The great blue heron is found statewide in Washington (Larrison and Sonnenberg 1968). The great blue heron has no federal status at this time, but the WDFW lists it as a state monitor species.

The great blue heron's habitat is listed as occurring near all types of fresh and saltwater wetlands including seashores, rivers, swamps, marshes, fields, meadows and ditches (Rodrick and Milner 1991). They are found at most elevations, but are more common in the lowlands. Habitat requirements include large nesting trees (both coniferous and deciduous), shallow-water feeding sites in close proximity to nests and protection from human disturbance. Prey items include shallow-water aquatic and marine animals. Great blue herons are colonial breeders, generally nesting in tall trees near wetland areas where colonies remain at the same sites from year to year (Rodrick and Milner 1991). In western Washington, nests have been built in 60- to 100-year-old Douglas-fir trees (Julin 1986). Feeding areas generally are within 3 miles of the rookery (Short and Cooper 1985).

It is likely that great blue herons are at least occasional visitors to the Mineral Tree Farm, particularly at lower elevations where they could feed on nearby lakes and rivers. No nesting is known to have occurred on the tree farm.

Harlequin duck *(Histrionicus histrionicus)*

The western range of the Harlequin duck extends from northeastern Siberia and the Aleutian Islands, through most of interior Alaska, and south to central California and Wyoming (Bellrose 1976). In western North America, it breeds locally in mountainous areas from the Aleutian Islands and central Alaska south to central California and Wyoming, and winters in rough coastal waters along the Pacific coast. In Washington, the Harlequin duck breeds in the Olympic, Cascade, Blue and Selkirk Mountains. The species has been found on the Cowlitz and Cispus Rivers (Washington Department of Fish and Wildlife 1994a), and is, therefore, likely to occur on the Mineral Tree Farm. The Harlequin duck is a candidate for listing by the USFWS, while the WDFW lists it as a game species.

The Harlequin duck nests along rocky shores adjacent to turbulent mountain streams, with nests located on the ground, among rocks and under bushes (Bellrose 1976). During the nesting season, Harlequin ducks have habitat requirements which include fast flowing water, one or more nearby mid-stream loafing sites, dense shrubs or timber, shrubs on stream banks and no human disturbance (Cassirer and Groves 1989, 1990). Summer foods of the Harlequin duck include crustaceans, mollusks and aquatic insects. During the winter they feed on marine snails, fish eggs, limpets, crabs, chitons and bivalves from rocky or gravel shorelines and in kelp beds close to shore. During surveys for spotted owls, marbled murrelets and northern goshawks, no Harlequin ducks have been seen, but is possible they are present along the larger streams of the Mineral Tree Farm.

Marbled murrelet *(Brachyramphus marmoratus)*

The marbled murrelet is found in North America from Alaska south to central California (American Ornithologist Union 1983; U.S. Fish and Wildlife Service 1994b). In Washington, the marbled murrelet forages in coastal waters year-round and nests in coniferous forest. Populations in Washington waters were estimated to be 3,800 to 5,000 individuals in 1979, and 1,900 to 3,500 breeding pairs in 1991 (Speich et al. 1988). The USFWS lists the marbled murrelet as threatened in Washington, Oregon and California (U.S. Fish and Wildlife Service 1992). Surveys of the Mineral Tree Farm in 1992, 1993 and 1994 have resulted in inconsistent detections of murrelet presence, and no clear indication of occupancy (i.e., nesting).

The marbled murrelet inhabits shallow marine waters and nests in mature and old-growth trees (Hamer and Cummins 1991; Rodway et al. 1991). It also utilizes inland fresh water lakes such as Lake Quinault and Lake Washington (Carter and Sealy 1986). Large concentrations of foraging marbled murrelets have been observed in the San Juan Islands, the Strait of Juan de Fuca, the Great Bend area of Hood Canal and along the outer coast of Washington (Marshall 1988). Major prey items of the marbled murrelet have been identified as sand lance, Pacific herring, capelin, other fish and euphausids (crustaceans) (Sealy 1975; Carter 1984; Sanger 1987).

Marbled murrelets nest primarily on the limbs of mature and old-growth coniferous trees (Ralph et al. 1994). As of 1993, 64 marbled murrelet nests had been located world-wide, 61 of these in North America. Six of these nests have been located in Washington State, all of which were located in mature to old-growth stands. Nearly all nest areas in Washington were in stands of conifers that were 150+ years of age and had average dbh of greater than 35 inches. Nest stands typically are composed of Douglas-fir, western hemlock and western redcedar below 3,300 feet in elevation. In

Washington and Oregon, marbled murrelets have been observed up to 52 and 66 miles inland, respectively, exhibiting behaviors believed to be associated with nesting over coniferous forest during the breeding season (U.S. Fish and Wildlife Service 1994b).

A habitat assessment was conducted for the Mineral Tree Farm in 1992 to identify any sites with the potential to support marbled murrelet nesting. Approximately 1,039 acres of forest were considered to be potentially suitable for murrelets (Hamer, pers. comm., 15 April 1992) which included the number of trees in the stand having horizontal limbs with diameters of at least 7 inches, the number of potential nest platforms observed in those trees and the size of the stand. Some old-growth coniferous forest on the tree farm was not considered potential murrelet habitat because it lacked suitable nest platforms.

A general survey for marbled murrelet presence also was conducted in and around potential habitat on the Mineral Tree Farm between 13 July and 5 August 1992 (Beak Consultants Incorporated 1992). The survey included all suitable habitat on the tree farm except small, isolated stands in Sections 33 and 35 of Township 13 North, Range 6 East and Section 21 of Township 13 North, Range 7 East. The survey consisted of 2-hour survey stations, starting 45 minutes before sunrise and lasting until 75 minutes after sunrise. In areas where suitable habitat covers a large portion of a drainage, stations were placed on prominent points throughout the drainage to sample the entire area. This was a modification of the general survey methodology described by Ralph and Nelson (1992). The modification was made because of the following protocol conditions:

- It prescribes a driving route with 10-minute stations placed no more than 5 minutes apart, but many roads in mountainous areas of Washington require more than 5 minutes of driving time to get from one stand of suitable murrelet habitat to the next; and

- It allows for as much as 30 percent of the survey period to be spent in the vehicle travelling between stations, at which time no murrelet detections are likely.

The modified general survey method used on the Mineral Tree Farm in 1992 allowed stations to be placed in areas not accessible by vehicles and to be placed on different road systems. This method also allowed the surveyors to spend the entire 2-hour survey period listening for murrelets. The methods for interpreting and recording survey information outlined by Ralph and Nelson (1992) were followed at all times.

Marbled murrelet keer calls were detected in three of the four survey areas on at least one of the visits in 1992 (Beak Consultants Incorporated 1992). A single wing-beat detection also was made, but bird height was not determined from this auditory detection. No other detections were recorded for this area. The greatest number of confirmed detections at a single station during one visit was three.

Surveys were conducted in 1993 using the intensive survey method developed by the Pacific Seabird Group (Ralph et al. 1993). Murrelets were detected on two occasions in separate areas of the same drainage (Beak Consultants Incorporated 1993). These detections were in the vicinity of other detections recorded in 1992. No behaviors associated with occupancy were observed.

During the fall 1993, a second, more detailed habitat assessment was conducted for all habitat on the tree farm that had been identified as potentially suitable for murrelet nesting through aerial photo interpretation. Criteria developed by the Scientific Advisory Group to the Washington Forest Practices Board on Marbled Murrelet Rule Making (SAG) were used for assessing stand suitability. In the assessment, all stands that met at least two of the three SAG criteria for suitable habitat were recommended for additional murrelet surveys in 1994. Those stands that did not meet at least two of the SAG criteria were not surveyed in 1994.

In addition, some habitat was included in the assessment that had not previously been surveyed. Portions of this habitat were found to meet two of the SAG criteria and were included in the 1994 surveys. Potentially suitable habitat acquired by Murray in land exchanges during 1993 was analyzed in early 1994 using the same method. Three stands were added to the 1994 survey schedule as a result of this analysis.

A third year of surveys was conducted on all potentially suitable habitat identified during the habitat assessment in 1994, again according to the current PSG protocol (Ralph et al. 1994). As recommended in the protocol, additional effort was expended to detect murrelet occupancy in those areas where presence (but not occupancy) was detected in any of the survey years. The additional effort consisted of either doubling the number of observers (from one to two) at one or more stations during the last two visits to each area, or by conducting one additional visit to the site. If an additional observer was used, the first observer was positioned at the standard survey station within the forest stand, while the second was positioned at a location which afforded a view over the canopy of the stand. The two observers remained in radio contact throughout the survey visit.

The results of the 1994 surveys were comparable to other years. While some inconsistent detections of presence were made, occupancy was not observed on the tree farm.

Golden eagle (*Aquila chrysaetos*)
The golden eagle is a widely-distributed resident species throughout western North America except for the recent extirpation in the Central Valley of California (Harlow and Bloom 1987). In Washington, this species more commonly breeds in the southeastern lowlands and deserts, but nesting has been occurring more frequently in western Washington due to the use of timber harvesting practices such as clearcutting (Bruce et al. 1982). The golden eagle is a candidate for listing by the WDFW, but is reported as common by all western states and has no federal status at this time.

The golden eagle is almost always associated with open habitats in deserts, grasslands and canyonland areas, although natural high mountain meadow areas and timberline are used as well. With the advent of clearcutting, however, many areas in western Washington are now providing suitable open habitat for golden eagles (Bruce et al. 1982). Nests are built on cliffs, in trees or on the ground. A survey in 1982 found 13 golden eagle nesting territories in western Washington (Bruce et al. 1982). Twelve of the 13 nests were in large Douglas-fir trees in mature to old-growth forests. Golden eagle were found to prey upon mountain beaver, snowshoe hare and European rabbits that lived in clearcuts or open fields. Sightings of golden eagles have been reported on and near the

Mineral Tree Farm and it is expected that they will continue to be present. Golden eagles were observed hunting over the Kiona Creek and East Fork Tilton River drainages during the breeding season in 1994 (Beak Consultants Incorporated 1995b). An active nest previously existed on the western portion of the tree farm, but the nest was reported abandoned in 1994 (Miller, pers. comm., 21 April 1994). This nest, and several others outside the tree farm (Washington Department of Fish and Wildlife 1994c), indicate the species is relatively common in the area.

Bald eagle *(Haliaeetus leucocephalus)*

The bald eagle is found throughout North America, primarily along coastlines, lakes and rivers (Peterson 1990). In Washington it is most common along saltwater, lakes and rivers in the western portion of the state and along the Columbia River east of the Cascade Range (Larrison and Sonnenberg 1968). Its primary wintering range in Washington is in Puget Sound and its major rivers where spawned-out salmon carcasses are available. This area includes the San Juan Islands, the Olympic Peninsula, the Cowlitz and Columbia Rivers and Hood Canal. The bald eagle is listed as threatened in Washington by the USFWS and the WDFW.

Habitat of the bald eagle is located primarily near seacoasts, rivers and large lakes, and the eagle typically nests in tall trees or on cliffs (American Ornithologists' Union 1983). Bald eagles select nesting trees which are taller than surrounding trees and near water (Anderson et al. 1986). Breeding territories in Washington are located in predominantly coniferous, uneven-aged stands with old-growth components (Anthony et al. 1982). Douglas-fir and Sitka spruce (*Picea sitchensis*) trees within 300 yards of open water are often used as nesting trees, as are black cottonwood (*Populus trichocarpa*) trees near rivers (Anderson et al. 1986). Communal night roosts are used near feeding areas during the winter, usually in old-growth forest stands near rivers with salmon (Rodrick and Milner 1991). Bald eagle prey include small fish such as herring (when abundant), large fish, water birds and small mammals (Anderson et al. 1986). In the winter, bald eagles feed on carrion, waterfowl and spawned-out salmon along river banks.

By 1991, 444 occupied nests were documented in Washington, 18 of which were in eastern Washington (Washington Department of Wildlife 1991b). This represented an increase of 44 new nests from the 1990 surveys. Productivity was slightly below one young per occupied nest for 15 consecutive years, which is a federally established recovery goal adopted by the WDFW. No active bald eagle nests are known to occur on the Mineral Tree Farm.

Northern goshawk *(Accipiter gentilis)*
The northern goshawk is a forest-dwelling bird-of-prey that breeds in coniferous, deciduous and mixed forests throughout much of the northern forest lands of North America. In the Pacific Northwest, its breeding distribution is limited to coniferous forest regions (Reynolds 1989). This species is a candidate for listing by the USFWS and the WDFW.

Although goshawks nest in a variety of forest types throughout their range, the vegetation structure and topography of nest sites remain relatively consistent (Reynolds et al. 1982; Speiser and Bosakowski 1987; Hayward and Escano 1989). Goshawk nest stands typically have a high density of large trees and relatively high degree of canopy cover (Reynolds et al. 1982). Preferred habitat during the breeding cycle is in older, tall forests (coniferous, deciduous or mixed) where goshawks can maneuver below or in the canopy while foraging and make use of large trees to build their bulky nest (Reynolds 1989). The home range size required by a pair of goshawks is approximately 6,000 acres and includes "nest sites" ranging from 12 to 30 acres (Bartelt 1977; Reynolds et al. 1992). The prey of the goshawk includes snowshoe hare, grouse, ground squirrels, tree squirrels, chipmunks, rodents and various bird species.

A general survey for northern goshawk presence on the Mineral Tree Farm was conducted during the 1994 breeding season (Beak Consultants Incorporated 1995b). The survey covered virtually all potentially suitable nesting habitat on the tree farm. This was accomplished by first mapping all potential nesting habitat on the tree farm. It was assumed for mapping purposes that potentially suitable habitat has a mean stand dbh of 12 inches or greater (Reynolds et al. 1992; Lilieholm et al. 1993), stand height of at least 80 feet, average stem density of 100 to 300 trees per acre and greater than 70 percent coniferous trees in the overstory. Approximately 4,900 acres of potentially suitable habitat were identified on the Mineral Tree Farm as of spring 1994.

Once mapped, potentially suitable habitat was surveyed using a modified version of the USFS protocol for surveying goshawks in the Pacific Northwest (U.S. Forest Service 1993). The modified survey was designed to elicit goshawk responses along forest roads by broadcasting goshawk calls with a more powerful tape player than used in the USFS protocol. Goshawk alarm calls were broadcasted by two powerhorn speakers powered by a vehicle cassette player. The number of calls was doubled (to 12), and the total observation period was extended 6 minutes (to 10 minute total) relative to the standard USFS protocol. To account for better broadcasting range and longer broadcast time, a spacing maximum of 0.3 miles (1,500 feet) was used for all broadcast stations. Roadless areas were surveyed on foot and broadcasts were made using a portable amplified megaphone wired to a mini-cassette player, as recommended by the USFS (1993).

A total of 179 broadcasting stations were completed with the modified method, including 61 sites at Connelly Creek, 57 at East Fork Tilton, 47 at Kiona Creek, 9 at Rainey Creek and 5 at West Fork Tilton. Northern goshawks were located by visual and/or audio response at three of the five areas surveyed (Connelly Creek, East Fork Tilton, Kiona Creek). At Connelly Creek, no detections occurred at the survey stations. One incidental observation was made by one of the surveyors of a large *Accipiter* (probable goshawk) soaring along the ridge. At East Fork Tilton, five detections occurred at survey stations, and two incidental sightings were noted. The incidental observations occurred while driving and during a 2-hour nest search. At Kiona Creek, only one detection was made as an adult was observed flying by just prior to the broadcast at a road station. No detections occurred at West Fork Tilton or Rainey Creek.

To compare the USFS protocol to the modified method, the Connelly Creek and East Fork Tilton River areas were re-surveyed using the USFS methods. The habitat in these areas appeared visually to be the most likely habitat to support goshawks. The USFS method consisted of establishing parallel transects 832 feet apart, with stations along the transects at intervals of 960 feet. Whenever possible, stations on parallel transects were offset by 480 feet. Broadcasts were made using an amplified megaphone wired to a mini-cassette player or with a Johnny Stewart Game caller cassette player.

With the USFS method, no detections occurred at survey stations at Connelly Creek, but one incidental sighting of an adult goshawk occurred while driving between stations. At East Fork Tilton River, three detections occurred at survey stations, and one incidental sighting occurred while hiking between foot stations. A 4-hour nest search revealed multiple audio responses of a juvenile with one visual confirmation of the juvenile at close range, thus confirming active reproductive status for the adult goshawks observed at East Fork Tilton River.

Overall, results were similar for the two methods, suggesting that either method performed adequately for detecting goshawks. The surveys revealed that goshawks were found only in areas with large concentrations of suitable habitat. However, in all three areas where goshawks were found, Murray owns considerably less suitable habitat than the typical home range size of 6,000 acres (Reynolds et al. 1992). For example, Murray owns 930 acres of suitable habitat along Connelly Creek and 1,579 acres along the East Fork Tilton River. The presence of goshawks in these areas probably is due to the presence of suitable habitat on adjoining USFS lands in Late-successional Reserve.

Osprey *(Pandion haliaetus)*

The osprey is a fish-eating raptor that has a nearly worldwide distribution, but in North America does not breed south of southern California (Brown and Amadon 1968). In Washington, its breeding distribution extends over much of the state except possibly southeast lowlands and deserts (Henny and Anthony 1989). The species is migratory in Washington, migrating in September to Mexico and South America for the winter and returning in April and May to breed. The osprey has no federal status at this time, but is a candidate for listing by the WDFW.

There are two basic habitat requirements of the osprey: a) availability of large trees and/or snags for nest building and b) productive water source providing abundant food (Kahl 1971; Johnson and Melquist 1973). Because ospreys feed almost entirely on fish, the second requirement mandates that ospreys nest within close proximity to large lakes or rivers which can produce large supplies of fish (Call 1978). Osprey generally nest in tall snags or trees with broken tops along lakes and rivers. Osprey prefer to have accessory perches available for sunning and roosting near the nest tree (Zarn 1974; Call 1978).

The osprey likely forages on the Mineral Tree Farm along rivers and small lakes during migration, but the likelihood of ospreys nesting on the tree farm is very low given the lack of large water bodies. However, a slight possibility exists for nesting along the Tilton River, the largest water resource in the area.

Vaux's swift *(Chaetura vauxi)*

Vaux's swifts breed from southeast Alaska, Northwestern and southern British Columbia, northern Idaho and western Montana south to central California, mainly west of the Cascades and Sierra Nevada Ranges (American Ornithologists' Union 1983). They winter from central Mexico south through Central America and Venezuela. In Washington, the Vaux's swift is a summer resident from April to September in forested areas of the state (Larrison and Sonnenberg 1968). The Vaux's swift has no federal status at this time, but is a candidate for listing by the WDFW.

Vaux's swifts are found in coniferous forests. They are consistently more abundant in old-growth forest (210 to 730 years old) than in younger stands (Lundquist 1988), and showed the strongest association with old-growth of all spring birds in the southern Washington Cascades (Manuwal and Huff 1987). Vaux's swifts nest and roost at night inside hollowed-out large snags or live trees with broken tops, and also nest in hollowed-out snags or live trees using holes excavated by pileated woodpeckers (Bull 1991; Bull and Hohmann 1993). Trees used by roosting swift colonies have been described in one study (Bull 1991) as 200 to 300 years old, 3.3 to 4.5 feet dbh and 50 to 68 feet tall in living or recently dead trees with the tops broken off, exposing the hollow core of the tree. The chambers were about 1 to 2 feet in diameter and 19 to 30 feet deep. The roost trees were in timber stands with about 70 percent canopy closure.

Vaux's swifts were observed on the Mineral Tree Farm during goshawk surveys in 1994. All sightings were in or near stands of mature or old-growth forest in the Connelly Creek, Kiona Creek and East Fork Tilton River drainages. Flocks of up to six birds were observed in the Connelly Creek drainage.

Pileated woodpecker *(Dryocopus pileatus)*

The pileated woodpecker is found in North America from British Columbia across to Nova Scotia and south to northern California, Montana and eastern Kansas and south along the Gulf Coast and in Florida (American Ornithologists' Union 1983). It lives in both deciduous and coniferous forests. In Washington, it is found throughout the state in dense forests of low to moderate elevation (Larrison and Sonnenberg 1968). Pileated woodpeckers were detected in all surveyed forest stands aged 55 years and older throughout the southern Cascades in western Washington (Lundquist and Mariani 1991). Optimum habitat has been described as coniferous forest with two or more canopy layers, with the upper canopy being at approximately 80 to 100 feet high. The pileated woodpecker has no federal status at this time, but is a candidate for listing by the WDFW.

Pileated woodpeckers are primary nesters and are strong excavators capable of digging cavities in completely sound conifer wood (Bull 1987). However, most nests reported are in trees with some degree of decay. Cavities are excavated just prior to nesting, relatively few nest trees are used more than once for nesting and each pair typically excavated a new nest cavity each year (Bull et al. 1992). The typical nest tree is one of a stand of many large diameter live and dead trees, with strong selection for trees larger than 21 inches dbh (up to 49 inches) needed for the large nest cavity (8 inches wide by 22 inches deep), which is found 20 to 86 feet above ground (Bull and Meslow 1977; Mannan et al. 1980; Bull 1987; Lundquist and Mariani 1991). Adult pileated woodpeckers always roost inside a cavity at night, all year long. Roost trees are often those used previously for nesting. Carpenter ants have been reported as the primary food of pileated woodpeckers, in addition to fruit, nuts, woodboring beetle larvae and other insects. The home range for a pair of pileateds has been most often reported to range from 490 to 1,550 acres using the minimum convex polygon method (McClelland 1979; Mannan 1984; Bull and Holthausen 1993). Pileated woodpecker are known to be present on the Mineral Tree Farm and have been detected as recently as 1994.

Western bluebird (*Sialia mexicana*)

Western bluebirds are found from southern British Columbia to western Montana and south through most of the western United States into central Mexico. Bluebirds breed throughout their range, and winter from the Puget Sound to southern Utah and southwestern Colorado (Peterson 1990).

There has been an apparent decline in the western bluebird population in western Washington since the early part of this century, which may be due to increased urbanization and development, coupled with nest site competition with starlings (Herlugson 1978). The WDFW (1993) lists the western bluebird as a state candidate species.

Basic habitat requirements of western bluebirds include elevated perches, open spaces, some cover and one or more nest cavities. Habitat is restricted to open woodlands, farms, burns and clearcuts at lower elevations (Larrison and Sonnenburg 1968). In western Washington, western bluebirds were found on the majority of all clearcuts where snags were present, and bluebirds showed a large and positive numerical response to snag density (Schreiber and DeCalasta 1992). Snag characteristics for bluebird use included a 10- to 54-inch dbh range (average 28 inches), a height range of about 12 to 55 feet (average 30 feet), bark cover of 0 to 100 percent (average 16%) and a tendency toward snags with intermediate and advanced stages of decay (softer wood, snags of 19 to 126+ years old). Cunningham et al. (1980) reported that western bluebird nests in ponderosa pine (*Pinus ponderosa)* in Arizona were most often found in snags rather than live trees.

Olive-sided flycatcher (*Contopus borealis*)

This neotropical migrant is probably part of the breeding bird community on the Mineral Tree Farm. It is listed as a federal candidate species (Category 2). In the Pacific Northwest, it inhabits mature and old-growth coniferous and mixed forests (Brown 1985; Sharp 1992), but also uses high perches (live trees and snags) found along the edge of clearings created by burns, windthrow and clearcuts (Sharp 1992). The olive-sided flycatcher has a territory size of about 10 acres and breeds at densities up to five pairs per 100 acres on the Siuslaw National Forest in Oregon (Mannan 1977).

Little willow flycatcher (*Empidonax trailli brewsteri*)

This neotropical migrant is probably part of the breeding bird community on the Mineral Tree Farm. In the Pacific Northwest, it inhabits riparian areas, open wetlands and edge habitat in willow or alder thickets, shrubs and young forest (Brown 1985; Peterson 1990). The willow flycatcher has a territory size of about 1.5 acres and breeds at densities ranging from 3 to 40 pairs per 100 acres in western Washington (Sharp 1992). It is a federal candidate for listing (Category 2).

Gray wolf *(Canis lupus)*

The gray wolf was once found in most of North America, but is now listed as endangered by the USFWS and the WDFW. In Washington, the gray wolf was eliminated as a breeding resident by 1930 (Young 1944). The last populations on the Olympic Peninsula, and in the Blue, Cascade and Selkirk Mountains were eliminated by the 1940s (Washington Environment 2010 1992). A study from 1973 to 1988 showed wolf sightings to be increasing (Laufer and Jenkins 1989). These recent sightings, along with the proximity of viable wolf habitat in nearby areas in southern British Columbia, led to the conclusion that gray wolves were recolonizing the Cascade Range. Since 1988 wolf tracks have been confirmed, two den sights have been located and wolf pack activities have been recorded in the Cascade Range.

The habitat of the gray wolf is listed to be open tundra and forests (Whitaker 1980). The presence of wolves in a particular area has been found to be linked to the availability of suitable prey, and not to the existence of a particular habitat type (Stevens and Lofts 1988). Prey of the gray wolf includes ground squirrels, rabbits and hares, beaver and larger mammals such as deer, elk, caribou, moose, bighorn sheep and mountain goats. Two home ranges for wolf packs on Vancouver Island were 40 and 47 square miles, and in northern British Columbia they varied from 93 to 248 square miles (Scott 1979).

Occasional unconfirmed sightings of gray wolves are made to the northeast and east of the Mineral Tree Farm, the most recent in 1992 (Behan, pers. comm., 8 January 1993). It is possible that wolves occasionally use the tree farm.

Grizzly bear *(Ursus arctos)*

The grizzly bear was once found throughout the western United States and Canada, but is now listed as threatened by the USFWS and as endangered by the WDFW. The species is considered to include both the Alaska brown bear and the grizzly bear, although formerly up to 94 species and subspecies of grizzly bear were listed. In Washington, small populations persist in the north Cascades and Selkirk Mountains. Occasional recent sightings of grizzly bears and/or their tracks have been made in the north Cascades of Washington (Larrison 1976; Whitaker 1980; Washington Environment 2010 1992). It is believed that these are recent disperses from viable populations in southern British Columbia. At the present time, it is estimated that there are approximately 10 individuals in the north Cascades and 18 in the Selkirk Mountains in northeast Washington (Washington Environment 2010 1992).

The habitat of the grizzly bear is listed as semi-open country, usually in mountainous areas (Whitaker 1980). The grizzly bear is considered omnivorous, consuming many kinds of plants including roots or sprouts, fungi, berries, fish, insects, large and small mammals and carrion. Grizzly bears also tear apart logs and ant hills for insects and excavate tracts of ground for rodents and tuberous roots. There is no recent evidence of grizzly bear reproduction in western Washington.

The north Cascades region (north of I-90) and the Selkirk Mountains in northeast Washington have been designated as grizzly bear recovery areas. Currently no plans exist for their recovery in the southern Washington Cascades. The potential exists for grizzly bears to use the Mineral Tree Farm due to its proximity to the Cascade Range and Mount Rainier National Park, but the potential is extremely low.

California wolverine *(Gulo gulo luteus)*

The California wolverine is found in California, Oregon and Washington and is a candidate species for listing by the USFWS and the WDFW. The USFWS distinguishes the California wolverine from the North American wolverine, *Gulo gulo luscus*, which is found in Colorado, Idaho, Minnesota, Montana, North Dakota, Nevada, Utah and Wyoming. Larrison (1976) lists the wolverine as occurring in the Cascades, the Okanogan region and the northeast part of the state.

Habitat of the wolverine is limited to high mountain coniferous forest, subalpine forest, alpine tundra and fresh water emergent wetland habitats (Ingles 1965; Larrison 1976; Whitman et al. 1986; Banci and Harestad 1990). Wolverines eat carrion and prey on small mammals, birds, bird eggs, insects and insect larvae in summer. In winter, they are capable of preying on large mammals in deep snow. The breeding period for wolverines is April to September, with the young born in early spring in dens located in protected areas such as thickets or rock crevices. Subalpine habitats are rare on the Mineral Tree Farm, and there are only scattered areas of mature and old-growth forest remaining. It is unlikely that the California wolverine is present on the tree farm.

Pacific fisher *(Martes pennanti)*

The Pacific fisher is found across southern Canada, in forested regions of the western United States and in New England and New York (Whitaker 1980). The range of the Pacific fisher includes most forested areas of Washington, Oregon and northern California, but it is considered rare throughout its range and is a candidate species for listing by the USFWS and the WDFW. It is most common in the Olympic Mountains, north Cascades and Okanogan areas in Washington and is absent in the southern Cascades (Yocom and McCollum 1973).

The Pacific fisher is believed to be associated with dense closed-canopy forest, with high forest floor structural diversity, large snags and riparian/wetland conditions (Aubry and Houston 1992). Fishers generally inhabit low- to mid-elevation areas, with 87 percent of western Cascade Range sightings reported below 3,280 feet. Maximum sighting elevation was 5,900 feet (Aubry and Houston 1992). It feeds on porcupines, squirrels, wood rats, hares, mice and grouse. Individual home ranges are large (up to 10 square miles in Canada) and large undisturbed tracts of mature coniferous forest (at least 100 square miles) are needed to maintain viable populations of fisher (Washington Department of Wildlife 1993). Because the fisher has shown a reluctance to use or cross large forest openings, it is believed they are rare in highly fragmented habitats (Ruggiero et al. 1994).

A fisher was reportedly released by a trapper near Morton in Lewis County in 1987 (Aubry and Houston 1992). An unconfirmed sighting of a fisher was made along the eastern edge of the Mineral Tree Farm as recently as 1991 (Behan, pers. comm., 8 January 1993). These reports indicate the potential that fishers could be present on the tree farm.

Townsend's big-eared bat (*Plecotus townsendii*)

Townsend's big-eared bat occurs in the western United States and is widely distributed throughout the Pacific Northwest (Burt and Grossenheider 1976; Maser and Cross 1981). It is a candidate species for listing by the USFWS and the WDFW.

Townsend's big-eared bat is a nocturnal, non-migratory species which hibernates for several months in winter (Maser et al. 1981). Caves and mines are the preferred habitat for roosting and hibernating, but they also use lava tubes, tunnels and abandoned buildings (Barbour and Davis 1969; Burt and Grossenheider 1976; Rodrick and Milner 1991). In the Pacific Northwest, big-eared bats may also be found roosting under bridges, inside large culverts, in buildings and in attics (Maser et al. 1981; Perkins 1989). Apparently, the bats can only tolerate roosting in buildings in the Pacific Northwest, where relative humidity is high enough to prevent dehydration (Barbour and Davis 1969). Roost sites also need to be within a certain range of temperature before they can be utilized by this species. Caves utilized for hibernation maintain a temperature close to freezing during the winter, and caves utilized for nursery colonies are generally above 50°F (10° C)(Perkins and Levesque 1987). Big-eared bats do not crawl into cracks and crevices, but hang in the spot where they first land (Barbour and Davis 1969). Thus, they must be able to fly directly to their roosting substrate.

Frequent disturbance to hibernating colonies can result in abandonment, reproductive failure and starvation (Graham 1966; Rodrick and Milner 1991). Therefore, caves should be closed from 1 November to 1 April (Perkins 1985). After hibernation, the females form nurse colonies to which they are loyal throughout the summer while the males generally disperse by April (Burt and Grossenheider 1976; Kunz and Martin 1982). Males move 5 to 31 miles from hibernacula (Stevens and Lofts 1988) and will frequently change roosts during the summer months. The nursing colonies of big-eared bats, composed primarily of females and young, are particularly vulnerable to disturbance and will readily abandon these sites (Humphrey and Kunz 1976; Pearson et al. 1952; Graham 1966; Barbour and Davis 1969). Thus, all visitation to nursery caves should be avoided from 1 May to 30 August (Perkins and Levesque 1987). The Mineral Tree Farm has not been surveyed for Townsend's big-eared bats, but they are not believed to be present due to the absence of suitable roosting and hibernating habitat.

Fringed myotis (*Myotis thysanodes*)

The fringed myotis is listed as a federal candidate species (Category 2). In the Pacific Northwest, it inhabits low to high elevation grasslands and shrub communities below subalpine level along riparian and wetland areas (Brown 1985). It is primarily dependent on caves and cliffs for roosting/nursing. Its winter hibernacula are unknown (Brown 1985). Its status on the Mineral Tree Farm is unknown.

Long-eared myotis (*Myotis evotis*)

The long-eared myotis is listed as a federal candidate species (Category 2). In the Pacific Northwest, it inhabits old-growth coniferous forest in temperate, high elevation, and subalpine communities and also depends on riparian forests, wetlands, shrubland and open young forest for foraging (Brown 1985). It is primarily dependent on snags for roosting/nursing/hibernating, but also uses caves (Brown 1985). Its status on the Mineral Tree Farm is unknown.

Long-legged myotis (*Myotis volans*)

The long-legged myotis is listed as a federal candidate species (Category 2). In the Pacific Northwest, it inhabits mature and old-growth coniferous forest below subalpine elevations and depends on riparian forests and wetlands for foraging (Brown 1985). It is dependent on snags, cliffs and caves for roosting/nursing, although it may be migratory in winter (Brown 1985). Thomas (1988) found long-legged bats occurred significantly more often in mature and old-growth forests than in young forests in the Cascades. Its status on the Mineral Tree Farm is unknown.

5.0 HABITAT CONSERVATION MEASURES

5.1 Overview

Multiple-resource management on the Mineral Tree Farm will occur through a three-step process involving: a) landscape-level planning, b) set-aside of selected areas as permanent forest habitat reserves and c) the implementation of habitat enhancement and management measures during the course of silvicultural and harvest operations on the remainder of the tree farm. Landscape-level planning will occur according to the procedures outlined in the Washington Forest Practices Board Watershed Analysis Process. Habitat reserves will occupy at least 10 percent of the total vegetated area of the tree farm; the locations of the reserves will be determined for the most part through Watershed Analysis. Active enhancement of habitats will occur through a number of resource programs that will be integral parts of the management of the tree farm. Each of the three steps is described in detail in the following subsections.

5.2 Watershed Planning

5.2.1 Washington Department of Natural Resources Watershed Analysis

Forest practices on state and private lands in Washington are regulated under the Forest Practices Act of 1974 (Chapter 76.09 RCW). In recent years, forest practice regulations have been modified to ensure more systematic treatment of cumulative effects of multiple forest practices over time and space. In 1992, the Washington Forest Practices Board adopted a Watershed Analysis Process for developing individual watershed plans based on a comprehensive understanding of basin-wide processes (Chapter 222-22 WAC). The state has been divided into approximately 400 Watershed Administrative Units (WAUs) ranging in size from approximately 10,000 to 50,000 acres. The DNR has been charged with performing Watershed Analysis on a priority basis, although individual landowners may initiate an analysis at their own expense if they own more than 10 percent of the lands in a WAU.

Watershed Analysis is a structured process for developing forest management plans based on biological and physical inventories (Figure 5-1). This process includes an evaluation of mass wasting, surface erosion, hydrology, riparian function, channel geomorphology, fish habitat, public water supply, public works and water quality. It is a collaborative scientific process involving resource scientists, managers, landowners, agencies, tribes and interested members of the public. In addition to detailed regulations, the Forest Practices Board adopted a manual of detailed standard methodologies for implementing analysis, which was developed by a diverse group of scientists (Washington Forest Practices Board 1993a).

In a Watershed Analysis, qualified scientists develop information and interpretations of watershed processes, resource conditions and sensitivities at the watershed scale. Inventory findings may include maps of sensitive areas (e.g., sensitive hillslopes) and reports describing the nature of the sensitivity. Risks to public resources are identified and supported with data generated by the analyst team. The basic premise of the analysis is that a change in erosion, hydrology or riparian function resulting from forest practices is significant when it is sufficient to cause an adverse change in a public resource of fish habitat, water quality or public works. This information is used to identify resource sensitivities to which site-specific protective measures called prescriptions will be applied. Land managers and resource agency representatives develop and implement the management prescriptions that have been tailored to watershed conditions in response to resource concerns identified by the scientific investigation. Optional monitoring plans are recommended to track the effectiveness of prescriptions. Such a plan is designed to provide feedback as to whether resources are actually protected or improving as a result of the prescriptions.

Watershed Analysis findings and proposed management prescriptions are made available for public review during the DNR review process and before final acceptance of a watershed plan by the DNR. Once the watershed plan is approved, further forestry activities in the watershed must be consistent with approved Watershed Analysis prescriptions, or be subjected to further ? environmental review. Under these rules, any proposed deviation will result in further environmental review by the DNR. Compliance is regulated by the DNR.

Processes, Variables and Resources Addressed in Watershed Analysis

Watershed Process
- Erosion
  - Debris torrents
  - Earthflow
  - Surface-roads
  - Surface-hillslopes
- Hydrology
  - Water availability during peak flow events
  - Water availability during low flow
- Riparian Function
  - LWD recruitment
  - Shading
  - Bank stability

Input Variable
- Sediment
  - Coarse
  - Fine
  - Washload
  - Catastrophic channel damage
- Water
  - Peak flow of large events
  - Frequency of channel forming discharge
  - Annual yield
  - Low flow
- Wood
  - In-channel obstructions
- Energy
  - Water temperature

Public Resource
- Fish Habitat
- Water Supplies
  - Municipal
  - Domestic
  - Hatchery
- Public Capital Improvements
  - Roads
  - Bridges
  - Reservoirs
  - Irrigation
  - Other significant structures

Source: Washington Forest Practices Board (1993a)

Figure 5-1. Processes, variables and resources addressed in watershed analysis.

Watershed plans are designed to be adaptive. Products of the Watershed Analysis are assumed to be valid for a period of 3 to 5 years or until a natural disaster occurs having a material adverse effect on the resource characteristics of the WAU, whichever occurs first, at which time the condition of the WAU is assessed and analysis is repeated if warranted. The intent of this approach is to implement an adaptive management process in which assessment tools, management and regulations are revised as new information becomes available.

The existing DNR Watershed Analysis Process is designed primarily to protect fish, water (including water quality and aquatic habitat) and capital improvements of the state (public works). Upland forest habitats for terrestrial plants and animals are protected only incidental to other resource measures. The DNR Watershed Analysis Process currently includes no direct planning or management for plants or animals, although indirect protection can be substantial, especially for aquatic species.

5.2.2 Murray Pacific's Commitment to Perform Watershed Analyses in the Mineral Block

An important element of the multi-species HCP Amendment requires Murray to perform Watershed Analyses on over 98 percent of the Mineral Tree Farm. There are eleven WAUs encompassing Murray lands in the Mineral Block; Murray has greater than 10 percent ownership in nine. Watershed Analyses have been already completed by Murray on two WAUs (Connelly Creek and East Fork Tilton River). Both Watershed Analysis reports are hereby incorporated by reference. The remaining seven analyses will be completed by the year 2004.

Management prescriptions to date for sensitive hillslope areas have included restrictive measures on new road construction, improvements to existing roads where problems occur and temporal and spatial timber harvest restrictions to avoid or minimize delivery of coarse and fine sediment to streams. Riparian buffers will be established along each side of DNR Type 1, 2 and 3 streams to improve delivery of LWD, provide shade, provide "barrier" trees to reduce the possibility of debris flows or dam-break floods, ensure channel stability and provide connective corridors for wildlife. Prescriptions for specific watersheds also may provide riparian forest protection along portions of

DNR Type 4 and 5 streams. Both reports completed to date contain extensive analyses and prescriptions. Murray has used and will continue to use a team of highly educated and experienced scientists in performing analysis and developing prescriptions, all with extensive experience in mountainous forest terrain of the Pacific Northwest.

In addition to the standard watershed methodology, Murray will include the following steps to address the full range of resources:

- Murray will continue performing detailed road inventories during Watershed Analysis to assess culvert concerns and potential road surface failures that may contribute to mass wasting and surface erosion processes in the watersheds. The results will be used in prioritizing annual road maintenance programs to address damaged, plugged or undersized culverts, and any culverts that hinder upstream migration of fish and specific water drainage issues that surface in each watershed;

- Murray will consider carrying out reasonable stream restoration prescriptions on its lands where practicable.

- Murray will continue monitoring programs for peak stream temperatures, water quality, fish habitat and fish populations.

- Murray will conduct wetland surveys during Watershed Analysis to identify any previously-unknown wetlands.

5.3 Habitat Reserves

Approximately 49,000 acres of the Mineral Tree Farm are vegetated uplands capable of supporting coniferous forest; the remainder of the tree farm is covered by road, water or rock. To provide a source of late-successional forest habitat, Murray will dedicate at least 10 percent of the vegetated area of the tree farm (4,900 acres) to the development and maintenance of reserves that will not be harvested for at least the term of the HCP (through 2094), unless timber harvest is warranted to improve water quality, fish or wildlife habitat or overall stream/wetland function and approved by the USFWS and NMFS. The majority of the reserves will be placed in the riparian zones along streams and wetlands to maximize the benefits to fish and wildlife while minimizing the impacts to operational forestry. For purposes of this HCP Amendment, a "reserve" is an area identified by Murray as such on a map based on the results of Watershed Analysis or determined by other criteria developed by Murray.

The interface between aquatic and upland habitat, referred to as the riparian zone, is a unique environment that is the focus of significant resource protection and management efforts. It is generally more biologically productive than upland environments because of the presence of water and a moderated microclimate. It is also considered one of the most biologically diverse portions of the landscape because of the presence of both aquatic and upland plants and animals. The riparian zone is integral to the function and health of the aquatic environment since water, sediment and nutrients flow downhill through the riparian zone before encountering the stream channel. It is also a key feature of the landscape from the perspective of the upland communities because it contains within it a source of water, which most animals in the upland forest require at regular intervals, and it supports a moderated microclimate that may have daily or seasonal significance to many species of wildlife.

The locations of the reserves will be determined by Murray and designated as such on a map for a permanent record. Most reserves will be identified through the Watershed Analysis Process described in subsection 5.2. Based on the two Watershed Analyses that have been completed to date on the tree farm, it is estimated that all fish-bearing streams (DNR Types 1, 2 and 3) will have no-harvest reserves averaging 100 feet in width on each side of the stream. Some non-fish-bearing streams (DNR Type 4) will have no-harvest reserves averaging 50 feet on each side of the stream, and some steep inner gorge areas of second-order streams (mostly DNR Types 4 and 5)

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will have no-harvest barrier tree reserves extending 20 feet in elevation above the ordinary high water mark. Regardless of the outcome of Watershed Analysis, Murray will maintain no-harvest riparian habitat reserves with an average width of 100 feet and minimum width of 25 feet on each side of all DNR Type 1, 2 and 3 streams. Reserves less than 75 feet wide will be rare, but the option to make portions of the reserves as narrow as 25 feet will be necessary to meet the joint concerns of economic forest management and watershed protection. In particular, narrow reserves may be necessary in isolated instances to enable Murray to access timber for harvest from the fewest miles of roads and with the least impact overall to the watershed. As a temporary measure to protect habitat prior to the completion of Watershed Analyses, Murray will maintain no-harvest zones with an average width of 100 feet and a minimum width of 75 feet on both sides of all DNR Type 1, 2 and 3 streams. Reserves will be no narrower than 75 feet along Type 1, 2 or 3 streams prior to Watershed Analysis. Murray also will maintain temporary no-harvest zones with an average width of 50 feet and minimum width of 25 feet on both sides of Type 4 streams for the first 1,000 feet above a larger stream, where the Type 4 streams contributes more than 20 percent of the flow to the larger stream.

Murray also will establish no-harvest buffers around all lakes and non-forested wetlands (DNR Type A and B wetlands, bogs and fens). Wetland buffers will have average widths of 100 feet and minimum widths of 50 feet from the wetland edge. Wetland buffers will remain for at least the term of the HCP Amendment, regardless of the results of Watershed Analysis.

Murray may place some of the 10 percent reserves in upland areas that are not contiguous with riparian reserves. Upland reserves could occur on steep headwalls, unstable slopes, inaccessible areas and sites poorly suited to the continued production of commercial timber, but currently available for harvest under Washington Forest Practices Rules and Regulations. Based on Watershed Analyses conducted to date, it is estimated that no more than one-tenth of the total reserve area of 4,900 acres will be in uplands. The actual amount could vary, based on the outcome of individual Watershed Analyses.

The forest stands in the potential reserve areas currently range in age from recent clearcut to old-growth. By the end of the HCP Amendment term, the minimum age of most reserve stands will be 100 years, and approximately 10 percent of the reserved area (494 acres) will be over 250 years old. To protect and enhance the habitat value of the reserves during the term of the HCP Amendment, Murray will manage its tree farm according to the following guidelines:

- Conduct no timber harvest or timber yarding in reserve areas unless such actions are good specifically prescribed to improve water quality, fish or wildlife habitat or overall stream/wetland function and approved in advance by the USFWS and NMFS.

- Build roads in reserve areas only when and where consistent with prescriptions resulting from Watershed Analysis. Minimize the number and lengths of new roads through reserve areas and construct new roads to minimize the total area of reserves impacted, consistent with the need to minimize overall road lengths for the tree farm as described in Section 5.4.3 of this HCP Amendment. The area occupied by roads will not be ? included in 10 percent reserves.

- Conduct no slash burning of any kind within reserve areas.

- Apply no herbicides or insecticides in streams, wetlands or deep water habitats.

not enough

- Apply no herbicides or insecticides within 100 feet of DNR Type 1, 2 or 3 streams, except where necessary to meet the objectives of this HCP Amendment to improve habitat for fish or wildlife and/or improve water quality and approved in advance by the USFWS and NMFS.

- Apply no fertilizer in streams, wetlands or deep water habitats, except where necessary to meet the objectives of this HCP Amendment to improve habitat for fish or wildlife and/or improve water quality and approved in advance by the USFWS and NMFS.

- Implement forest management measures prescribed for the tree farm by Watershed Analysis to maintain or enhance water quality or habitat features.

5.4 Forest Habitat Management

5.4.1 Forest Habitats

Traditionally, management activities of private industrial forest lands that were intended to increase the amount and/or quality of wood fiber also altered fish and wildlife habitats and determined the species that ultimately inhabited the forest. In some cases, the effects have been beneficial to native species. In other cases, the effects have been detrimental. Commercial forests cannot be dedicated solely to the production of fish and wildlife habitat without the loss of the economic return from the land, but measures can be taken during the course of commercial forest management to enhance beneficial effects and minimize or avoid detrimental effects to fish and wildlife. When done in conjunction with management for late-successional forest on adjacent federal lands, the combination of habitat reserves in riparian areas and management measures within the operational forest stands can contribute significantly to the maintenance of viable fish and wildlife populations on the landscape.

Second-growth upland forest occupies the majority of the land area on the Mineral Tree Farm, where intensive management for commercial timber production is the principal activity. The growing and harvesting of trees has a significant effect on habitat conditions within uplands, and it can have an effect on downstream riparian and aquatic environments as well. Murray's stands are managed on even-aged rotations of 45 to 60 years, with clearcutting as the primary means of harvest. Trees are planted by hand, thinned, freed from brush competition and sometimes fertilized and pruned, primarily to accelerate the growth and development of commercially valuable logs. Simultaneously, the tree farm is managed to provide a landscape conducive to the dispersal of juvenile spotted owls. Individual forest stands are silviculturally manipulated to promote the development of roosting and foraging habitat for dispersing spotted owls, and the timing and spacing of timber harvests are planned to maintain suitable spacing between stands of suitable habitat.

Habitat for some species of wildlife is enhanced during the current management of the tree farm, while habitat for other species is reduced or eliminated altogether. Species that require large tracts of undisturbed forest cannot be accommodated solely on the commercial forest landscape, but many other species can be maintained at relatively low cost if conscious efforts are made to provide the necessary habitat features. The objective of multi-species management is to provide for the habitat needs of as many species as possible within the operational and economic constraints of commercial timber production.

The Murray multi-species HCP Amendment also includes a series of resource measures that will be incorporated into management of the tree farm. Each measure will focus on one or more aspects of commercial forest management that has the potential to affect fish or wildlife habitat. The overall objective of each measure will be to maximize the beneficial effects of the respective forest management activity, while minimizing or avoiding the detrimental effects.

Specific resource management measures include the following:

- During even-aged harvest of timbered stands on the tree farm, Murray will retain a minimum of four live coniferous trees and four snags (where available) per acre of harvest. At least one of the four live trees will be from the dominant size class of the previous stand, at least two of the four will measure at least 18 inches in dbh and all four will measure at least 10 inches in dbh (Figure 5-2). If trees of the prescribed sizes are not available, trees of the largest available sizes will be substituted. All live trees will have at least one-third of the total tree height in live crown. Snags will measure at least 12 inches in dbh and be at least 10 feet tall (where available). If fewer than four snags are available per acre prior to harvest, or if fewer than four snags can be left because of con-

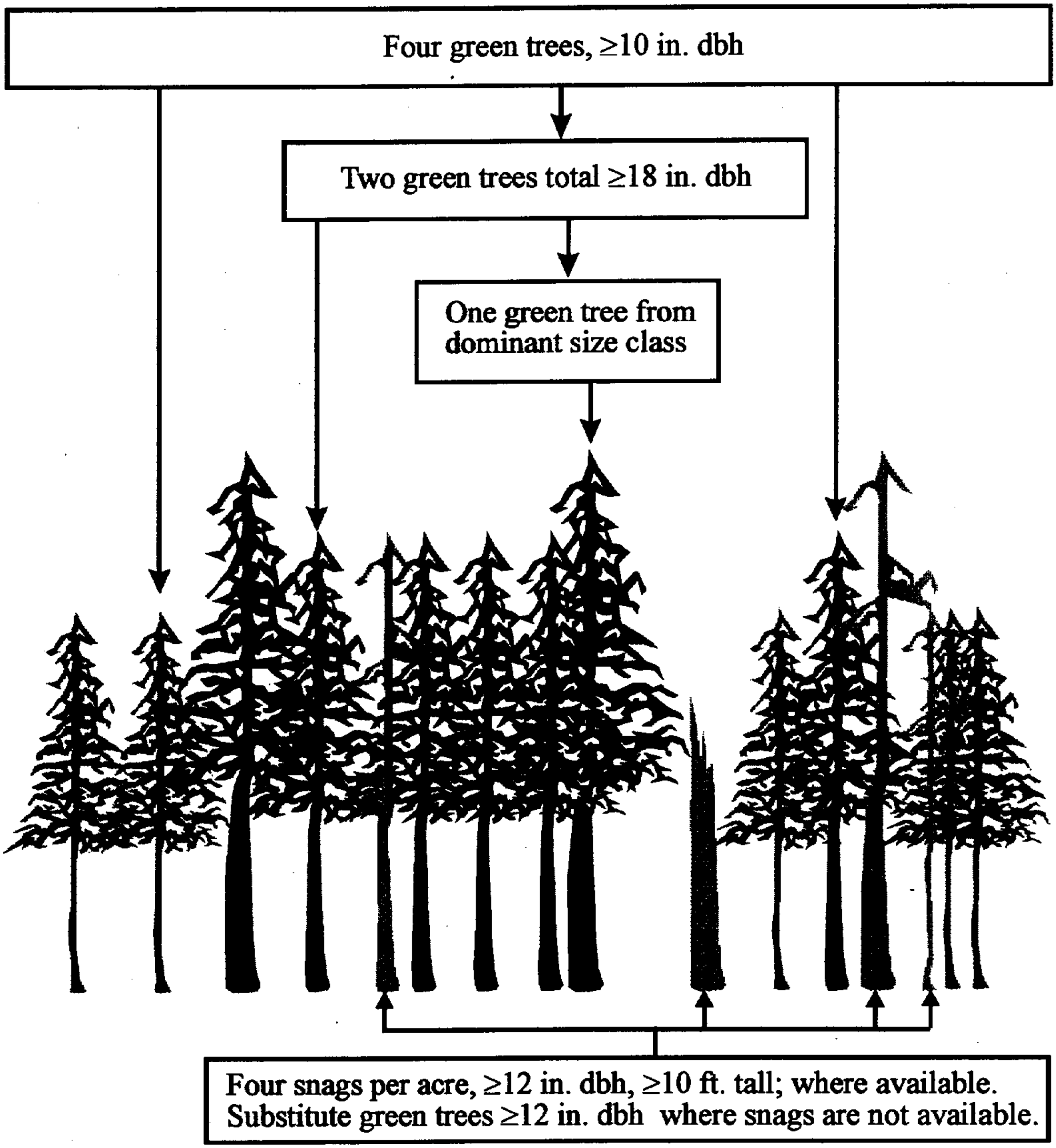

Figure 5-2. Diagram of snag and green leave tree selection cirteria prescribed in the HCP Amendment.

cerns for safety or interference with harvest equipment, additional live trees measuring at least 12 inches in dbh will be left so that the total number of stems left after harvest is at least eight per acre. Live trees and snags will be clumped, dispersed or left in or adjacent to riparian forest reserves. The distance between individual live trees or snags will not exceed 800 feet (Figure 5-3). Of primary concern in the selection of all snags and green trees will be the desire to minimize the potential for them to blow down or be damaged during or after harvest. Live trees and snags of appropriate sizes within designated reserve areas may be counted toward meeting the retention requirements for harvests within 800 feet of the reserves.

- In order to protect talus habitat during even-aged harvest, Murray may leave the required green trees and snags clumped within 200 feet of talus habitat, where it can be accomplished in a practicable and economically reasonable manner and consistent with prescriptions resulting from Watershed Analysis. If the density of green trees greater than 10 inches in dbh within 200 feet of a talus slope is at least 100 trees per acre (or an equivalent basal area of larger trees) over 1 or more contiguous acres (with a minimum width of 100 feet) after even-aged harvest, Murray may increase the maximum distance to the next green tree or snag from 800 feet to 1,600 feet, provided that the total density of four live trees and four snags is maintained in the area.

- During harvest of timbered stands, Murray will leave all snags known to be occupied by Vaux's swifts, unless leaving the snags would be in violation of state or federal regulations governing worker safety.

- During even-aged harvest of timbered stands, Murray will meet the current Forest Practices Rules and Regulations by leaving a minimum of 2 down logs per acre of harvest. Individual logs will measure 12 inches or greater at the small end and be a minimum of 20 feet in length (or have equivalent volume with a larger diameter). Logs will be left dispersed across the harvest unit, where practicable. It is assumed that a portion of

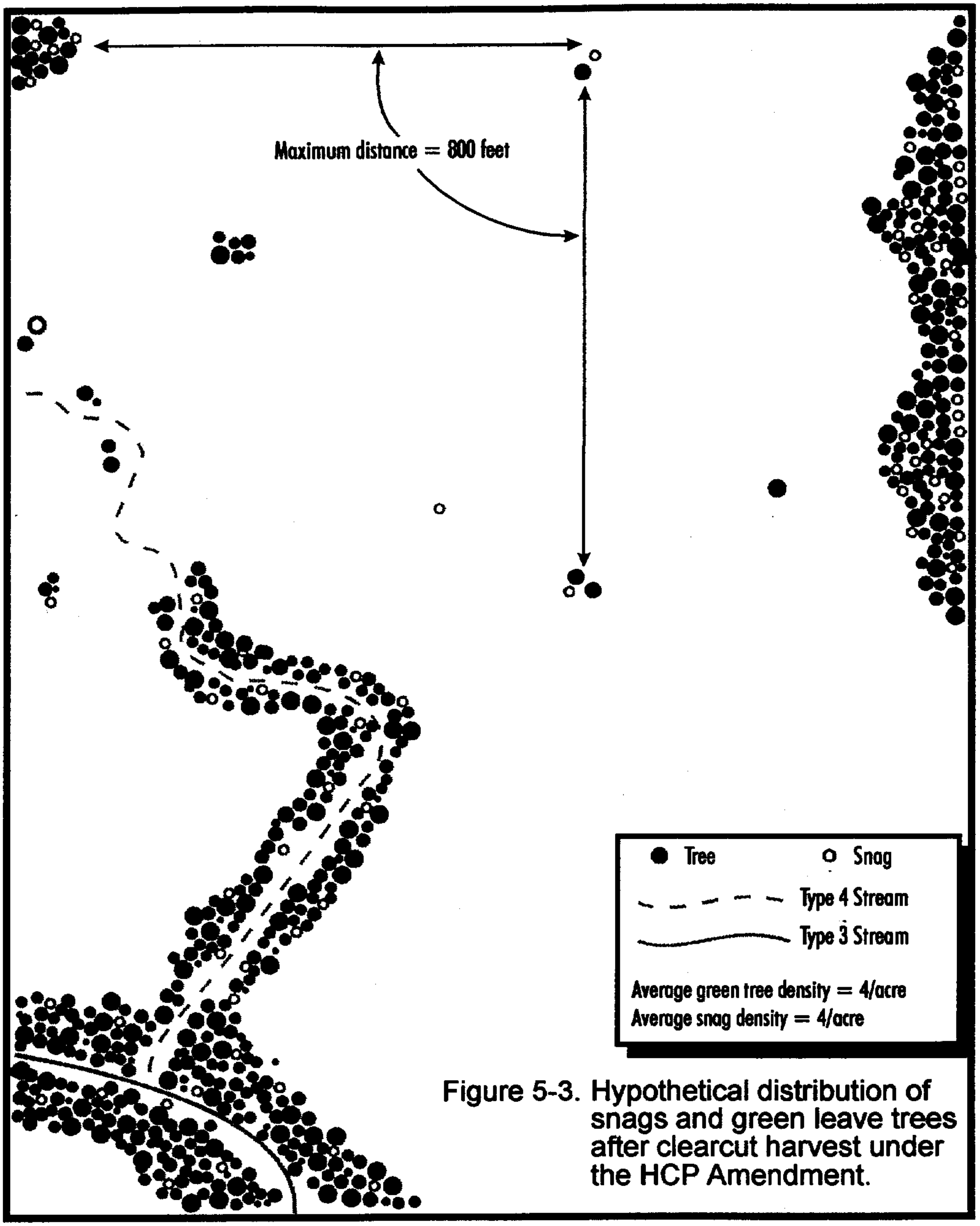

Figure 5-3. Hypothetical distribution of snags and green leave trees after clearcut harvest under the HCP Amendment.

Figure 5-3. Hypothetical distribution of snags and green leave trees after clearcut harvest under the HCP Amendment.

the snags and live trees left during harvest (as described above) will succumb to wind and add to the overall density of down logs on the tree farm.

- Murray will limit broadcast burning to those sites where it is needed to reduce fire danger to acceptable levels and/or facilitate adequate reforestation. Murray will leave slash in piles where it does not present a fire hazard or impediment to forest management.

- If prescribed by Watershed Analysis, Murray will conduct no harvest of trees within 20 feet in elevation above the ordinary high water mark in any inner gorge area of a second order stream channel where the side slope exceeds 73 percent (36 degrees) to retain barrier trees and reduce the potential for downstream propagation of debris torrents.

- Murray will continue to meet all stand structure, stand size and stand spacing requirements of the original spotted owl HCP.

- Murray will conduct no even-aged harvest in forested wetlands greater than 1 acre, and no selection harvest that would leave fewer than 100 square feet of basal area per acre in trees greater than 8 inches dbh.

- Murray will minimize soil disturbance and disturbance to understory vegetation and leave trees during harvest in forested wetlands.

- Murray will suspend logs from at least one end during timber yarding in forested wetlands.

- Murray will limit ground-based yarding systems where feasible in forested wetlands, and allow no ground-based system when soils are saturated.

- Murray will minimize the number of skid trails in forested wetlands. Murray will construct and/or decommission skid trails in such a manner as to minimize erosion and avoid altering or obstructing water movement through wetland areas.

- Murray will lop and scatter logging slash generated during harvests in forested wetlands in such a manner so as to avoid impeding animal movement or restricting water movement.

- Murray will conduct timber harvest and road construction in areas of unstable slopes only in accordance with prescriptions resulting from Watershed Analysis.

- There currently are no known caves on the Mineral Tree Farm, and the potential for their occurrence is considered to be low. If caves are discovered in the future, Murray will protect the cave habitat subject to the following conditions:

  - Caves will be protected on the tree farm if they are known or determined to be occupied by the Larch Mountain salamander, Townsend's big-eared bat, fringed myotis, long-eared myotis or long-legged myotis.

  - Up to 1 acre of forest habitat will be protected from clearcut harvest around the mouth of each cave. Selective harvest may occur in the protected areas, and yarding of timber may occur through the protected areas, as long as the density of coniferous trees greater than 10 inches in dbh does not fall below 100 per acre (or an equivalent basal area of larger trees). If coniferous trees greater than 10 inches in dbh are not present in the area surrounding the cave opening prior to harvest, then 50 percent of the dominant and codominant trees in the area will be left after harvest, with preference given to conifers when selecting leave trees.

  - The distance from the mouth of each cave and the edge of the protected area will not be less than 100 feet. No permanent roads will be built within 100 feet of the mouths of the caves, provided that the relocation of roads around caves can be accomplished in a practicable and economically reasonable manner and consistent with prescriptions resulting from Watershed Analysis and with the HCP objectives of minimizing road construction on unstable soils and in riparian reserves.

- The locations of caves will be kept confidential by Murray, the USFWS and WDFW. Public access to caves will be discouraged by maintaining gates locked to the general public at the entrance to the tree farm. Human activity at the mouths of the caves will be kept to a minimum.

- The total area of the tree farm restricted, in whole or in part, from intensive timber management (e.g., clearcutting) by cave protection will not exceed 5 acres except at Murray's discretion. If protection of 1 acre of habitat at any cave results in the isolation of additional timberland, or in any way makes additional timberland unavailable, in whole or in part, for the Murray's desired management activity, the additional acreage will be added to the total area dedicated to cave protection and the cumulative total of protected acres for caves on the tree farm will not exceed 5 acres except at Murray's discretion.

- All live coniferous trees left standing for cave protection may be counted by Murray toward the total leave tree requirement specified in elsewhere Section 5.4.1.

5.4.2 Species-Specific Nest Protection Measures

In addition to the general habitat protection and enhancement measures described above, Murray also will implement specific protection measures to reduce the potential for the direct take of bald eagles, golden eagles, osprey, northern goshawks, great blue herons, grizzly bears, gray wolves, wolverines and Pacific fishers.

- Murray will conduct no timber felling, yarding or new road construction within 660 feet of known nests of the bald eagle, golden eagle, osprey, northern goshawk and great blue heron between 1 March and 1 September during years when nests are active.

- Murray will conduct no timber felling, yarding or new road construction within 660 feet of known active dens of the grizzly bear between 1 October and 30 May in years when the dens are active. The maximum number of grizzly bear dens that will be protected at any time will be two, and the maximum period of time that timber felling, yarding or new road construction will be interrupted or precluded in any one area will be 2 years.

- Murray will conduct no timber felling, yarding or new road construction within 660 feet of known active dens of the gray wolf between 15 March and 30 July in years when the dens are active. The maximum number of gray wolf dens that will be protected at any time will be two, and the maximum period of time that timber felling, yarding or new road construction will be interrupted or precluded in any one area will be 2 years.

- Murray will conduct no timber felling, yarding or new road construction within 660 feet of known active dens of the wolverine between ____________ in years when the dens are active. The maximum number of wolverine dens that will be protected at any time will be two, and the maximum period of time that timber felling, yarding or new road construction will be interrupted or precluded in any one area will be 2 years.

- Murray will conduct no timber felling, yarding or new road construction within 660 feet of known active dens of the Pacific fisher between __________ in years when the dens are active. The maximum number of fisher dens that will be protected at any time will be two, and the maximum period of time that timber felling, yarding or new road construction will be interrupted or precluded in any one area will be 2 years.

5.4.3 Roads

One of the primary contributors to the increase in sediment production over and above natural hillslope erosion and mass wasting in managed watersheds is the construction and use of logging roads. Roads can increase sedimentation in rivers from surface erosion and landslides. Surface erosion occurs when unstable soils on sufficiently steep slopes are exposed to overland flow and/or the impact of rainfall. Sediments introduced to streams are generally fine-grained and can influence water quality and aquatic habitat (Washington Forest Practice Board 1993). Forest roads can accelerate natural mass wasting processes (Harr and Nichols 1993). Inadequately located, designed, constructed and/or maintained roads can be associated with dam-break floods and other mass wasting events, resulting in deposits of large amounts of sediment.

Watershed Analysis has two modules which address roads; Surface Erosion and Mass Wasting. One purpose of the surface erosion module is to identify specific road-related problem areas where excess sediment is currently routed or will potentially be routed to a watercourse.

These may include areas of inadequate road surfacing, unstable fills, under-designed or plugged culverts, collecting water from numerous small drainages into one culvert and over-steep slopes. The mass wasting module is responsible in part for identifying unstable slope conditions. This information is useful for determining placement of future roads and deciding the fate of existing roads. Site-specific conditions influencing the potential for road drainage to malfunction and contribute to mass-wasting processes will be identified in each WAU as part of the watershed assessment.

Roads also have the potential to influence surface hydrology by interrupting overland flow and shallow subsurface flow from seeps and wetlands. This can lead to the creation or elimination of wetlands, depending on site-specific conditions. As part of the HCP Amendment, Murray will continue with its road drainage assessment program, which involves identifying individual locations or road segments with existing or developing drainage problems. Murray also will implement road management measures which represent a combination of standard Washington Forest Practices Rules and Regulations and additional measures developed by Murray to further protect water quality and fish habitat.

- In addition to Washington Forest Practices Rules and Regulations, Murray will employ the following measures:

  - When consistent with Watershed Analyses results, Murray will deactivate or maintain existing roads through bedrock hollows (convergent areas), heads of first-order stream channels and inner gorge areas adjacent to first, second and third order channels where slopes exceed 73 percent (36 degrees). Temporary roads will be used in these areas only if: a) the roads are designed by a qualified forest engineer and approved by a geomorphologist to guard against landslide initiation; and b) the roads are constructed no earlier than 1 April and are completely deactivated prior to 31 October to avoid the season of heavy winter runoff.

  - During Watershed Analysis, Murray will inventory all roads on the tree farm to identify road segments with existing or developing drainage problems. Murray will identify site-specific conditions influencing the potential for drainage to malfunction and contribute to surface erosion or mass wasting, and address the conditions.

  - When prescribed by Watershed Analysis, Murray will revegetate all spoils areas and exposed soils on non-traveled surfaces of roads.

  - Murray will minimize the temporary placement of excavated material, fill and logging debris in natural drainages and wetlands during road construction, and remove all excess material from drainages and wetlands daily during construction.

  - Murray will maintain locked gates at all points of public access to the tree farm to minimize vehicular traffic on roads.

  - Murray will implement road construction, maintenance and closure recommendations resulting from Watershed Analysis.

- Murray will assess all existing roads for the need for additional cross-drainage and implement measures to restore natural drainage patterns, where appropriate.

- In conjunction with Watershed Analysis, Murray will develop and implement a comprehensive Road Maintenance and Road Abandonment Plan for its lands within each WAU.

■ Murray will meet or exceed the requirements of Washington Forest Practices Rules and Regulations pertaining to the construction, maintenance, use and abandonment of roads (WAC 222-24), including the following:

Road Location (WAC 222-24-020):

- Fit new roads to existing topography and minimize new roads along or within narrow canyons, riparian management zones, wetlands and wetland management zones, where this can be accomplished without causing significant increases in overall road lengths.

- Minimize the number of stream crossings, and cross streams at right angles to the main channel where practical and consistent with the need to minimize overall road lengths.

- Minimize construction of duplicative roads by using existing roads wherever practical and avoiding isolation of timber patches that may require unnecessary road construction.

- Minimize locating roads on excessively steep or unstable slopes or known slide-prone areas as determined by the DNR.

Road Design (WAC 222-24-025):

- Minimize road subgrade width to no more than 32 feet for double-lane roads and 20 feet for single-lane roads (exclusive of ditches, turnouts and curves which may require additional widths).

- Deposit as much excavated material as practical in roadway fill sections and design suitable embankments for end-haul deposit areas where full bench construction is necessary.

- Design and construct cut-and-fill slopes to the normal angle of repose for the material involved, or a lesser angle if practicable.

- Outslope or ditch all roads on the uphill side and provide appropriate surface drainage.

- Install cross drains at all Type 1 through 5 streams and wetlands to prevent discharge onto erodible soils, over fill slopes or into streams and wetlands and to meet the spacing requirements of Table 5-1.

- Use culverts at least 18 inches in diameter at all cross drains, and slope culverts at least 3 percent to the outside edge of the road.

- Prevent roadside ditches from discharging directly into Type 1 through 5 streams or Type A or B wetlands by diverting discharge water onto the adjacent forest floor at the first practical location within 300 feet of the surface water body.

- Comply with Forest Practices Board regulatory requirements where more than 0.5 acre of wetland will be filled or drained.

Table 5-1. Maximum allowable spacing between cross drains on forest roads [adapted from WAC 222-24-025 (7)].

Road Grade (%)	**Max. Distance Between Drains (feet)**
0-7	1,000
8-15	800
>15	600

Road Construction (WAC 222-24-030):

- Remove and deck merchantable right-of-way timber where decks will not be covered by fill or act as support for the fill or embankment.

- Construct roads with fill free of large organic debris (logs, stumps and large branches).

- Place road fill in layers, and compact individual layers with a tractor, bulldozer or other heavy equipment.

- Seed or treat soils exposed by road construction where soils appear to be unstable and will likely affect Type 1 through 5 waters through slides, slips, slumps or sediment.

- Clear stream channels of debris and slash generated during operations prior to either equipment removal or the winter season.

- Require all drainage measures to be installed concurrent with roadway construction, and cross drain uncompleted roads left over the winter season.

- End-haul material excavated during road construction adjacent to Type 1 through 5 streams, Type A or B wetlands, forested wetlands, wetland management zones or wherever side slope exceeds 50 percent.

- Dispose of excavated material outside the 50-year floodplain of Type 1 through 5 streams, Type A or B wetlands and forested wetlands.

Landing Location and Construction (WAC 222-24-035):

- Locate landings to avoid excessive excavation and filling, avoid location in Type A or B wetlands and minimize placement in other wetlands.

- Construct landings requiring sidecast and fill to be no larger than necessary, and use fill free from stumps and other debris.

- Mechanically compact fill and slope skid trails, fire trails, truck roads and landing areas to minimize accumulation of water on the landing or the toe of landing fill.

- Sidecast excavated material outside the 50-year floodplain of Type 1 through 5 streams, Type A or B wetlands and forested wetlands.

Water Crossing Structures (WAC 222-24-040):

- Construct bridges to prevent constricting stream channels and erosion from the 50-year flood level, protect bridge approaches from erosion by high water and install curbs on bridges where earthen materials are used for surfacing to prevent material falling into the stream bed.

- Use culverts adequate to carry the 100-year flood, or construct roads to provide erosion protection from 100-year flood waters that exceed the capacity of the drainage structure.

- Place and align culverts to protect the natural flow of the stream, and minimize erosion due to culvert entrance or discharge.

- Employ culvert design and placement to allow fish passage in anadromous fish streams.

- Use temporary crossings adequate to carry the highest anticipated flow during use, and remove, abandon and restore crossings when completed.

Road Maintenance (WAC 222-24-050):

- Maintain active roads by crowning, outsloping or water barring, by removing berms from the outside edge and by keeping culverts and ditches clear and functional.

- Clear culverts and ditches, and crown, outslope or water bar inactive roads before the first winter rainy season following termination of active use.

- Leave abandoned roads in a suitable condition to control erosion and maintain wetland water movement. Remove bridges, culverts and fills, and block access by four wheel highway vehicles.

- Avoid chemical control of roadside brush where chemicals will directly enter a Type 1 through 5 water or a Type A or B wetland.

- Apply oil to road surfaces only under appropriate climactic conditions, and take appropriate steps to prepare the road surface for treatment. Shut off oil flow at all bridges.

Rock Quarries, Gravel Pits, Borrow Pits and Spoil Disposal Areas (WAC 222-24-060):

- Locate quarries, pits and spoil disposal areas above the 50-year flood level. In addition, spoil disposal areas will be located on slopes no steeper than 1.5:1, where risk of erosion and ponding is minimal and outside of Type A and B wetlands.

- Divert water to the forest floor or through settling basins during construction. Pits and spoil disposal areas will be reclaimed once abandoned.

5.5 Summary of Mitigation Measures

The mitigation measures proposed under this HCP Amendment are generally summarized as follows but are explained in more detail in the preceding text:

- Murray will conduct Watershed Analyses on the tree farm:
  - Murray will initiate and fund Watershed Analysis for all watershed administrative units (WAUs) in which Murray owns 10 percent or more of the land area (approximately 98 percent of the tree farm).
  - good
  - Murray will participate in Watershed Analyses initiated by other parties for WAUs in which Murray owns less than 10 percent of the land area (approximately 2 percent of the tree farm).
  - Murray will implement watershed management/protection measures prescribed in the Watershed Analysis process.
  - Murray will consider carrying out reasonable stream restoration prescriptions on its lands where practicable.
  - Murray will conduct no commercial timber harvest within an average of 100 feet and minimum 75 feet of fish-bearing streams (DNR Stream Types 1, 2 or 3) prior to the completion of Watershed Analysis for the respective WAU.
  - Prior to Watershed Analysis, Murray will conduct no commercial timber harvest within an average of 50 feet and minimum of 25 feet of the lower 1,000 feet of Type 4 streams that contribute more than 20 percent of the flow to a Type 1, 2 or 3 stream.

measured from where - the confluence?

  - Regardless of the outcome of Watershed Analysis, Murray will maintain no-harvest riparian habitat reserves with an average width of 100 feet and minimum width of 25 feet on each side of all DNR Type 1, 2 and 3 streams.

  - Murray will construct no roads within 100 feet of DNR Type 1, 2, 3 or 4 streams prior to completion of Watershed Analysis unless roads are designed by a qualified forest engineer and approved by a geomorphologist to guard against landslide initiation. - aren't they always?

- Murray will reserve at least 10 percent of the tree farm for growth and maintenance of late-successional coniferous forest for the term of the HCP Amendment (through 2094).

- Murray will protect wetland resources on the tree farm:

  - Murray will conduct no commercial timber harvest or road construction within an average of 100 feet and minimum of 50 feet of lakes and non-forested wetlands (DNR Type A and B wetlands, bogs and fens).

  - Murray will conduct no even-aged harvest in forested wetlands greater than 1 acre, and conduct no selection harvest that would leave fewer than 100 square feet of basal area per acre in trees greater than 8 inches dbh.

- Murray will leave a minimum of 4 snags, 4 green trees and 2 logs per acre of harvest at the time of even-aged harvest. Snag and tree size and spacing criteria will exceed those prescribed in current Washington Forest Practices Rules and Regulations. Snag and green tree numbers will be at least 60 percent greater than current regulations, and the maximum distance between snags and green trees will be reduced by at least half.

- Murray will continue the measures prescribed in the original spotted owl HCP to develop and maintain a landscape conducive to the dispersal of juvenile spotted owls.

- Murray will meet or exceed current Washington Forest Practices Rules and Regulations concerning the construction, use and maintenance of forest roads.

- Murray will maintain locked gates on the tree farm to minimize public use of roads and forest habitats.

- Murray will protect known active nests of the bald eagle, osprey, northern goshawk, golden eagle and great blue heron.

6.0 IMPLEMENTATION SCHEDULE

The HCP Amendment will be implemented according to the schedule described in the original spotted owl HCP (Murray Pacific Corporation 1993). All reporting and monitoring will occur on that schedule. All Watershed Analyses will be completed no later than 2004. All new habitat reserves described in this Amendment will be identified during those analyses.

7.0 MONITORING AND REPORTING

Monitoring and reporting under the HCP Amendment will proceed as described in the original spotted owl HCP (Murray Pacific Corporation 1993). In addition, Murray will implement the monitoring programs described below. Given the short operating season on the Mineral Tree Farm, monitoring surveys or similar activities will not delay timber harvest and other forest management activities, except as provided for spotted owls and marbled murrelets in the original spotted owl HCP.

7.1 Fish Monitoring

Benefits of the HCP Amendment to fish will include an overall increase in the quantity and quality of fish habitat over time. Murray will conduct a habitat monitoring program in fish-bearing streams on the Mineral Tree Farm to assess long-term trends in fish habitat quality. The program is designed to document ambient conditions and assess the effectiveness of the HCP Amendment and Watershed Analysis prescriptions in minimizing and mitigating adverse effects of management activities to fish habitat. Monitoring data will be provided to the USFWS and NMFS and will be included or referenced in the appropriate Watershed Analysis reports. The following plan describes in general terms the fish habitat monitoring program. Specific program details will be developed cooperatively with staff biologists of the USFWS and NMFS.

The fish habitat monitoring program will address substrate quality, pool size and frequency, LWD, peak stream temperatures, water quality and fish populations on the tree farm. Substrate quality (grain size analysis), pool characteristics and LWD information on the tree farm will be collected at least every 5 years in each WAU (Figure 7-1). Where management impacts are more likely to affect fish habitat downstream of the tree farm, and access is allowed by the applicable landowner, Murray will collect information downstream from the tree farm to the next order stream. Monitoring assessments will be conducted using methods employed in standard DNR Level 2 Watershed Analyses.

Figure 7-1. Monitoring schedule for the Murray Pacific HCP Amendment.

ELEMENT	YEAR									COMMENTS
	95	96	97	98	99	00	01	02	03	
Stream Water Temperature	X	X	X	X	X	X	X	X	X	Surveys will be repeated at a maximum interval of 5 years after 2003. Actual year of monitoring will vary for each WAU, depending on the year the initial Watershed Analysis is completed. Stream temperature monitoring will continue in any WAU where instream temperatures exceed 19 °C for more than 24 hours in a year or the high temperatures are a result of factors beyond Murray's control.
Stream Water Quality	X	X	X	X	X	X	X	X	X	
Stream Substrate				X					X	
Stream Pool Characteristics				X					X	
Instream Large Woody Debris				X					X	
Fish Populations	X	X	X	X					X	
Upland Habitats	X	X	X	X	X	X	X	X	X	Annually for the term of the HCP Amendment.
Breeding Birds	X	X					X			Every 5 years after 2001.
Northern Goshawks	X	X					X			Every 5 years after 2001.
Aerial Nest Searches	X	X	X	X	X	X	X	X	X	Annually for the term of the HCP Amendment.
Amphibians	X	X					X			Every 5 years after 2001.
Spotted Owl Prey	X	X								Surveys will be repeated in 2023 through 2025.

Instream temperature data on the tree farm will be collected annually during the summer warm period for the first 10 years of the HCP Amendment. Monitoring locations will be located in fish-bearing waters on the tree farm where maximum stream temperatures would be expected. A minimum of one and a maximum of three monitoring sites will be located in each WAU. After 10 years, temperature monitoring will continue in any areas on the tree farm where instream temperatures exceed 19 °C for more than 24 cumulative hours in a year. Monitoring will continue until the limit is not exceeded for 2 successive years or the high temperatures are the result of factors beyond Murray's control. In addition, water temperature data will be collected in conjunction with each Watershed Analysis (at least every 5 years). Water quality data including dissolved oxygen, pH, conductivity and channel information including shading (as measured with a densiometer) and channel widths will be collected at each temperature monitoring gauge location during installation and retrieval of the temperature monitors.

Fish populations will be monitored on the tree farm to document trends in species composition and gross changes in fish abundance. Up to 10 pools in each WAU will be snorkeled annually for the first 5 years to collect information on baseline population characteristics. Subsequent monitoring surveys will occur on the tree farm every 5 years. All fish will be counted, keyed to species and measured (visual estimate). Fish density, species diversity and size class distribution will be calculated for each WAU. Fish populations for each WAU on the tree farm over time will be graphed. Results will be included in the Watershed Analysis report and provided to USFWS and NMFS.

In addition to the above described habitat monitoring program, other monitoring activities will occur as part of Murray's efforts to protect fish habitat. The Road Maintenance and Road Abandonment Plan (Section 5.4.3) will include continual monitoring of road surfaces and culvert conditions. Written checklists of scheduled maintenance events will be kept to ensure complete coverage of the tree farm. Road and surface erosion monitoring will be carried out to assess prescription effectiveness at least every 5 years as part of Watershed Analysis (Section 5.2.2). Results will be used to modify existing prescriptions or implement new ones if necessary. Together, these additional upslope monitoring activities will help reduce sediment input to streams.

7.2 Upland Habitat Monitoring

As noted in the original spotted owl HCP, Murray will track the amount and distribution of forest habitats on the tree farm with the aid of GIS. This monitoring will include all habitat reserves created under the HCP Amendment, and will occur annually through 2094.

7.3 Wildlife Monitoring

7.3.1 Breeding Birds

Breeding bird surveys will be conducted on the Mineral Tree Farm in 1995 and 1996, and thereafter at 5-year intervals (2001, 2006, etc.). The purpose of the surveys will be to describe the breeding bird community on the Mineral Tree Farm and assess its contribution to the breeding bird community of the region under the management of the HCP Amendment. The surveys will monitor the presence, distribution and habitat use of resident and migrating species that use riparian and upland habitats as well as special status bird species not monitored by other surveys (Vaux's swift, pileated woodpecker, western bluebird, olive-sided flycatcher and little willow flycatcher). This includes many species of neotropical migrants with the potential to be listed in the future.

Breeding bird surveys will be scheduled during the early summer period (mid-May to early July). Breeding birds will be surveyed using point counts, with points located at least 0.2 mile apart along driveable logging roads where possible. During point counts, all birds that are seen and/or heard within 300 feet of the point during a 5-minute period will be recorded. Counts will begin at daylight and continue for approximately 4 hours. Point count routes will be placed along Type 1, 2, 3 and 4 streams (riparian reserves) and non-forested wetlands designated as reserve areas. Routes will be well distributed over the tree farm to adequately monitor all major habitats, elevations and management histories. Due to differences in land use that will occur during the term of the HCP Amendment, selection of sites in pure habitat types will not be possible. Trends in bird communities on the tree farm can be compared to changes in habitat over the term of the HCP Amendment (which will be tracked by the Murray geographic information system).

7.3.2 Northern Goshawk

During the first 2 years of the plan (1995 and 1996), Murray will conduct second and third years of surveys for the presence of northern goshawk following methodologies developed during the 1994 survey (subsection 4.5). This will involve surveying stands of suitable habitat (as selected by GIS modelling) with the modified method between the last week in May and the last week in July. The primary concentrations of suitable habitat were located in the East Fork Tilton, Connelly Creek and Kiona Creek drainages, and all suitable nesting stands over 40 acres, will be surveyed in these areas. Immediately following detections, if any, searches will be conducted to locate active nests. These searches are not standardized, but will generally follow the advice given in the USFS protocol (at least 3 days should be allotted to search for active nests). If an active nest is found, surveys for that year will be terminated within a 0.5-mile radius (Joy et al. 1994) to avoid the potential for disturbing nesting goshawks with taped goshawk calls.

Future surveys will be conducted on a 5-year basis beginning in the year 2001. Surveys will be used to monitor effects of the HCP Amendment on goshawks as well as to document new active nests which require protection.

7.3.3 Bald Eagle, Golden Eagle, Osprey and Great Blue Heron

The Mineral Tree Farm will be surveyed annually by helicopter to search for nests and nest occupancy of the bald eagle, golden eagle, osprey and great blue heron. Surveys will be conducted during nest occupancy in the late spring by a qualified biologist. Surveys will consist of one fly-over under favorable weather conditions.

Golden eagles were readily detectable during 1994 goshawk surveys, especially along road stations with clear panoramic views, but no bald eagles or ospreys were observed on the Mineral Tree Farm (Beak Consultants Incorporated 1995b). Major cliff sites were examined with binoculars and spotting scopes for golden eagle nests, but no nests were found. In forested areas, golden eagles often nest in trees where they might be difficult to find in heavily forested areas of the Mineral Tree Farm. Continued viewing of potential nest sites and searching for summering adult golden eagles, bald eagles, osprey and great blue heron will also be done during scheduled goshawk and breeding bird surveys, starting as early as May. If birds are detected, intensified searches will proceed to ascertain residency status on the tree farm. If residency is confirmed, searches for active nests will proceed in areas near detections.

7.3.4 Amphibians

During the first 2 years of the plan, and following on a 5-year basis (2001, 2006, etc.), 2-week amphibian surveys will be conducted on the Mineral Tree Farm. Most of the amphibian species of concern are closely tied to aquatic habitats, of which streams represent the major type on the Mineral Tree Farm. To maximize survey efforts for all species of concern, stream reaches and their adjacent banks will be searched such that a combination of aquatic and terrestrial surveys are utilized (Corn and Bury 1990, 1991). The survey crew will work upstream, searching shallow water, splash/flood zones and adjacent stream banks. Time-constrained searches (TCS), which involve searching study areas for a specified duration by hand collecting, will be used. TCS are most useful for determining presence or absence of a species of amphibian and when several study areas need to be surveyed in a short time (Corn and Bury 1990). With TCS, equal effort is expended in different stream reaches so that comparisons can be meaningful.

During TCS, surveyors will overturn large (>10 cm) rocks, logs and bark piles (Corn and Bury 1990), particularly if the site is moist. Rocks and logs that are dry underneath are usually host to ants and seldom contain salamanders. Amphibians will be identified in the field or photographed for later identification. After being identified and/or photographed, all amphibians will be released downstream of the survey crew. During the survey, each stream reach will be searched for 1 hour, not including time taken to hike, photograph or identify specimens.

A total of 20 stream reaches will be sampled throughout the tree farm during spring or fall. Corn and Bury (1991) suggest that one sample per stream is adequate to sample the amphibian community. Stream reaches will be selected to be well distributed throughout the tree farm and will include the following drainages: Connelly Creek, West Fork Tilton, East Fork Tilton, Rainey Creek, Kiona Creek, Gallup Creek and Mineral Creek. Surveys will be repeated in 5-year intervals to track the response of amphibian populations to habitat changes. Several of the major wetlands will also be surveyed, including McKinley Lake and North Fork Swamp. In addition, searches of wet talus slopes will be conducted to determine the presence of Larch Mountain salamander. Because of the unique and fragile nature of this habitat type, it is not recommended to frequently lift or move talus (Leonard et al. 1993), so surveys for this species will not be repeated frequently, or be as intensive as stream/bank surveys.

8.0 COSTS AND FUNDING

The additional costs of the management measures required by this HCP Amendment will be substantial. The initial cost estimates associated with the original spotted owl HCP remain unchanged at approximately $42,000,000 during the first 50 years[1]. These original cost projections do not include opportunity costs such as the inability of Murray to respond appropriately to changing market conditions or the risk of product obsolescence. The original estimates also do not include the extended overhead costs attributable to Murray management personnel fulfilling the requirements of the HCP during daily operations.

While all of the costs associated with Murray's original spotted owl HCP remain unchanged, the following additional costs are projected over the first 50 years of the term of the HCP Amendment:

- Watershed Analysis across the entire Mineral Tree Farm will cost approximately $3,600,000; analysis of two of the nine watersheds on the tree farm, deemed to be "critical watersheds", has been completed. Analysis of the seven remaining watersheds will be accelerated, with completion expected by 2004.

- Forest land set-asides beyond those required under the original spotted owl HCP consist of additional set-asides and protection for riparian areas directed by Watershed Analysis. These reserves are projected to cost $29,375,000, in addition to other set asides that are projected to cost $2,500,000.

[1] The components of the estimates set forth in the original spotted owl HCP are: (a) silvicultural activities of $8,462,500; (b) administration costs (resource management, roads and road maintenance, monitoring, computer analysis, field verification) of $10,375,000; and (c) forest land set asides and dispersal habitat rotation adjustments (longer and shorter rotations) of $25,000,000.

- Additional trees which will be left standing after harvest of a particular unit, as required by the HCP Amendment, will have an estimated value of $7,920,000.

- Additional monitoring functions under the HCP Amendment, to verify that the habitat management obligations of Murray have been satisfied and to validate the assumptions of the HCP, will cost approximately $5,000,000.

- The current cost estimate to Murray for completing this HCP Amendment is $500,000.

The foregoing additional costs attributable to this HCP Amendment total approximately $48,000,000 and do not include additional administration costs beyond those set forth in the original spotted owl HCP. Murray believes the administration costs of this Amendment will be adequately covered by the administration cost estimate of the original spotted owl HCP and by the additional monitoring costs included in the estimates for this HCP Amendment. Like the original spotted owl HCP, this estimate also excludes the costs of future market fluctuations and changing product requirements or obsolescence over the term of the HCP Amendment, none of which can be predicted with reasonable certainty. All other projections are based on Murray's long experience in the timber industry and on currently available valuations and cost information affecting Murray, in particular, and the industry as a whole, applied over the first 50 years during which the HCP Amendment will be in effect. Beyond 50 years, management costs cannot be responsibly estimated despite Murray's active business experience in this industry since the early days of this century.

As with the original spotted owl HCP under which Murray now operates, a lengthy history of successful business operations stands behind Murray's commitment to carry out all of the management measures required by this HCP Amendment. Murray's ability to continue successful operations, together with the value of its land and forest, assures payment of the required costs and implementation of the additional habitat management requirements. Like the original spotted owl HCP, this HCP Amendment will become a covenant binding on the land, as well as a contractual obligation of Murray. The covenant will be binding on any successor to Murray as the landowner over the next 100 years. While Murray believes its earnings from timber operations will support the requirements of the original spotted owl HCP and the requirements of this Amendment, this projection is subject to the inherent risks of the business, market conditions, natural calamities and other factors within the contemplation of *force majeure*.

While the costs and risks associated with Murray's investment in this HCP Amendment are very substantial given the size, location and condition of Murray's forest lands, Murray believes its investment is justified and that the requirements of this HCP Amendment can be satisfied given the new "certainty" approach recently adopted by the U.S. Department of the Interior. This investment and long-term commitment by Murray relies upon the assurances that no additional land restrictions or financial obligations will be required from Murray beyond the activities and restrictions set forth in this HCP Amendment, except in unforeseen or extraordinary circumstances as provided in the Implementation Agreement.

9.0 EFFECTS OF THE AMENDMENT ON THE RESOURCES OF THE AREA

9.1 Watershed Analysis

The primary habitat protection element of the HCP Amendment is the protection of late-successional forest in no-harvest reserves. Murray will dedicate 10 percent of the vegetated area of the tree farm to the development and maintenance of these reserves. Most reserves are expected to be located in riparian areas, with exact locations determined using site-specific prescriptions from Watershed Analysis. The 10 percent target may be exceeded in some WAUs and not met in others, but the average over the entire tree farm will be at least 10 percent. If, after completing all assessments, less than 10 percent of the ownership is set aside in reserves, the difference will be made up by designating additional reserve areas which would provide benefit to fish and/or wildlife resources.

To estimate the location and distribution of future reserves on the tree farm, results of the two completed Watershed Analyses for Connelly Creek and East Fork Tilton River were analyzed. Total acreage restricted from harvesting averaged 10.4 percent of Murray ownership in the two WAUs (Figures 9-1 and 9-2). Prescriptions for the rest of the tree farm resulting from Watershed Analysis are expected to be similar.

Protection by water type in the Connelly and East Fork Tilton WAUs includes a 100-foot average reserve on both sides of all DNR Type 1, 2 and 3 streams and riparian reserves as necessary to protect channel stability on 59 percent of Type 4 streams and 23 percent of Type 5 streams (Table 9-1). The 100-foot reserve on all DNR Type 1, 2 and 3 streams will be prescribed for all WAUs under the HCP Amendment. Protection for Type 4 and 5 streams in other WAUs will vary depending on local conditions.

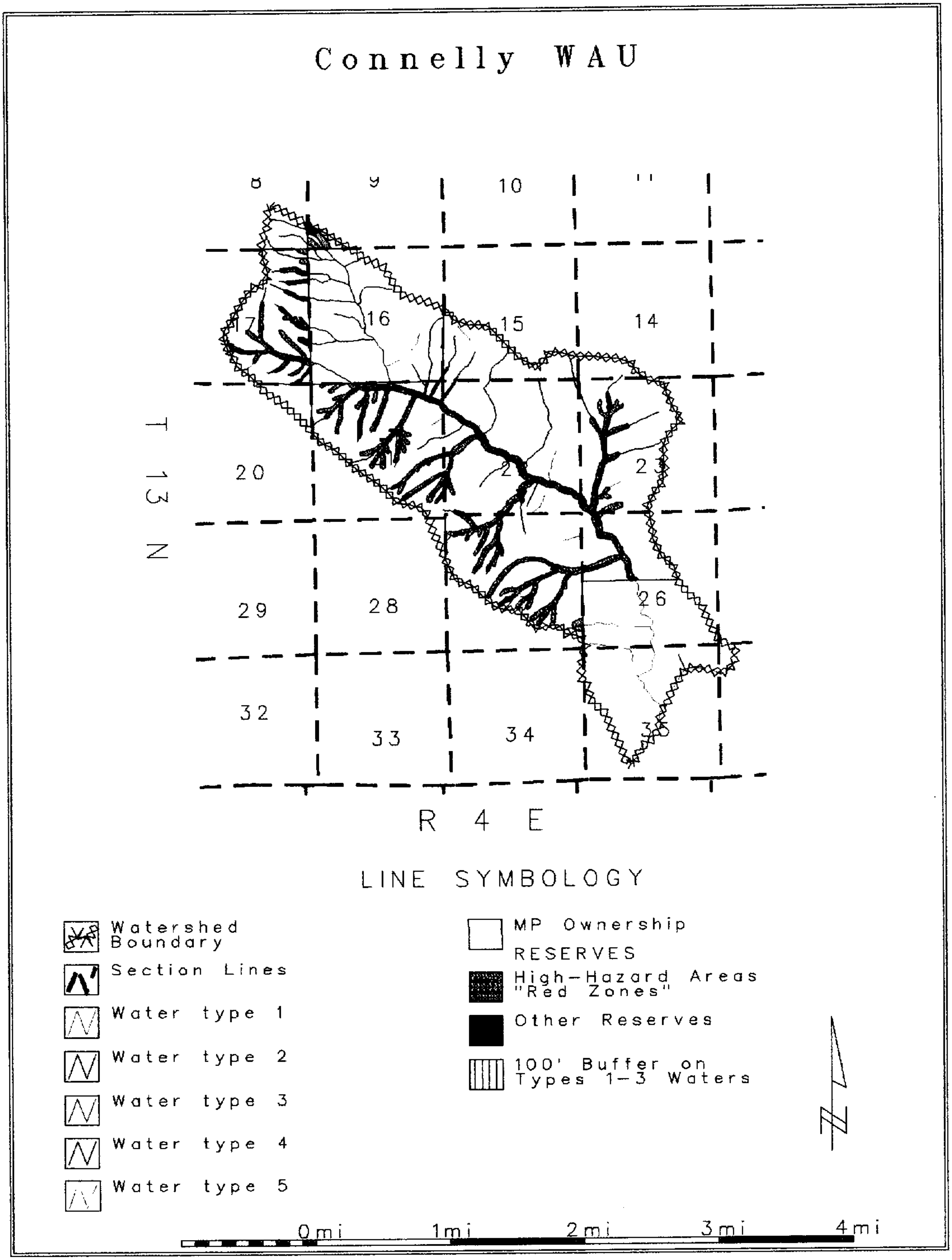

Figure 9-1. Connelly Creek Watershed Analysis reserve location map.

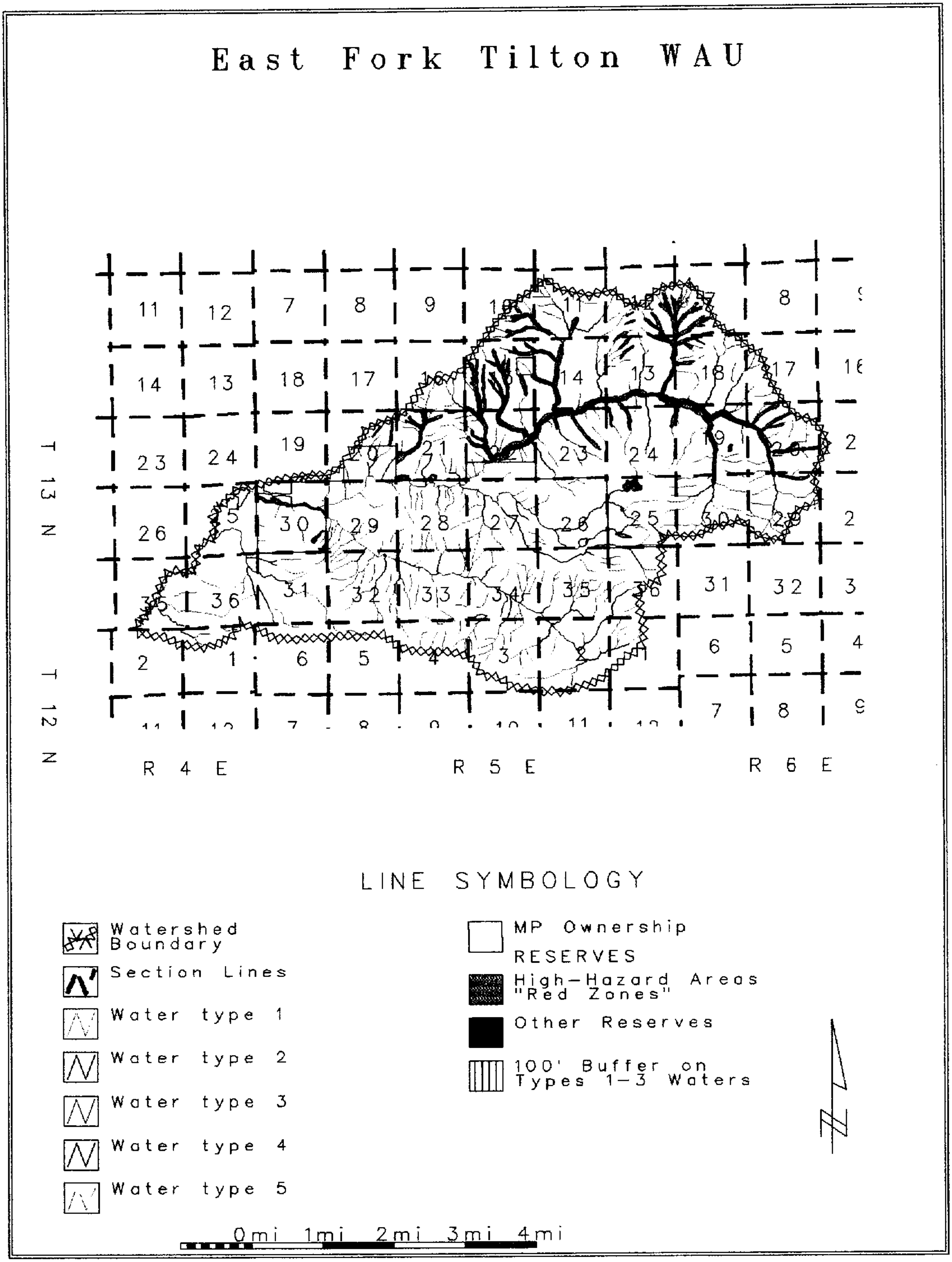

Figure 9-2. East Fork Tilton Watershed Analysis reserve location map.

Table 9-1. Streamside protection prescribed as a result of Watershed Analysis in the Connelly Creek and East Fork Tilton River WAUs.

	Percent of total stream length on the tree farm protected by forested riparian buffer		
DNR Water Type	East Fork Tilton River (%)	Connelly Creek (%)	Combined (%)
Type 1	100	100	100
Type 2	100	100	100
Type 3	100	100	100
Type 4	50	69	59
Type 5	21	50	23

9.2 Surface Water Resources

The state of Washington has established surface water quality standards pursuant to Chapter 90.48 RCW (the Water Pollution Control Act) and Chapter 90.54 RCW (the Water Resources Act of 1971) to protect wildlife and human beneficial uses of water. These standards are specified in WAC 173-201A-030 through 173-201A-070. Beneficial uses intended for protection by these water quality standards include water supply, aquatic habitat and upland habitat, among others. The Washington Forest Practices Board Manual references RCW 90.48.420 regarding water quality standards affected by forest practices. RCW 90.48.420 states that, whereas the Ecology is, "*solely responsible for establishing water quality standards for waters of the state, both the Forest Practices Board and Ecology shall jointly regulate water quality issues related to silviculture in the State of Washington.*" As a result, WAC 173-202 to protect Water Quality (Washington Forest Practices Rules and Regulations) was jointly developed and adopted by the Forest Practices Board and Ecology so compliance with Forest Practices Rules and Regulations would achieve compliance with water pollution control laws. Furthermore, the Forest Practices Act, and the regulations adopted thereunder related to water quality protection, shall be utilized to satisfy the planning and program requirements of Sections 208, 209 and 305 of the federal Clean Water Act, as they regard silvicultural activities. In addition to Forest Practices Rules and Regulations, the Watershed Analysis process results in further management prescriptions which help to avoid or minimize detrimental impacts to water quality and to beneficial uses, including habitat.

Water quality in forest streams and water bodies is strongly linked to the surrounding forest watershed. Attributes of the forest which support water quality-related habitats can be described and analyzed as separate functions. For example, riparian vegetation strengthens streambanks and filters dispersed surface water entering the streams (thereby reducing the potential for sediment input to streams and affecting water quality and habitat values). Other riparian functions include: a) supplying woody debris which can stabilize and improve stream channel structure, thereby slowing water passage and improving water quality; and b) shade, which directly influences water temperature.

Most of the lake and wetland systems encountered on the Mineral Tree Farm are associated with streams. Therefore, support of stream water quality functions will, in large part, maintain beneficial uses related to water quality in wetlands and lakes as well. Some of the provisions of the HCP Amendment are targeted specifically to wetlands and lakeshores, and those are analyzed as well for water quality enhancement potential.

9.2.1 Water Quality Functions

Sediment Control

The shrub and overstory riparian, wetland and lakeshore vegetation retained and grown in reserves will enhance bank stability and buffer water resources from fine sediments carried in dispersed surface flows. Trees and shrub root systems hold soils in place and thereby help reduce erosion which can degrade water quality and aquatic habitat. Since the root systems of trees growing immediately adjacent to the channel generally have the greatest influence on bank stability, adverse impacts can be minimized by retaining a root system adjacent to the channel edge.

Vegetated buffers have been reported to reduce nutrient and fine sediment loss after clearcutting and slash burning (Synder et al. 1975). Riparian vegetation also can help prevent pollutants such as pesticides and herbicides from reaching streams, because many of them adhere to and are removed with fine sediments. This sediment removal function is particularly important between water bodies and runoff discharge from timber road systems, which can be a primary source of fine sediment release. The ability of vegetation to control sediment is dependent on slope and the density and texture of the vegetation or forest litter.

Fine sediment input to streams is assessed during a Watershed Analysis. A basin is evaluated to determine the erosion potential of hillslopes, the sensitivity of various areas to forest practices and the potential delivery of fine sediment to streams. Areas with particularly sensitive slopes or areas that deliver to a vulnerable resource are protected by site-specific prescriptions for that area. The

100-foot reserve is considered adequate to protect the majority of fish-bearing streams from damaging levels of fine sediments. Where necessary to protect the resource, site-specific prescriptions may require a wider buffer or reduced or a different type of harvesting activity in sensitive areas.

Nutrient Transport

Dissolved nutrients are transported to the aquatic environment primarily through shallow groundwater flow. Plants that will be protected in the riparian reserves will take up nutrients from shallow groundwater moving towards streams, and also influence stream nutrients by seasonal drop of deciduous leaves and continual drop of evergreen needles. Even a fairly narrow riparian buffer with intact vegetation has been shown to influence stream water chemistry (Lowrance et al. 1984). Because groundwater that will recharge a stream is most shallow closest to the stream, the greatest amount of plant influence to nutrients in the channel occurs fairly close to the banks.

Temperature Control

Under the HCP Amendment, Murray will conduct Watershed Analysis on 98 percent of the Mineral Tree Farm and identify any measures needed to maintain appropriate stream temperatures. The relationship between water temperature and riparian vegetation shading is a function of many parameters. Chief among them are elevation, air temperature, stream width, water depth, slope and aspect (Beschta et al. 1987). Methods for analysis and protection of stream temperatures through control of shading have been formalized in the 1992 Washington Watershed Analysis protocols. The protection of riparian reserves will provide protection for temperature control while the Watershed Analysis is being completed, and the prescriptions prepared during Watershed Analysis will provide long-term protection.

Water temperature data collected during Watershed Analyses in the Connelly and East Fork Tilton WAUs found that temperatures detrimental to fish do not occur in these basins even during summer low flow below clearcuts. Existing shading and groundwater influences keep water temperatures below 64° F (18°C). Salmonids do not usually experience any detrimental effects until temperatures exceed approximately 68° F (20°C); mortality typically does not occur until 75° F (24° C). (Environmental Protection Agency 1986; Hackman and Raleigh 1982).

Large Woody Debris Recruitment

The protection and development of mature forest in the reserves will provide a source for LWD. Large woody debris is well recognized for its positive habitat and water quality influence by forming pools and waterfalls. The stream structure provided by LWD affects the transport and distribution of sediment, gravel and organic litter (an important food source at the bottom of stream food chains), and provides habitat and cover for fish and other aquatic biota. Conifer LWD decays at a slower rate than hardwood LWD (Harmon et al. 1986).

9.3 Vegetation

9.3.1 Threatened and Endangered Plant Species

No federally-listed plant species are likely to occur on the Mineral Tree Farm. Tall bugbane (*Cimicifuga elata*), which is listed as a state threatened species, is the only state-listed threatened or endangered plant species and the only federal candidate species which may occur on the tree farm. Tall bugbane is typically found in moist, shady forests at lower elevations. Suitable habitat for tall bugbane on Murray ownership would most likely occur in forest stands adjacent to streams and wetland habitat. Tall bugbane also can occur in moist stands outside of riparian and wetland buffers. However, it is expected that moist forest conditions are more likely to be found in the riparian and wetland buffers on the Mineral Tree Farm. The habitat reserves that will be designated by Murray along fish-bearing waters and around Type A wetlands, Type B wetlands, bogs and fens could provide habitat for tall bugbane and could afford the species more protection than current

Washington Forest Practice Rules and Regulations. Under the HCP Amendment, there will be no timber harvest within the reserves unless specifically prescribed to improve habitat or water quality conditions, and road building will be limited to those areas approved through Watershed Analysis. Approximately 50 percent more habitat will be protected for this species in the habitat reserves than under current forest practices.

9.3.2 State Sensitive Plant Species

The preferred habitat for five of the state sensitive species which could occur on the tree farm is also moist or wet habitat found in moist woods and along streams in lower elevations to high montane areas. Four of these species are moonworts (*Botrychium lanceloatum, B. lunaria, B. montanum, and B. pinnatum*), most of which are suspected to occur in mid- to high elevation areas. The USFS has included each of the moonworts on the Regional Forester's Sensitive Species List. Three of the moonworts are known to occur on the Randle District, and the fourth, *B. montanum*, is suspected to occur there. The small-flowered trillium (*Trillium parviflorum*) is most likely to occur in moist woods along lower elevation streams on the Mineral Tree Farm. Although listed as sensitive by the state, the small-flowered trillium is not included on the USFS Regional Forester's List for Region 6. Each of these species could be provided additional protection under the HCP Amendment because of the designation of habitat reserves adjacent to fish-bearing streams, Type A wetlands, Type B wetlands, bogs and fens. Moist stands outside of the stream and wetland habitat reserves will not receive additional protection under this proposal.

Two state sensitive species which are likely to occur in the vicinity of the tree farm prefer open areas. The common blue-cup (*Githopsis specularioides*) is the most likely of these two species to occur on the tree farm. There are documented observations of common blue-cup on adjacent USFS lands. Its preferred habitat is open, dry areas in the lowland and foothills. Tall agoseris (*Agoseris elata*), suspected to occur on the Randle District, is found in meadows and open forest stands from low to mid-elevations. Management of the tree farm under the HCP Amendment will not alter the level of protection afforded these species under current Forest Practices Rules and

Regulations. Both species prefer upland habitats which are the focus of intensive forestry under both the original spotted owl HCP and the HCP Amendment.

Two state sensitive species which occur in mature coniferous forests, pine broomrape (*Orobanche pinorum*) and fringed pinesap (*Pleuricospora fimbriolata*), have been documented on the Randle District and could likely occur in suitable habitat on the tree farm. Both species are saprophytic. The HCP Amendment management strategy is not likely to provide additional protection to these two species, since their preferred habitat is older coniferous stands. Although a few recent observations of fringed pinesap have documented this species to occur along stream margins, its habitat is not widely recognized as riparian. However, depending on stand structure, especially understory composition, the reserves may provide a limited refuge for these two species.

Curved woodrush (*Luzula arcuata*) and Mt. Rainier lousewort (*Pedicularis rainierensis*) are two state sensitive species which could possibly occur in open rock or alpine areas at or above timberline or open coniferous forest above 4,000 feet elevation on the Mineral Tree Farm. As these two species would most likely occur in habitats which support little or no harvestable timber, the HCP Amendment would have minimal effect on them. Only 2,440 acres of forest occur above 4,000 feet in elevation on the tree farm.

9.4 Fish

Murray's development of specific watershed plans for the nine WAUs in the Mineral Block should provide substantial benefits to aquatic, riparian and wildlife habitat included in each basin on Murray Pacific ownership. Management prescriptions should result in reduced hillslope failures, improved water capture and drainage and reduced direct entry of sediment from road surfaces into nearby streams, thereby reducing input of coarse and fine sediment to stream channels. Water quality also should be improved and the potential for catastrophic channel events should be reduced. Riparian buffers averaging 100 feet around fish-bearing waters should result in increased input of large woody debris to streams, improving channel roughness and the ability to capture spawning gravel, increasing the frequency and quality of pools and providing additional cover for fish. Aquatic habitat diversity also should be increased with direct improvement of fish production and the conservation and enhancement of all aquatic habitats.

Road maintenance measures, future hillslope management activities and no-harvest riparian buffers could have immediate benefits to stream channels and associated habitats. The restoration of watersheds, including options for enhancement measures, could readily be a 50- to 100-year process in regard to growth of riparian buffers in areas where they have been previously harvested.

A long-term monitoring program under development by Murray will include an evaluation of the effects and benefits of prescriptions derived during Watershed Analysis. Monitoring in each WAU will take place at least every 5 years in association with future Watershed Analyses. Particular attention will be paid to sediment production, mass-wasting frequency and road surface erosion, LWD input, fish habitat characteristics, fish use of streams on the tree farm and channel stability. Monitoring of stream temperature and water quality parameters also will continue as described in Section 7.1.

Riparian Protection Zones and Reserves

Under the HCP Amendment, Murray will designate temporary riparian protection zones averaging 100 feet in width along both sides of DNR Type 1, 2 and 3 streams and 50 feet in width along both banks of the first 1,000 feet of selected Type 4 streams (see Section 5.3). Permanent riparian reserves will be designated during Watershed Analysis. Riparian reserves should provide long-term benefit to all fish species which have evolved to exist in cold mountain streams. Short-term benefits include maintaining existing shade characteristics with a continued increase in overhead cover development. Insect populations should stabilize and increase as trees re-establish in cleared areas. Sediment input should slow as vegetative material stabilizes creek banks. Riparian buffers serve a variety of channel forming functions by enhancing bank stability, reducing delivery of fine sediments and providing for the recruitment of LWD. Riparian buffers also provide a source of nutrient inputs needed for a healthy riparian ecosystem. By retaining a corridor of trees along a stream during harvest operations, many of the functions of an intact streamside forest can be continued to lessen or prevent the impact of timber harvest on fish resources.

The average 100-foot no-harvest riparian buffer around fish-bearing streams, and site-specific buffers developed for non-fish-bearing streams, are expected to provide as much shade, bank stability, reduction of fine sediment and nutrient input on the tree farm as the site potential tree height distance suggested by the Forest Ecosystem Management Assessment Team (FEMAT) and others. LWD input should slowly increase to a level exceeding 90 percent of that found in mature coniferous forests (McDade et al. 1990).

Large Woody Debris (LWD)

Large woody debris forms pools and other important fish rearing areas, controls sediment and organic matter storage, modifies water quality, provides food and shelter from predators and stream flow and influences channel structure and development of side channels (Bisson et al. 1987; Lisle and Kelsey 1982; Keller and Swanson 1979; Swanson et al. 1976; Heede 1972). Logs can widen or deepen a channel, store sediment or cause meanders, cutoffs and secondary channels that are frequently used for salmon spawning and rearing (Hogan 1986; Sedell and Swanson 1984; Sedell et al. 1982; Keller and Tally 1979). Loss of LWD in streams has lead to decreased pool frequency and pool volume, reducing the carrying capacity of the stream (Bilby 1984; Bisson and Sedell 1984; Teows and Moore 1982). The shift in stream habitat composition may favor young-of-year steelhead, coho and cutthroat at the expense of older age classes (Bisson et al. 1987). In small channels, LWD can serve a dominant channel-forming role and provides abundant sediment storage sites. On these small channels, removal of the LWD would change the basic morphology of the channel. In channels which are significantly wider than the height of mature trees, LWD has little effect on pool formation.

LWD Recruitment

Most LWD input occurs within 100 feet of a stream channel. McDade et al. (1990) found that 90 percent of the mature coniferous LWD in a stream channel comes from within 28 meters (92 feet) of the stream. They found approximately 53 percent of the conifers ending up in the stream originated within 10 meters (33 feet) of the stream, and approximately 80 percent originated within 20 meters (65 feet) of the stream. No hardwoods were contributed from distances greater than 25 meters (82 feet) from the stream, and only a few conifers reached the stream at distances greater than 45 meters (148 feet).

However, stream channels migrate and trees a great distance from the existing channel may be important LWD sources in the future. This is not likely to occur on the tree farm due to the steep, confined nature of most of the stream channels. Only 9.9 percent of the tree farm is in low-gradient, unconfined channels (Table 4-4). Most of this channel type (58 percent) is located in the North Fork Swamp at the top of the Mineral and North Fork Mineral WAUs, and is not likely to migrate. The remainder is found in the lower East and West Fork Tilton Rivers. Some channel migration is possible in these areas but would likely be minimal based on the presence of roads and other bank-protecting features in the vicinity of the streams.

Many years of growth will be required to develop mature riparian stands in areas where past harvest occurred near stream margins. Large woody debris input will remain low until mature tree stands develop and begin falling into the river. Within 20 to 30 years after harvest, trees will begin to reach the 4-inch dbh class. Trees of this size provide some fish habitat function in the channel (Washington Forest Practices Board 1993b). True channel-forming wood probably will not be available for another 100 years (Heimann 1988; Murphy and Koski 1989). Grette (1985) states that significant amounts of conifer LWD do not enter a stream until a stand reaches 120 to 150 years old. Long-term benefits should accrue as trees in the no-harvest areas mature and begin supplying LWD to the channel. All target fish species should benefit from this process.

Bank Stability

Mass-wasting events or failure of a stream bank can contribute excessive amounts of fine sediment to a stream or contribute to debris slides and debris flows. Root strength provided by trees and shrubs contributes to bank stability, especially in areas with steep slopes. By eliminating harvest within areas adjacent to a stream, root strength is maintained, reducing the incidence of debris slides and flows (Sidle et al. 1985). The contribution of tree root strength to maintaining streambank integrity declines at distances greater than one-half the crown diameter of a tree (Burroughs and Thomas 1977). Providing a no-harvest buffer zone maintains root strength and will reduce the incidence of mass wasting events in low-order stream riparian areas.

Bank stability issues are addressed during Watershed Analysis. Areas with unstable slopes are defined and designated no-harvest reserves if believed necessary to protect fish resources or public works projects downstream. The riparian protection provided for all fish-bearing waters, and those non-fish-bearing waters with unstable banks, is expected to provide benefits similar to measures developed under FEMAT guidelines.

Nutrients

Leaves, needles, twigs and branches contribute much of the organic matter that is readily available for processing by organisms in forested streams (Sedell et al. 1974). Organic matter is a source of nutrients for communities of algae and diatoms. Some aquatic insects feed on the algae and diatoms, while other insects feed directly on organic particulate matter (Murphy and Meehan 1991). Fish populations are supported by both aquatic insects and by terrestrial invertebrates that fall into the stream.

Organic matter must first be retained in the channel before it can be processed and become part of the food web of a stream. Large woody debris plays a major role in the retention of organic matter, which may be more important than substrate size in determining the abundance of invertebrates (Harmon et al. 1986). Without the debris jams and other complex channel features, organic matter flushes through a channel, reducing the opportunity for nutrient cycling. By retaining organic matter and nutrients within stream areas with complex LWD, spiralling lengths are decreased, thus increasing the energy available to invertebrates and potentially to fish (Cummins 1974).

The delivery of organic material to a stream is primarily contributed by trees within the immediate vicinity of the stream (Forest Ecosystem Management Assessment Team 1994). With 100 percent of fish-bearing waters and an estimated 59 percent of permanent non-fish-bearing waters surrounded by riparian buffers under proposed management measures, organic material input should remain more than adequate for fish resources within and downstream of the tree farm.

Shade

The amount of shade provided by tree canopy closure can warm up or cool down stream water temperature. Where increased exposure to sunlight results in excessive water temperature, the density and species composition of the fish community may change. Increased water temperature may alter the biological processes of fish including timing of fry emergence, juvenile outmigration, adult migration and spawning.

The overall effectiveness of riparian tree canopy closure in providing shade varies with topography, channel orientation, extent of canopy opening above the channel and structure of the riparian forest. Within 1,000 feet of relatively uniform canopy closure, water temperatures should reach equilibrium with ambient air temperatures (Sullivan et al. 1990). The size of a stream is inversely related to the influence of potential tree canopy closure; streams over 100 feet wide under low flow conditions are only marginally influenced by the amount of tree canopy closure in riparian areas. Small streams are directly affected. Type 4 tributaries contributing 20 percent of the flow to a Type 1, 2 or 3 water can have a significant influence on local stream water temperatures in fish-bearing waters (Caldwell et al. 1991).

Riparian buffer widths of 100 feet or more were reported by Steinblums (1977) to provide as much shade as undisturbed late-successional and old-growth forests in the western Cascade Mountains. A generalized curve, prepared by the Forest Ecosystem Management Assessment Team (Forest Ecosystem Management Assessment Team 1993), indicated a riparian buffer width of one tree height provided nearly 100 percent functional shade effectiveness to stream processes. Most Type 1 through 3 stream reaches on lands addressed by this HCP Amendment are less than 100 feet wide under low flow conditions and are significantly influenced by the amount of tree canopy closure. Proposed buffers averaging 100 feet in width should provide temperature protection for fish-bearing waters. Providing a 50-foot buffer along larger Type 4 reaches for 1,000 feet upstream of Type 3 streams should provide shade and mitigate temperature impacts associated with timber harvest near non-fish bearing waters. Although riparian buffer zones are not proposed for all Type 5 streams, these reaches may be dry during late summer months when stream temperatures are critical. Loss of shade in these reaches should not significantly impact downstream water temperatures.

Water temperature data collected during Watershed Analyses in the Connelly and East Fork Tilton River WAUs found that temperatures detrimental to fish do not occur in these basins even during summer low flow below clearcuts. Existing shading and groundwater influences keep water temperatures below 64° F (18°C). Salmonids do not usually experience any detrimental effects until temperatures exceed approximately 68° F (20°C); mortalities may start to occur at 75° F (24° C) (Environmental Protection Agency 1986; Hackman and Raleigh 1982). Riparian shade conditions should continually improve over those evaluated during Watershed Analysis. At the same time, reserves over 100 feet wide are not expected to offer any additional thermal protection from peak summer temperatures.

No Harvest Within 20 Feet Above Ordinary High Water Mark

Dam-break floods and debris flows damage fish habitat, primarily by burying existing habitat, filling pools with sediment and reducing channel complexity. Effects may be long term, and may last for decades if LWD is carried away and no new sources are available (Murphy and Koski 1989). Slopes exceeding 73 percent (36 degrees) are often unstable and vulnerable to mass wasting (Chatwin et al. 1994). Debris flow initiation is generally confined to steep DNR Type 4 or 5 streams (Benda 1988). Dam-break flood flows rarely transport materials in excess of 20 feet in height (Coho 1993). Large barrier trees left in these riparian areas are expected to help reduce the propagation of dam-break floods and associated debris torrents.

Benefits to fish resources result from reducing the possibility of habitat degradation. Within the run-out zone, these events may reduce in-channel LWD levels, remove standing trees in the immediate riparian area, decrease pool frequency and size, scour and remove spawning gravel, eliminate channel features likely to trap spawning gravel in the future, destabilize stream banks and bury or displace fish. Chronic effects in the run-out zone may include reduced channel and habitat complexity, reduced macroinvertebrate populations and potentially increased stream temperatures. Downstream in the depositional area, fish habitat also can be affected. Large amounts of deposited sediment can cause widening of the channel, stream bank instability, redd burial, sub-surface stream flow, increased deposition of fine sediment (<.085 mm), pool filling, reduced macroinvertebrate populations and increased stream temperatures. Therefore, reducing the initiation and propagation of dam-break floods will have a direct long-term benefit to fish production by stabilizing habitat conditions.

9.5 Wildlife

9.5.1 Wildlife Habitat

The Mineral Tree Farm contains forested habitats in a variety of seral stages that range from clearcut to old-growth coniferous forest (Figure 4-3). The amount and distribution of each seral stage will change over the term of the HCP Amendment, and the change will be somewhat different from the original spotted owl HCP because of the designation of the reserve areas under the

Amendment. A minimum of 10 percent of the vegetated area of the tree farm (4,900 acres) will be dedicated to permanent forest reserve. This will include the 1,222 acres of forest reserves identified in the original spotted owl HCP. The reserves will lie primarily along streams (Figures 9-1 and 9-2).

After an initial decline in older forest on the tree farm during the first decade, the general trend will be an increase in the total area of old-growth, and large sawtimber forest, an eventual decrease in the total area of small sawtimber and relatively constant amounts of pole, sapling, seedling, mixed and hardwood forest (Figures 9-3 and 9-4). Between 1994 and 2094, the total area of coniferous forest greater than 100 years old will almost double (from 2,834 acres to 4,900 acres). Most of the older forest in 2094 will be in the 101- to 250-year age class, but an estimated 494 acres of old-growth (250 years and older) will still remain. Under the original spotted owl HCP, the total area of forest over 100 years old in 2094 would be 2,407 acres, and the portion of that in excess of 250 years old would be 302 acres. The net increase in forest over 100 years old under the HCP Amendment (as compared to the original spotted owl HCP) will be 2,493 acres. The net increase in forest over 250 years old will be 192 acres.

The distribution of habitat types under the HCP Amendment will be comparable to the original spotted owl HCP, with the addition of the older forest in riparian and wetland reserves. The spatial requirements of the HCP for spotted owl dispersal landscape will be met under the HCP Amendment, and comparable Dispersal Landscape Index (DLI) scores will be obtained. Within the various forest types that will be present on the tree farm under the HCP Amendment, wildlife habitats will be created or determined by the size, shape and spacing of stands and by the structural conditions within each stand. Of particular importance to wildlife are the amount of interior forest, the amount of edge between forest types, the amount of riparian forest, the amount and type of wetland habitat and the structural habitat components contained within all forest types, particularly snags and logs. Each of these habitat features is considered separately.

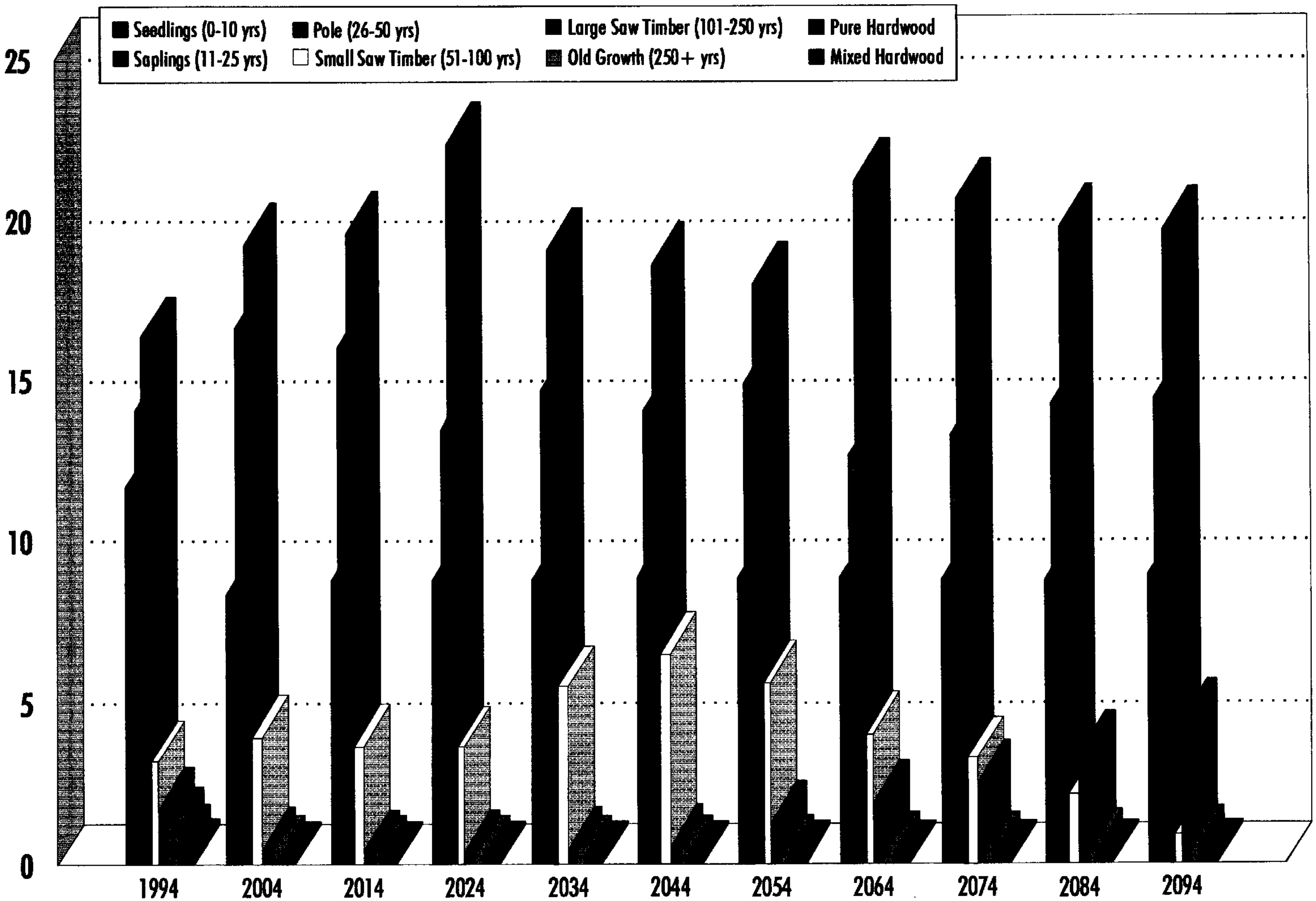

Figure 9-3. Projected trends in forest habitat types on the Mineral Tree Farm under the Amended HCP.

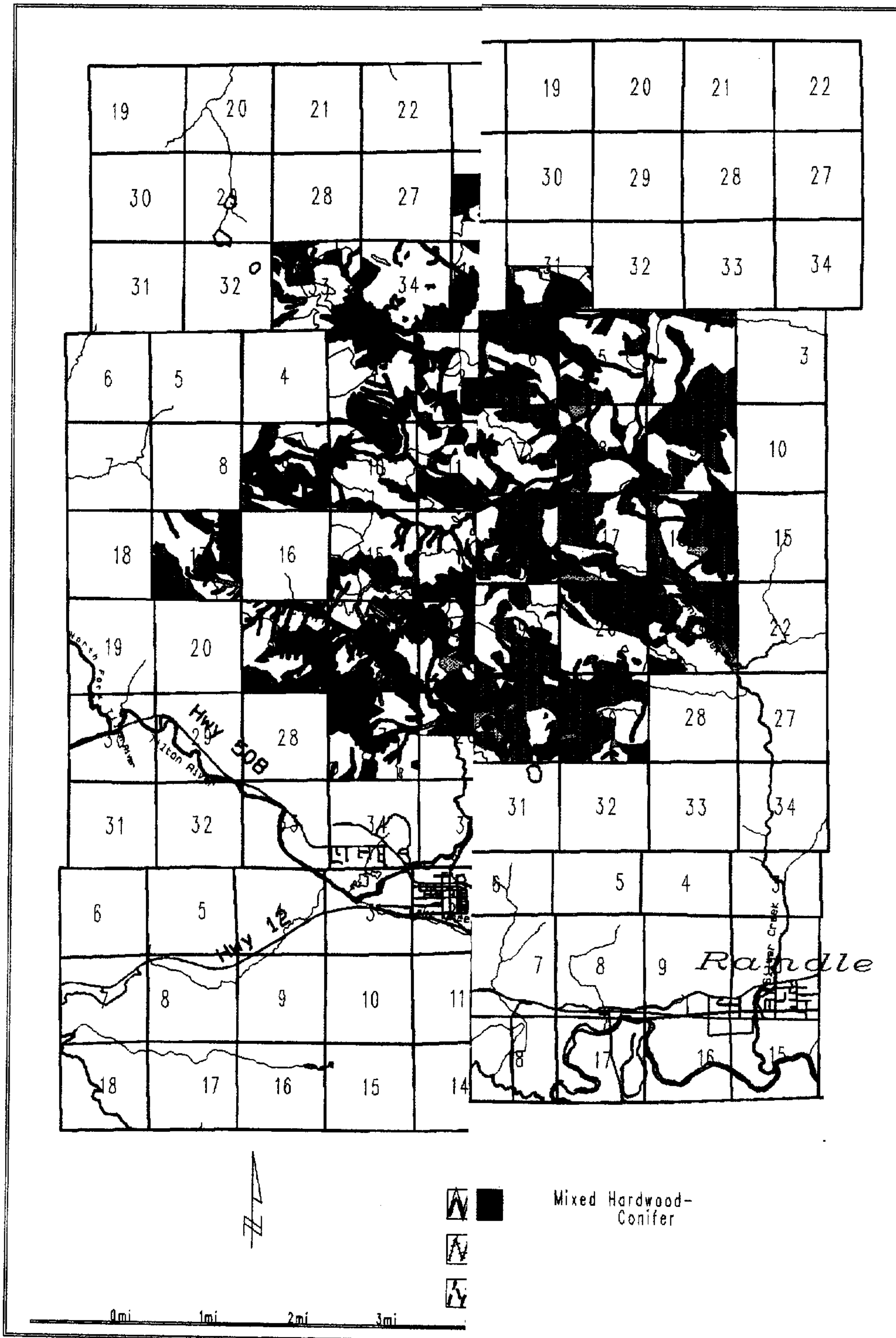

Figure 9-4. Projected distributicdment.

Interior Forest Habitat

Interior forest habitat was defined in the original spotted owl HCP as forest meeting at least the minimum definition of dispersal habitat and lying more than 200 feet from non-forest habitat or early-successional forest. The actual distance into a stand that is influenced by the edge will vary with the specific site location and the species being considered (Yahner 1988; Wilcove 1985; Brown 1985). Rosenberg and Raphael (1986) found that most interior forest species in their study were at least weakly associated with stand size, and some interior forest species were not present in stands smaller than 50 acres. Most species associated with interior forest have been found to make at least limited use of the edge as well, but few have been found using the adjacent non-forest habitat (Rosenberg and Raphael 1986; Strelke and Dickson 1980). The amount of interior forest within a stand depends on the size and shape of the stand; larger stands generally have more interior forest in relation to edge.

There are currently 5,336 acres of interior forest habitat on the Mineral Tree Farm. The amount of interior forest is expected to increase to approximately 10,365 acres by the year 2094. The interior forest will occur in smaller stands, as large stands will be broken up to develop the spotted owl dispersal matrix described in the original spotted owl HCP. The smaller stands may reduce the density of some species that require large patches of interior forest, except in some cases where they directly abut permanent riparian reserves or adjacent Forest Service lands. The amount and distribution of interior forest habitat will not differ significantly between the original spotted owl HCP and the HCP Amendment.

Forest Edge Habitat

The edge between different habitat types has been recognized to benefit many species by providing a greater structural diversity than is present in a single habitat type (Leopold 1935; Thomas 1979; Brown 1985; Clarke 1954; Strelke and Dickson 1980). Which species will benefit, and to what degree they will benefit, depends on the type of edge that is present, the size of the stands creating the edge and the amount of edge on the landscape (Kremsater and Bunnell 1992; Brown 1985).

The effective width of influence an edge will have on the adjoining habitats will vary depending on the physical characteristics of the site and the species being considered (Yahner 1988; Wilcove 1985; Brown 1985). Edge is the interface or ecotone between forest that meets or exceeds the criteria for spotted owl dispersal habitat and young forest stands that are 0 to 10 years of age. All habitat within 200 feet of the interface is considered edge habitat. Currently there are 4,410 acres of edge habitat on the Mineral Tree Farm. The amount of edge will increase through the term of the HCP, until there are an estimated 6,953 acres of edge habitat in the year 2094. The increase in edge habitat should benefit those species able to utilize this habitat condition. Those species that require larger amounts of interior forest habitat, or are not able to cross unforested areas to disperse, will not benefit by the increase in fragmentation that will accompany the increase in edge. The amount and distribution of edge habitat will not differ significantly between the original spotted owl HCP and the HCP Amendment.

Riparian Forest Habitat

Riparian zones are transitional between aquatic and upland zones, and as such they contain elements of both aquatic and terrestrial ecosystems (Brown 1985). Riparian zones are complex areas due to the many combinations of gradient, aspect, topography, soil, type of stream bottom, water quality, elevation and plant communities that exist there (Odum 1971). In coniferous forests, riparian zones frequently produce several strata of vegetation, providing many diverse habitats and edges in a small area, making them a critical source of diversity within a forest ecosystem (Thomas et al. 1979). The riparian zone itself, being elongated in shape, has a very high edge-to-area ratio (Odum 1971) and being distributed throughout a watershed, interfaces with many other habitat types (Brown 1985), further increasing the amount of edges important to wildlife (Thomas et al. 1979).

Riparian zones typically make up a minor proportion of the total landscape, but are disproportionately more productive and provide more habitat niches than any other type of habitat, making them very important for wildlife use (Brown 1985; Thomas et al. 1979). The effect of riparian zones is not limited to wildlife directly dependent on these zones; wildlife in adjacent areas are strongly influenced by the presence and quality of the riparian zone, utilize them as preferred habitat during certain seasons of the year, or use them as travel corridors, or as a source of drinking water (Thomas et al. 1979; Stevens et al. 1977; Taber 1976; Tabor 1976).

The designation of permanent no-harvest reserves averaging 100 feet in width along both sides of DNR Type 1, 2 and 3 streams and lakes, DNR Type A and B wetlands, bogs and fens will be beneficial to a variety of wildlife species. In addition, many Type 4 and 5 streams will be completely or partially buffered by permanent riparian reserves averaging 50 feet in width as determined by Watershed Analysis. The two Watershed Analyses that have been completed so far indicate that an average of 59 percent of Type 4 streams (permanent, non-fish bearing streams) and 23 percent of Type 5 streams (intermittent or seasonal streams) will be protected by riparian buffers (Table 9-1).

Riparian zones are among the most heavily used wildlife habitats occurring in forest lands of the Pacific Northwest, supporting an estimated 359 wildlife species during some seasons or parts of their life cycles (Brown 1985). Of 248 species of vertebrates that could potentially occur on the Mineral Tree Farm (Appendix A), 123 species are predicted to be favorably affected by riparian reserve functions, and another 58 non-riparian species should benefit from late-successional forest provided by riparian reserves. Most of the special-status species on the tree farm should benefit directly or indirectly from riparian forest reserves that will continue to mature over the term of the HCP Amendment.

Riparian forest can be defined in a number of ways, depending upon the criteria used and specific site conditions. For the purpose of this analysis, it will be assumed that all forested habitat within an average of 100 feet on either side of DNR Type 1 through 4 streams and around lakes and DNR

Type A and B wetlands will be considered riparian forest. On the Mineral Tree Farm as a whole, there are 4,215 acres of timberland that lie within 100 feet of Type 1 through 4 streams, and DNR Type A and B wetlands, bogs and fens. Of the 4,215 acres, an estimated 3,197 acres will be protected in the reserves and will eventually develop into mature riparian forest. As of 1994, approximately 142 acres within reserve areas are occupied by forest that is over 100 years old, and approximately 1,577 acres meet the minimum definition of spotted owl dispersal habitat. Within 30 years (by the year 2024), most if not all of the forest in reserves will be dispersal habitat. By the end of the HCP Amendment (through 2094), all of the reserve forests should be at least 100 years old unless natural disturbances create new forest openings (Figure 9-5).

Riparian zone species could benefit from the additional acres of riparian zone habitat provided by the HCP Amendment compared to requirements of the current Forest Practices Rules and Regulations. Current Forest Practices Rules and Regulations require the retention of specified numbers of trees along streams, but they do not require no-harvest reserves of the type prescribed in this HCP Amendment. The amount and type of riparian forest habitat will be significantly greater under the HCP Amendment. The riparian zones will provide habitat for most forest species, but may not meet the habitat requirements of some species that require larger areas of interior late-successional forest habitat.

Non-Forested Wetland Habitat

The number and acreage of non-forested wetlands will not change under the HCP Amendment, but the quality of wetland habitat for wildlife will improve. All DNR Type A and B wetlands, bogs and fens will be protected from disturbance with no-harvest buffers averaging 100 feet in width under the proposed HCP Amendment. The reserves established around these wetlands will protect riparian vegetation and promote riparian vegetation development that should control sediment delivery and provide LWD, nutrients, shade and hiding cover to the wetlands. Murray will conduct no prescribed burning within reserve areas. Currently the protected areas are made up of a variety of age classes. Providing protection zones around wetlands will allow all areas to follow

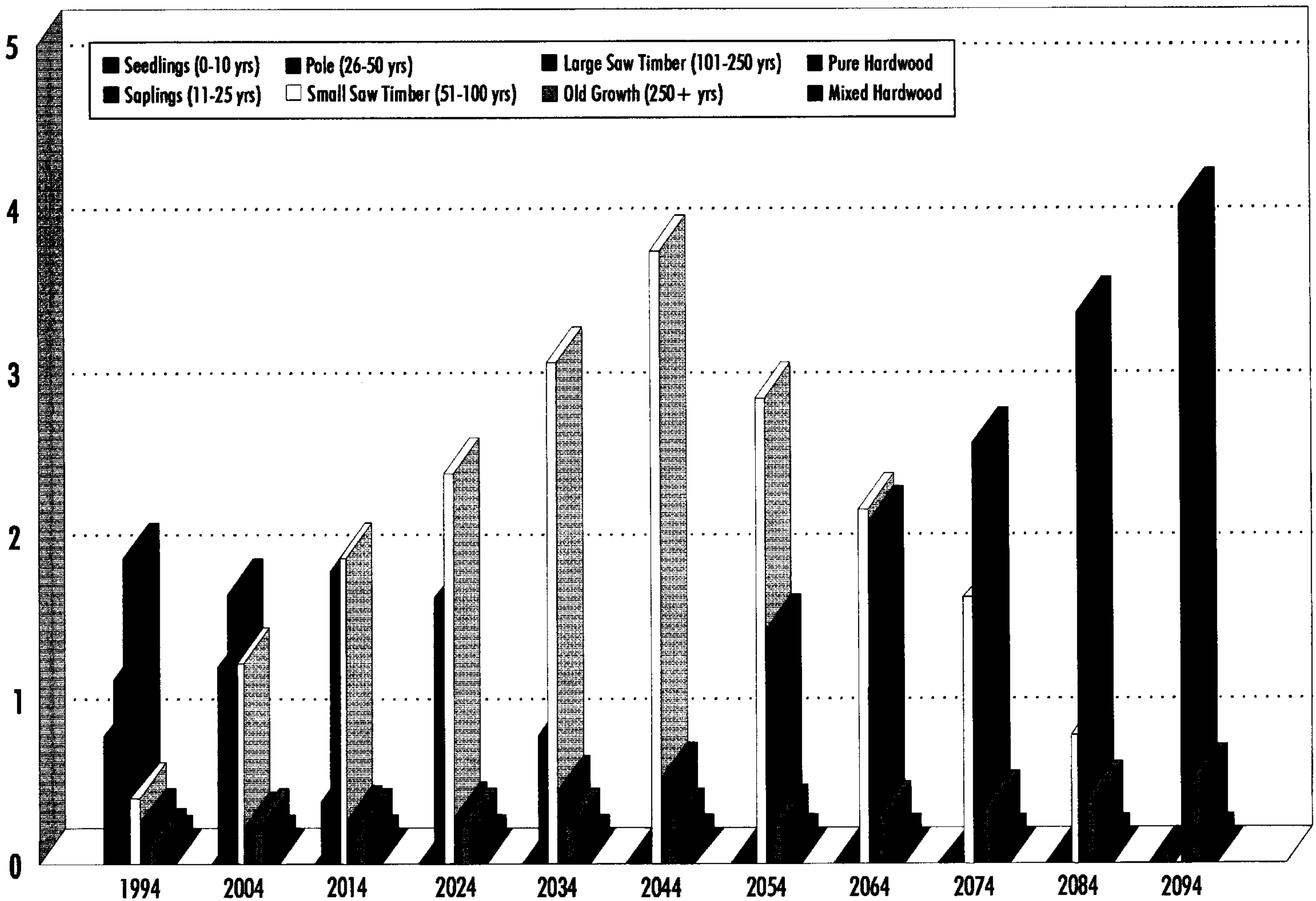

Figure 9-5. Projected trends in forest habitat types within reserve areas on the Mineral Tree Farm under the original HCP.

a natural succession of forest vegetation throughout the term of the HCP Amendment. This should provide habitat to the benefit of several wildlife species that use non-forested wetlands (Brown 1985).

Snag and Log Habitat

Murray's commitment to leaving additional larger snags and green trees in clearcuts will be beneficial for wildlife. Snags are an important structural component in forest habitat. In western Washington and Oregon, snags are used by nearly 100 species of wildlife, of which 53 species (39 birds and 14 mammals) are cavity-dependent (Brown 1985). Two species of concern for the HCP Amendment, the pileated woodpecker and the Vaux's swift, are obligate cavity-dwellers.

The additional snag habitat and green trees will be retained in an average of approximately 900 acres of clearcuts per year for the next 100 years. This additional habitat will then be available throughout the timber cycles of those acreages and will help to provide a more continuous supply of snags in these areas for the term of the HCP Amendment. The additional green trees will help insure that a more continuous supply of snags will be available for the term of the Amendment. Benefits include a continued larger supply of nests, dens, roosts, perches, foraging sites, food storage sites and courtship sites for a large number of species (Jackman 1974; Bull 1975; White and Raphael 1975; Swearingen 1977; Evans and Conner 1979; Franklin et al. 1981; McComb and Noble 1981; Brown 1985). The surrounding clearcut will grow back around the snags and live trees, resulting in a more vertically diverse forest habitat structure which will provide additional wildlife habitat benefits (Niemi and Hanowski 1984), although the number of snags available may not be enough to provide optimal conditions for all snag-dwelling species. Snag number requirements are not known for all obligate snag-dwelling species of wildlife. Table 9-2 summarizes requirements for those species where quantification exists, and demonstrates the adequacy of the HCP Amendment in providing for those requirements. The additional snags and green trees will be clumped or distributed throughout the clearcuts and have varying effects on habitat distribution, quality and quantity for individual species of concern.

Table 9-2. Snag requirements per 100 acres for selected western Washington woodpeckers, based on Brown (1985), with a comparison to snags provided by the HCP Amendment.

MINIMUM-DIAMETER CLASS (inches)	SNAG DECAY CLASS (snags/100 acres)		TOTAL SNAGS/100 ACRES NEEDED	TARGET SNAGS/100 ACRES UNDER HCP AMENDMENT
	Hard 2-3*	Soft 4-5*		
11+		Downy Woodpecker (16)	16	400
15+	Red-breasted Sapsucker (45)	Hairy Woodpecker (192)	237**	200
17+	Three-toed Woodpecker (6) Black-backed Woodpecker (12)	Northern Flicker (48)	66**	200
25+	Pileated Woodpecker (6)		6	100
TOTAL	69**	256**	325**	400***

* Decay stages after Cline et al. (1980).

** Assumes individual species requirements are additive (e.g., 192 snags/100 acres for hairy woodpeckers do not include the 45 necessary for red-breasted sapsucker).

*** Total snags are not the sum of each diameter class; smaller diameter classes have a higher target in case larger diameter classes are not available. The total target number for all classes combined is 400 snags/100 acres.

Murray's commitment to save larger snags and live trees from the dominant size classes will provide more benefit to wildlife than saving smaller trees. Those snags that remain standing the longest potentially provide the most benefit to wildlife. The rate of deterioration of snags depends upon the size of the snag; larger snags require more time to decay than small snags, break off at the ground line less often than small snags, and generally remain standing longer (Cline et al. 1980; Graham 1981; Raphael and White 1984). Greater numbers of cavity-nesting wildlife are present when large snags are available (Mannan et al. 1980; Raphael 1980). Existing snags may not be large enough to benefit all species, but the Amendment allows for the retention of the largest snags present.

Snags left standing after clearcutting will go through a steady deterioration until they eventually disappear. Green leave-trees will eventually mature and die, replacing the older snags, and will then also deteriorate. This provides a continuum of useable snags in various stages of decomposition. Since different stages of deterioration of snags provide different habitat components and benefit different species (Conner et al. 1975, 1976; Thomas et al. 1979; Cline et al. 1980; Mannan et al. 1980; Raphael and White 1984), this continuum will provide a wide variety of wildlife habitats through time. Some leave trees may be too small to replace larger snags by the time existing snags disappear, but the requirement to leave trees of the dominant size class will ensure that the largest snags available will be recruited in the future.

Some of the snags and/or green trees left in clearcuts will eventually be recruited to the forest floor as downed logs. Since any snag or green tree could fall, there will potentially be a larger number of downed logs available due to the additional retained snags and green trees. Downed logs are important components of wildlife habitat in western Oregon and Washington, providing feeding, reproductive and resting sites for 150 species of terrestrial wildlife (Brown 1985). The increased number of downed logs will provide more habitat and a greater diversity of sizes and decomposition stages of downed logs, which could increase downed log usefulness to wildlife (Maser et al. 1979). In general, logs of larger diameters and greater lengths provide better wildlife habitat than smaller logs (Maser et al. 1979).

9.5.2 Wildlife Species of Concern

The anticipated benefits to wildlife species of concern of the HCP Amendment are discussed in detail below and summarized in Table 9-3.

Columbia Pebblesnail (*Fluminicola columbianus*)
Columbia pebblesnails occur in permanent, cold, well-oxygenated rivers with cobble and boulder substrate. Riparian reserves created under the HCP Amendment are likely to improve aquatic conditions compared to the original Spotted Owl HCP.

Fenders Soliperlan Stonefly (*Soliperla fenderi*)
This species is associated with fast, cold mountain streams. Riparian reserves under the HCP Amendment will maintain or improve conditions for this species on the tree farm.

Van Dyke's salamander (*Plethodon vandykei*)
The Van Dyke's salamander is generally considered to be the most aquatic species of woodland salamander (Leonard et al. 1993). They generally inhabit streamside habitat, seepages or splash zones. Van Dyke's salamanders also have been found on upland, north-facing slopes with heavy moss cover (Leonard et al. 1993). Under the HCP Amendment, reserve areas established along streams, steep headwalls and unstable slopes will protect most of the aquatic and upland habitat of the Van Dyke's salamander. The riparian reserves also will allow movement up and down streams to suitable unharvested forest blocks. This will aid in dispersal to other drainages and watersheds. Overall, the extensive riparian protection under the HCP Amendment should improve habitat suitability and dispersal conditions for the Van Dyke's salamander population compared to the original spotted owl HCP.

Larch Mountain salamander (*Plethodon larselli*)
This salamander occurs in semi-wet, moss-covered talus slopes (>60%) with a dense canopy cover of coniferous forest up to 3,400 feet in elevation, although a few have been found in caves and lava tubes (Rodrick and Milner 1991; Leonard et al. 1993). In Skamania County, Bury and

Table 9-3. Anticipated benefits of the HCP Amendment on special-status species potentially present on the Mineral Tree Farm.

Common Name	Chance of Occurrence	Anticipated Benefits
FISH		
Bull trout	Low	Riparian buffers should improve water quality, control floods, increase LWD, improve pool depth and frequency and increase nutrients for aquatic food chain.
Olympic mudminnow	Low	Riparian buffers will provide shade, nutrients and flood control.
Mountain sucker	Low	Riparian buffers should improve water quality, improve stream channel and pool development and provide shade, nutrients and flood control.
Pygmy whitefish	Low	Riparian buffers should provide shade, nutrients and flood control and improve water quality.
Sandroller	Moderate	Riparian buffers will provide cover, shade, nutrients, flood control and pool development.
INVERTEBRATES		
Columbia pebblesnail	Moderate	Riparian buffers will reduce floods and erosion, improve water quality and increase LWD for food chain and pool development.
Fender's soliperlan stonefly	Moderate	Riparian buffers will result in improvements to stream channel and water quality.
AMPHIBIANS		
Van Dyke's salamander	Present	Riparian buffers will provide habitat and improve dispersal.
Larch Mountain salamander	Moderate	Upland and Type 5 stream reserves on steep slopes will protect some existing talus habitat.
Tailed frog	Present	Riparian buffers will improve dispersal and protect habitat along DNR stream Types 1, 2 and 3 and the majority of DNR Type 4 streams.
Northern red-legged frog	Present	Riparian buffers will provide habitat and improve dispersal.
Cascades frog	Present	Riparian buffers will provide habitat and improve dispersal opportunities along most suitable aquatic habitats.

Table 9-3. Continued.

Common Name	Chance of Occurrence	Anticipated Benefits
AMPHIBIANS Continued		
Spotted frog	Low	Aquatic habitats will be improved by riparian buffer zones.
REPTILES		
Northwestern pond turtle	Low	Riparian buffers will protect forests around ponds and increase woody debris.
BIRDS		
Great blue heron	Moderate	Riparian buffers will improve fishing success and increase retention of large trees and snags for nesting or roosting.
Harlequin duck	Moderate	Riparian buffers will improve water quality and food sources and provide LWD for loafing sites.
Marbled murrelet	Moderate[1]	Retention of old-growth trees in riparian buffers could provide potential nest sites.
Golden eagle	Present	Riparian buffers and leave tree quotas will increase the number of large trees and snags available for nesting or perch-hunting.
Bald eagle	Moderate	Riparian buffers could improve fishing success and will protect large trees and snags for nesting, perching and roosting.
Northern goshawk	Present	Riparian buffers and leave tree quotas will retain some mature and old-growth forest. Dispersal landscape matrix will probably increase grouse and hare populations.
Osprey	Moderate	Riparian buffers could improve fishing success and will protect large trees and snags for nesting, perching and roosting.
Vaux's swift	Present	Retention of old-growth trees and snags in buffer zones and leave tree areas could provide suitable nest and roost sites.

1 Surveys of the tree farm conducted according to PSG protocol determined presence but no occupancy for the marbled murrelet.

Table 9-3. Continued.

Common Name	Chance of Occurrence	Anticipated Benefits
BIRDS Continued		
Pileated woodpecker	Present	Retention of old-growth trees and snags in buffer zones and leave tree areas and downed logs will provide potential nesting and foraging sites.
Western bluebird	Moderate	Retention of snags and green trees in clearcuts will increase potential nesting sites.
Olive-sided flycatcher	Moderate	Retention of mature and old-growth forest in reserves along streams, wetlands, lakes and steep slopes will provide a steady source of nesting habitat.
Little willow flycatcher	Moderate	Riparian buffers will protect and improve wetland and riparian habitats.
MAMMALS		
Gray wolf	Moderate	Riparian buffers will likely improve prey populations along waterways. Dispersal habitat matrix is expected to increase prey abundance in uplands. Road closures would reduce human disturbance.
Grizzly bear	Low	Road closures would reduce human disturbance. Riparian buffers will increase fish and game species abundance.
California wolverine	Low	Reserves on steep slopes and in riparian areas will improve fish and game species abundance. Road closures would reduce human disturbance.
Pacific fisher	Moderate	Riparian buffers are likely to improve prey populations and improve dispersal opportunities.
Townsend's big-eared bat	Moderate	Caves will be protected (if present).
Fringed myotis	Moderate	Caves will be protected (if present). Riparian buffers will protect and improve wetland and riparian habitats.
Long-eared myotis	Moderate	Caves will be protected (if present). Retention of old-growth forest in reserves along streams, wetlands and lakes will protect riparian habitats most often used.
Long-legged myotis	Moderate	Caves will be protected (if present). Retention of mature forest in reserves along streams, wetlands and lakes will protect riparian habitats most often used. Increased snag retention will create reserves and leave-tree areas.

Corn (1989) only found them inhabiting old-growth forests, although all seral stages were sampled. Suitable habitat for Larch Mountain salamanders could occur at the base of talus slopes, where seasonal springs and dense coniferous cover occur in combination. This type of habitat is rare on the Mineral Tree Farm. Other forested areas with rocky soils also might be suitable habitat. Watershed Analyses will eventually initiate protection of some of the steep headwalls and inner gorges along Type 4 and 5 streams which might potentially overlap with talus habitat, but an unknown amount will probably remain unprotected. While this plan will only provide partial protection of Larch Mountain salamander habitat, it will protect more than current Forest Practices Rules and Regulations and the original spotted owl HCP.

Tailed frog (*Ascaphus truei*)

The tailed frog is found in cold, fast-flowing permanent mountain streams within forested areas (Nussbaum et al. 1983; Leonard et al. 1993). The riparian reserves established along all Types 1, 2 and 3 streams and the majority of Type 4 streams will steadily increase the principal habitat of the tailed frog. This measure also will protect most of the adjacent forested area in which tailed frogs are known to forage (most frequently within 80 feet of a stream). Harvest beyond the reserves could prevent longer movements, but the reserves should allow movement up and down streams to larger unharvested forest blocks. This will also aid in recolonization of streams that lack tailed frogs due to past disturbance. Under the HCP Amendment, habitat and dispersal conditions for tailed frogs should steadily improve as the forests in the reserve areas grow and mature. This riparian reserve system is expected to provide more protection than the original spotted owl HCP.

Northern red-legged frog (*Rana aurora aurora*)

Outside of the breeding season, the red-legged frog can be found foraging along the adjacent banks of streams, lakes and non-forested wetlands (Leonard et al. 1993). The more extensive riparian reserves of the HCP Amendment will provide forested habitats adjacent to riparian areas for these foraging adults as well as permanent protection of the aquatic systems they depend on for breeding. Riparian buffer strips should allow dispersal and foraging movements between drainages and to unharvested forest. Habitat conditions will improve for northern red-legged frogs as the forest in the reserves grows and matures compared to the original spotted owl HCP.

Spotted frog (*Rana pretiosa*)

This species is highly aquatic, but prefers non-woody wetland plant communities (sedges, rushes, grasses) (Leonard et al. 1993). While these habitats are rare on the Mineral Tree Farm, through time the riparian reserves will protect and possibly improve their habitat suitability for spotted frogs. The riparian reserves along lakes, ponds and non-forested wetlands will protect and enhance aquatic habitat required by the spotted frog. Habitat for spotted frogs will improve as the forest matures in the more extensive reserves around small lakes and ponds, thus significantly improving dispersal opportunities on the tree farm as compared to the original spotted owl HCP.

Cascades frog (*Rana cascadae*)

This species occurs most commonly along streams in alpine meadows and forests, but also in lakes, ponds, swamps and marshes (Leonard et al. 1993). Reserves primarily will be established along streams, lakes and non-forested wetlands, protecting nearly all of the aquatic habitat of the Cascades frog on the Mineral Tree Farm. As the riparian forest in the reserves matures, it will provide additional habitat which is currently unsuitable. The riparian buffer strips also will allow for movement up and down streams, and should aid in dispersal between different drainages. Enhanced protection of riparian areas under the HCP Amendment could expand the potential range and increase populations of the Cascades frog on the Mineral Tree Farm compared to the original spotted owl HCP.

Northwestern pond turtle (*Clemmys marmorata marmorata*)

This is a thoroughly aquatic turtle species inhabiting ponds, marshes, streams and irrigation ditches (Stebbins 1966). Although pond turtles are not known to occur on the Mineral Tree Farm, the reserves along lakes, ponds and non-forested wetlands will protect and enhance the aquatic environment for northwestern pond turtles if they are present or colonize the area in the future. The development of late-successional forest in the reserves will provide a future supply of LWD to open water areas that can be used for basking by pond turtles. It also will provide a protected area away from the water that is relatively undisturbed in which turtles could nest. The reserves will not protect the full distance from water that pond turtles are known to use for nesting. The area beyond the riparian buffers will experience periodic disturbances (every 45 to 60 years), which might temporarily reduce the overall selective possibilities for choosing a nest site. However, the HCP Amendment is expected to provide a more extensive riparian protection plan than the original spotted owl HCP.

Great blue heron (*Ardea herodias*)

The great blue heron is an obligate wetland species, nesting and foraging along rivers, lakes and marshes (Rodrick and Milner 1991). The size of the reserves in and adjacent to riparian and wetland habitats will increase with the HCP Amendment. Over the term of the HCP Amendment, these permanent buffers will provide additional potential nest and roost sites due to the retention and increase in the production of large trees and snags near water and food sources. Under the HCP Amendment, more extensive riparian reserves will likely enhance water quality and the potential forage base (fish and amphibians) for great blue herons compared to the original spotted owl HCP.

Harlequin duck (*Histrionicus histrionicus*)

The Harlequin duck nests only along rocky shores of turbulent mountain streams (Bellrose 1976). The riparian reserves will increase under the HCP Amendment resulting in the retention and production of late-successional forest in along permanent streams. This will provide potential Harlequin duck nesting habitat and a more dependable supply of woody debris for mid-stream loafing sites. Riparian buffer zones are likely to improve stream quality by controlling soil erosion, sedimentation and lowering flood levels. Due to the Amendment, improvements to riparian protection are expected which could improve habitat suitability and food supply for Harlequin ducks compared to the original spotted owl HCP.

Marbled murrelet (*Brachyramphus marmoratus*)

Management of the Mineral Tree Farm under the HCP Amendment will have a minor effect on marbled murrelets because of the low numbers of murrelets likely to be present on the tree farm. Murrelets leave the salt water and fly inland only for the purpose of nesting, which occurs in large coniferous trees. The Mineral Tree Farm was surveyed for marbled murrelet presence for 3 consecutive years (1992 to 1994). The last 2 years of survey were conducted using the intensive survey protocol developed by the Pacific Seabird Group (PSG) (Ralph et al. 1994). The results of the surveys indicated the presence of murrelets in the vicinity of the tree farm (i.e., murrelets flew over observation points on the tree farm during the surveys). There were no detections indicating murrelet occupancy during any of the 3 years of surveys, but the PSG protocol is not definitive as to the absence of occupancy. The results of the surveys suggest the potential for a small number of murrelets occupying habitat on or near the tree farm.

Under the proposed HCP Amendment, 800 acres of the 1,091 acres identified as potentially suitable marbled murrelet nesting habitat will be harvested. Most, if not all of it, will be harvested in the first 10 years. In the event marbled murrelets do occupy the tree farm, harvesting could impact nesting murrelets.

The HCP Amendment will provide more late-successional forest for the last 20 years (from 2074 to 2094) than is currently available, but the age and structure of the forest will be different. Depending on the tree size, tree density and distribution of these stands, benefits to marbled murrelets could occur. The total area of late-successional forest (forest greater than 100 years old) will increase from 2,834 to 4,900 acres during the term of the HCP Amendment, for a net gain of 2,066 acres (Figure 9-1). Forest over 250 years old will decrease from 1,144 to 219 acres. The average density of suitable nest trees could be lower in the future if the average age of the forest is younger, but the increase in the total amount of potential habitat could offset a lower density of nest trees. The size and shape of potential nesting habitat also will change. Currently much of the older forest habitat is in large and/or uniformly-shaped blocks with low edge to interior ratios. Future habitat will occur in narrow reserves averaging 100 feet on both sides of streams. While there are few data upon which to base predictions of habitat suitability, it has been suggested that murrelets are more vulnerable to nest predators along the forest edge. At various points in time, each of the riparian reserves will be bordered by closed-canopy forest in the adjacent managed uplands, effectively eliminating the edge for at least part of each rotation. The amount of mature forest reserve (forest greater than 100 years old) that will be bordered by closed-canopy forest (i.e., spotted owl dispersal habitat) is projected to be 3,226 acres by 2094. All of this could potentially be nesting habitat for marbled murrelets. Under the HCP Amendment more potential nesting habitat will be available on the Mineral Tree Farm compared to the original spotted owl HCP. This, combined with the maintenance of potential nesting habitat on adjacent federal LSRs, will help ensure the continued existence of the local murrelet population.

Golden eagle (*Aquila chrysaetos*)

The golden eagle is a bird of open habitats and has benefited from clearcutting practices (Bruce et al. 1982). The retention and production of late-successional trees in the reserve areas in riparian and steep-sloped habitats will increase under the HCP Amendment. This will preserve potential nesting trees and perch sites for golden eagles that would not ordinarily be protected under existing Forest Practice Rules and Regulations. The number of green trees and snags in the upland areas also will also increase, providing additional nesting and perching opportunity. Over time, these green trees and snags will increase the amount of downed logs, providing cover and nutrients (mushrooms) for potential prey species. The more extensive riparian reserves of the HCP Amendment also will improve cover and food for prey species, thus ultimately benefiting golden eagles compared to the original spotted owl HCP.

Bald eagle (*Haliaeetus leucocephalus*)

In Washington, bald eagle nesting occurs along large lakes and rivers in predominantly coniferous, uneven-aged stands with old-growth components (Anthony et al. 1982). The potential for bald eagle nesting on the tree farm is low, given the lack of large reservoirs, lakes or rivers. Riparian reserves under the HCP Amendment will provide for better water quality and fish habitat, but salmon runs have been blocked by dams. The riparian protection also will provide potential nest and roost sites due to the retention and increase in the production of large trees and snags near water bodies. This might increase the potential for nesting in the future if salmonid fisheries are ever completely restored. Habitat suitability and fishing success are expected to improve under the extensive riparian reserve system of the HCP Amendment compared to the original spotted owl HCP.

Northern goshawk (*Accipiter gentilis*)

The northern goshawk is a forest-dwelling raptor which requires forest with a minimum average dbh of 10 inches (Lilieholm et al. 1993) to 12 inches (Fleming 1987). Habitat of this type first appears in managed stands on the tree farm at 35 to 50 years, depending on site conditions and management history. Under the HCP Amendment, habitat reserves will occur in riparian zones, wetlands and some uplands according to Watershed Analyses, covering up to 10 percent of the tree farm. The combination of riparian protection and the spotted owl dispersal habitat matrix is likely to improve habitat conditions for important prey species like grouse (Johnsgard 1973; Gullion 1977) and snowshoe hare (*Lepus americana*) by increasing the amount of edge, increasing riparian plant foods, reducing the size of clearcuts and reducing average distance to cover (Irwin et al. 1989). Most, if not all, of the owl dispersal habitat will represent suitable conditions for goshawk foraging movements and prey species. Dispersal habitat will cover approximately 40 percent of the farm over the term of the original spotted owl HCP.

Within the dispersal habitat matrix, the total acreage of suitable nesting habitat for goshawks (forest >35 to 50 years old) will vary from 8.9 to 12.7 percent (4,272 to 7,334 acres) of the total area of the tree farm (Figure 9-6). Nesting could occur in the riparian reserves, especially if these areas were buffered by large blocks of owl dispersal habitat or adjacent to suitable habitat on neighboring USFS lands. The number of green leave-trees and snags in upland areas also will be increased, thus providing for a larger prey diversity and abundance. Clumps of leave trees will provide more vertical and horizontal diversity once the surrounding clearcut has grown back to a suitable size for goshawk nesting (in about 35 to 50 years). Overall, habitat suitability will increase for goshawks under the HCP Amendment compared to the original spotted owl HCP.

Osprey (*Pandion haliaetus*)

The osprey is an obligate fish-eating raptor that generally nests in the vicinity of productive bodies of water, including large rivers, lakes and reservoirs (Kahl 1971; Johnson and Melquist 1973; Call 1978). The establishment of riparian reserves will improve water quality and fish habitat, but large, fish-bearing waters are limited on and near the tree farm. Currently, there are no known osprey nests on the ownership, but migrating ospreys probably stop to fish for brief periods. The larger

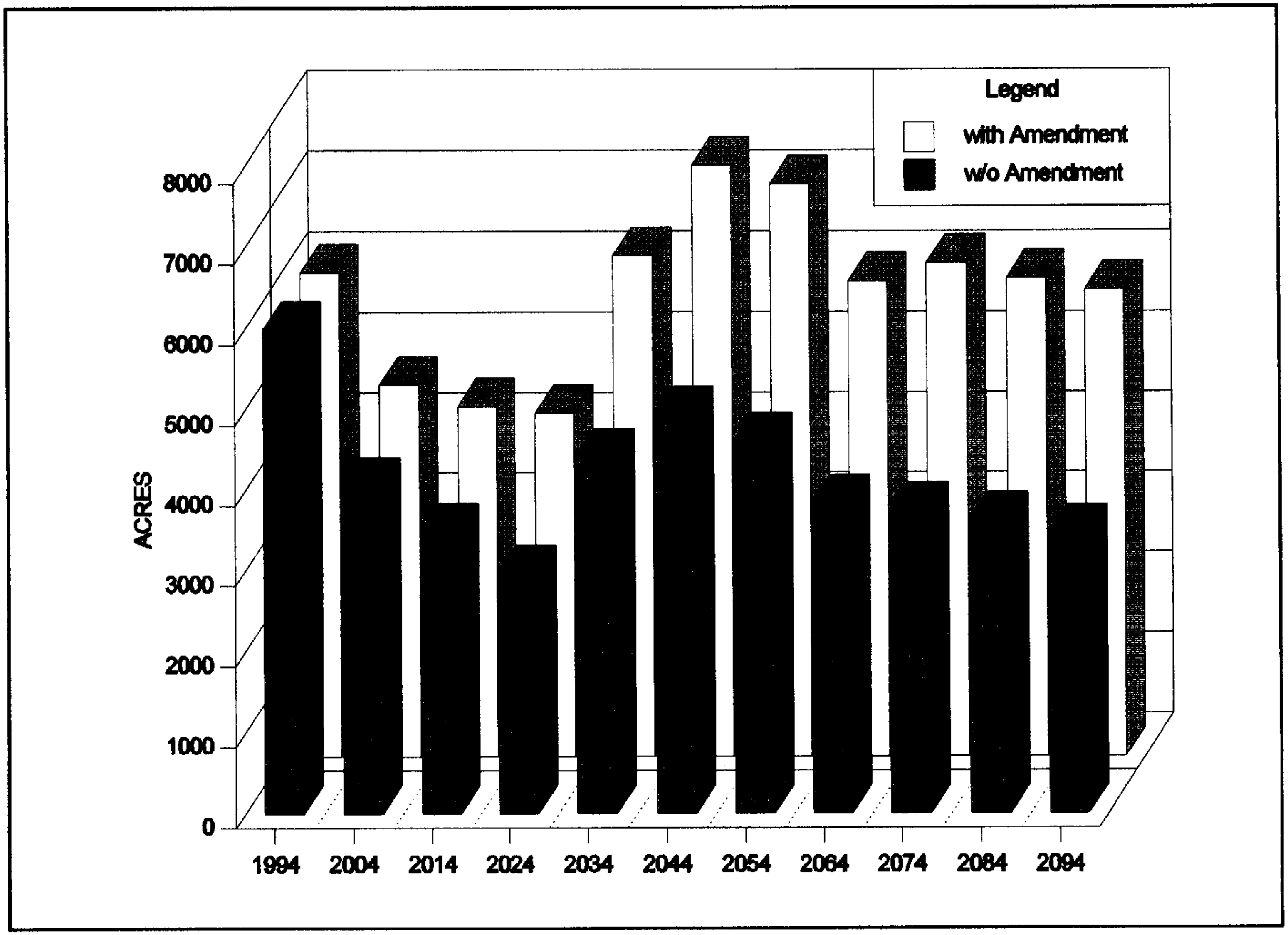

Figure 9-6. Mature forest (>50 years old) trends on the Mineral Tree Farm.

riparian reserves of the HCP Amendment will provide additional potential nesting and roosting sites due to the retention and increase in the production of large trees and snags along waterways. Over time, the riparian condition is expected to improve with the HCP Amendment, which could increase both fishing success and habitat suitability for nesting ospreys compared to the original spotted owl HCP.

Northern spotted owl (*Strix occidentalis caurina*)

This plan is an amendment to an HCP implemented for spotted owls in 1993. The management plan outlined in this HCP Amendment will not change the protection measures for spotted owls in the original spotted owl HCP. Spotted owls will be protected and managed under the original HCP. The dispersal habitat landscape will not be significantly altered by this HCP Amendment. The reserves in the proposed Amendment will increase late-successional habitat on the landscape over the term of the HCP Amendment, which will provide additional benefits to spotted owls over the long-term compared to the original HCP.

Vaux's swift (*Chaetura vauxi*)

The Vaux's swift requires large, hollow trees and snags for nesting (Bull 1991). Under the HCP Amendment, 10 percent of the ownership will be dedicated to riparian forest reserves. These reserves will contain significant numbers of old-growth trees and snags (219 acres), and over the 100-year plan, this amount will increase to 494 acres (Figure 9-5). There also will be an increase in the number of green leave-trees and snags retained in the upland areas along with specific protection of any snags inhabited by Vaux's swifts. The HCP Amendment will provide a larger number of old-growth trees and snags on the ownership than the original spotted owl HCP.

Pileated woodpecker (*Dryocopus pileatus*)

In Washington, pileated woodpeckers generally have been found in forest stands greater than 55 years old (Lundquist and Mariani 1991). The HCP Amendment will result in a fairly stable mature forest component (>50 years old) throughout the 100-year term (Figure 9-6). This will be due primarily to the reserves established along riparian areas, steep Type 4 and 5 stream ravines and steep and unstable headwalls. The increased number of green trees and snags in the upland areas also will provide additional opportunities for foraging. Clumps of leave trees also may be used for nesting or roosting sites if located adjacent to mature forest. Overall, the future impact of timber harvest to pileated woodpeckers should be almost completely mitigated by these various management actions. The HCP Amendment will retain and produce better habitat conditions for pileated woodpecker than the original spotted owl HCP.

Western bluebird (*Sialia mexicana*)

This species apparently breeds in open forests, burns and clearcuts, provided that snags are present for nest sites (Schreiber and DeCalesta 1992). This species is not expected to occur in dense contiguous forest and may benefit from clearcutting practices used on the Mineral Tree Farm. The increase in leave tree and snag densities and riparian buffer strips will provide greater snag densities over time than current forest practice rules. These changes are expected to enhance habitat suitability for western bluebirds on the tree farm compared to the original spotted owl HCP.

Olive-sided flycatcher (*Contopus borealis*)

This species inhabits mature and old-growth coniferous and mixed forests in the Pacific Northwest (Brown 1985; Sharp 1992), but also uses high perches (live trees and snags) found along the edge of clearings created by burns, windthrow and clearcuts (Sharp 1992). Under the HCP Amendment, the permanent reserves along streams, wetlands, lakes and steep headwalls will retain substantial acreages of mature and old-growth forest which would not be protected under existing Forest Practices Rules and Regulations. The HCP Amendment will provide a higher and fairly stable level of mature forest throughout the 100-year term (Figure 9-6) compared to the original spotted owl HCP.

Little willow flycatcher (*Empidonax traillii brewsteri*)

The little willow flycatcher inhabits riparian areas, open wetlands and edge habitat in willow or alder thickets, shrubs and young forest in the Pacific Northwest (Brown 1985; Peterson 1990). Riparian buffers will likely improve wetland and riparian habitats and probably improve insect prey diversity and abundance for flycatchers. The HCP Amendment is likely to improve conditions for this riparian species on the tree farm, compared to the original spotted owl HCP.

Gray wolf (*Canis lupus*)

The gray wolf inhabits remote tundra and forests (Whitaker 1980). Wolves can use a variety of habitats as long as cover and a food supply are available (Stevens and Lofts 1988). While wolves have not been known to inhabit the tree farm, wolf sightings have been reported to the USFS in the vicinity. Murray's commitment to controlling public access to the tree farm will benefit gray wolves that may be in the area. The reserves along streams, lakes and wetlands will protect areas that could potentially be used as den and rendezvous sites. The dispersal habitat landscape and riparian reserves are likely to increase the abundance of big and small game animals due to an increase in riparian plant foods and edge and decreasing distance to cover. Even though wolves are not expected to be present on the tree farm, the protection of riparian areas, the control of public access and the protection of known active dens will improve conditions for wolves if they do colonize the area. The HCP Amendment is expected to provide better conditions for wolves on the tree farm than the original spotted owl HCP.

Grizzly bear (*Ursus arctos*)

The grizzly bear is a habitat generalist, usually observed in mountainous areas in semi-open country and generally avoiding roads and areas of human disturbance (Whitaker 1980). The recovery zone for the grizzly bear in the Washington Cascades lies north of Interstate 90, while the Mineral Tree Farm lies approximately 47 miles south of this area. Although grizzly bears have been reported south of Interstate 90, the likelihood of grizzlies ever occupying the Mineral Tree Farm is remote. The continued harvesting of timber could have mixed impacts on grizzly bears. Continued harvesting will necessitate the maintenance of roads and cause periodic human disturbances. Conversly, the same harvest activities will maintain a landscape of varied habitats that could benefit a generalist feeder like the grizzly bear, and the seasonal protection of known active dens will minimize the effects of harvesting on grizzly bears. In addition, the riparian reserves are likely to increase the abundance of small game animals as well as fish populations on the tree farm. Overall, grizzly bears are expected to benefit from the HCP Amendment compared to the original spotted owl HCP.

California wolverine (*Gulo gulo luteus*)

The wolverine is a habitat generalist (Ruggiero et al. 1994), but can typically be found in high mountain coniferous forest, subalpine forest, alpine tundra and freshwater emergent wetland habitats (Ingles 1965; Larrison 1976; Whitman et al. 1986; Banci and Harested 1990). The HCP Amendment will result in a fairly stable mature forest component (>50 years old) throughout the 100-year plan (Figure 9-6). The reserves will be established along riparian areas, steep Type 4 and 5 stream ravines and steep and unstable headwalls. The number of green trees and snags in the upland areas will increase, and up to 40 percent of tree farm will remain in closed-canopy forest (stands of owl dispersal habitat or older). Although the wolverine generally avoids areas of human activity and is not known or expected to occur on the Mineral Tree Farm, these forest management activities are expected to improve habitat suitability for wolverines compared to the original spotted owl HCP. The protection of known active wolverine dens will further benefit the species if it occurs on the tree farm.

Pacific fisher (*Martes pennanti*)

The habitat of the Pacific fisher is reported as dense closed-canopy forest with a high structural forest floor diversity and riparian or wetland conditions (Aubry and Houston 1992; Ruggiero et al. 1994). Under the HCP Amendment, the permanent reserves will be established along riparian areas, steep Type 4 and 5 stream ravines and steep and unstable headwalls. Reserves will eventually provide mature closed-canopy forest in all riparian areas, the areas used most used by fisher. This management will result in a fairly stable mature forest component (>50 years old) throughout the 100-year plan (Figure 9-6), and as much as 40 percent of tree farm will remain in closed-canopy forest (stands of owl dispersal habitat or older) at all times. The increase in snag, green tree and down logs left will produce more snags and structural forest floor diversity, improving future habitat conditions for fishers (Aubry and Houston 1992). The protection of known active fisher dens will help minimize impacts to fishers if they do make use of the habitat provided under the HCP Amendment. Overall, these forest management activities will improve habitat suitability for fishers compared to the original spotted owl HCP.

Townsend's big-eared bat (*Plecotus townsendii*)

Information is limited for habitat associations of the big-eared bat in the Pacific Northwest, but apparently it forages in young forest and roosts in caves (Brown 1985). The species is relatively rare and may not presently occur on the Mineral Tree Farm because of its requirements for special types of caves for roosting and rearing young. The riparian protection of the HCP Amendment could provide an increase in potential prey species compared to the original spotted owl HCP.

Fringed myotis (*Myotis thysanodes*)

In the Pacific Northwest, this species inhabits low to medium elevation grasslands and shrub communities along riparian and wetland areas (Brown 1985). It is primarily dependent on caves and cliffs for roosting/nursing, but its winter hibernacula are unknown (Brown 1985). Riparian buffers will likely improve wetland and riparian habitats and probably improve insect prey diversity and abundance for bats. The HCP Amendment is likely to improve conditions for this riparian species compared to the original spotted owl HCP.

Long-eared myotis (*Myotis evotis*)

The long-eared myotis inhabits old-growth coniferous forest in temperate, high elevation and subalpine communities and depends on riparian forests, wetlands, shrub and open young forest for foraging (Brown 1985). It is primarily dependent on snags for roosting, nursing and hibernating, but also uses caves (Brown 1985). Under the HCP Amendment, the permanent reserves along streams, wetlands, lakes and steep headwalls will retain substantial acreages of old-growth forest in areas most likely used for foraging by this species. These reserves also will retain substantial numbers of large snags for roosting. In uplands, increased leave tree quotas will also produce larger and more numerous snags. The riparian protection will likely improve insect prey diversity and abundance for bats. These habitat changes are likely to improve conditions for long-eared myotis compared to the original spotted owl HCP.

Long-legged myotis (*Myotis volans*)

In the Pacific Northwest, this species inhabits mature and old-growth coniferous forest below subalpine elevations and depends on riparian forests and wetlands for foraging (Brown 1985). It is dependent on snags, cliffs and caves for roosting and nursing, although it may be migratory in winter (Brown 1985). Thomas (1988) found long-legged bats occurred significantly more frequently in mature and old-growth forests than in young forests of the Cascades. Under the HCP Amendment, the permanent reserves along streams, wetlands, lakes and steep headwalls will maintain higher levels of mature forest in areas most used for foraging by this species (Figure 9-6). These reserves will include significant acreages of old-growth forest including substantial numbers of large snags for roosting. In uplands, increased leave tree quotas will produce larger and more numerous snags. Riparian protection will likely improve insect prey diversity and abundance for bats as well. Overall, habitat suitability for long-legged myotis is expected to improve compared to the original spotted owl HCP.

10.0 ALTERNATIVES TO THE PROPOSED CONSERVATION MEASURES

Alternatives to the proposed HCP Amendment are described in detail in the Environmental Assessment (EA) prepared for the Amendment under the direction of the USFWS and NMFS.

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APPENDIX A:

ANTICIPATED EFFECTS OF THE HCP AMENDMENT ON NATIVE VERTEBRATES

In this appendix, all wildlife species which could possibly occur on the Mineral Tree Farm are listed along with a brief habitat description and a checklist on the predicted effects of the HCP Amendment. The habitat descriptions were summarized largely from Brown (1985), but additional information was obtained from species accounts in Chapter 4 as well as from field experience of Beak biologists. The effects of the HCP Amendment were determined by comparing habitat conditions under the amendment to the habitat that would result under the the original spotted owl HCP. Four major habitat changes have been defined in the footnotes of the table, along with a column for special species protection measures. To assess the effects of these habitat changes on each wildlife species in the list, the individual habitat descriptions were evaluated in each case to determine if the HCP Amendment change would be beneficial (+), neutral (=) or detrimental (-) compared to the original spotted owl HCP. In assigning these predicted effects, the following rules were used to attain a consistent and objective classification system:

1. Closed-canopy, mature or old-growth preference resulted in + for LS[1] and + for OD (any stand >10 inches dbh);

2. Young forest preference resulted in + for OD, - for LS (because OD contains pole as well as mature and old-growth);

3. Forest edge resulted in = for OD and = for LS since the amount of forest edge is not expected to change significantly with the amendment;

4. Grass-shrub preference resulted in - for OD and - for LS since increases in both of these will provide less grass-shrub habitat than the original spotted owl HCP;

[1] See page A-18 for a complete definition of abbreviations.

5. All raptors received + for SL since downed logs provide for higher prey base, and most species use snags for nesting or perch hunting;

6. No species received - for SL or RR since there are no known detrimental effects for these actions.

7. Any wet habitat preference (riparian, wetlands, wet meadow, spring, etc.) received + for RR.

8. Tundra preference was assummed to be unaffected (=) for all four habitat changes.

9. Subalpine preferences were treated the same as other preferences, except RR was assumed to have no effect (=) because reserves should affect only lower elevations.

Table A-1. Anticipated effects of the HCP Amendment on wildlife species potentially present on the Mineral Tree Farm.

SPECIES	SCIENTIFIC NAME	HABITAT	EFFECTS OF THE HCP AMENDMENT[1]			
			RR	LS	SL	OD
AMPHIBIANS						
Northwestern salamander	*Ambystoma gracile*	riparian-wetland, mixed mature forest	+	+	+	+
Long-toed salamander	*Amystoma macrodactylum*	riparian-wetland, grass-shrub	+	-	+	-
Pacific giant salamander	*Dicamptodon tenebrosus*	riparian, seeps, mature forest	+	+	+	+
Cope's giant salamander	*Dicamptodon copei*	riparian, seeps, cold mountain lakes	+	=	=	=
Cascade torrent salamander	*Rhyacotriton cascadae*	cold streams, seeps	+	=	=	=
Ensatina	*Ensatina eschscholtzii*	riparian, closed-canopy forest	+	+	+	+
Western redback salamander	*Plethodon vehiculum*	riparian, seeps, closed-canopy forest	+	+	+	+
Van Dyke's salamander	*Plethodon vandykei*	riparian, seeps, closed-canopy forest	+	+	+	+
Larch Mountain Salamander	*Plethodon larselli*	steep, moist talus, old-growth forest, caves	+	+	+	=
Cascades frog	*Rana cascadae*	riparian-wetland, closed-canopy forest	+	+	=	+
Roughskin newt	*Taricha granulosa*	lakes, wetlands	+	=	=	=
Western toad	*Bufo boreas*	riparian-wetland, grass-shrub-young forest	+	=	+	=
Pacific tree frog	*Pseudacris regilla*	riparian-wetland, grass-shrub-forest	+	=	+	=
Tailed frog	*Ascaphus truei*	streams, mature mixed forest	+	+	+	+
Red-legged frog	*Rana aurora*	ponds-wetlands, closed-canopy forest	+	+	+	+
Spotted frog	*Rana pretiosa*	riparian-wetland, closed-canopy forest	+	+	+	+
Bullfrog	*Rana catesbeiana*	ponds/wetlands	+	=	=	=

[1] See page A-18 for a complete definition of column headings.

Table A-1. Continued.

SPECIES	SCIENTIFIC NAME	HABITAT	EFFECTS OF THE HCP AMENDMENT[1]			
			RR	LS	SL	OD
REPTILES						
Northwestern pond turtle	*Clemmys marmorata*	lakes, ponds, wetlands	+	=	+	=
Northern alligator lizard	*Elgaria coeruleus*	grass-shrub, young forest	+	=	+	+
Western fence lizard	*Sceloporus occidentalis*	variable habitats with exposed perches	=	=	+	=
Western skunk	*Eumeces skiltonianus*	grass-shrub	=	-	+	-
Rubber boa	*Charina bottae*	grass/forest edge	=	=	+	=
Racer	*Coluber constrictor*	riparian, grass/shrub edge	+	-	=	-
Sharptail snake	*Contia tenius*	moist grass-shrub forest	+	=	+	=
California mountain kingsnake	*Lampropeltis zonata*	open riparian, grass/pole forest edge	+	=	+	=
Gopher snake	*Pituophis melanoleucus*	grass-shrub	=	-	+	-
Western terrestrial garter snake	*Thamnophis elegans*	riparian, grass-shrub-pole forest	+	=	+	+
Northwestern garter snake	*Thamnophis ordinoides*	wet meadows, grass/forest edge	+	=	+	=
Common garter snake	*Thamnophis sirtalis*	riparian-wetland, grass-shrub	+	-	+	-
BIRDS						
Common loon	*Gavia immer*	lakes	+	=	=	=
Horned grebe	*Podiceps auritus*	lakes and rivers	+	=	=	=
Red-necked grebe	*Podiceps grisegena*	lakes	+	=	=	=
Eared grebe	*Podiceps nigricollis*	lakes, wetlands	+	=	=	=

[1] See page A-18 for a complete definition of column headings.

Table A-1. Continued.

SPECIES	SCIENTIFIC NAME	HABITAT	EFFECTS OF THE HCP AMENDMENT[1]			
			RR	LS	SL	OD
BIRDS (Continued)						
Western grebe	*Aechmophorus occidentalas*	lakes	+	=	+	=
Pied-billed grebe	*Podilymbus podiceps*	ponds, lakes, streams, marshes	+	+	=	=
Double-crested cormorant	*Phalacrocorax auritus*	lakes	+	=	+	=
American bittern	*Botaurus lentiginosus*	lakes, emergent wetlands	+	=	=	=
Great blue heron	*Ardea herodias*	riparian-wetland, mature forest edge	+	+	+	=
Green-backed heron	*Butorides striatus*	lakes, marshes, slow streams	+	=	=	=
Black-crowned night-heron	*Nycticorax nycticorax*	riparian-wetland	+	=	=	=
Tundra swan	*Cygnus columbianus*	lakes, large rivers	+	=	=	=
Canada goose	*Branta canadensis*	open riparian-wetland	+	=	=	=
White-fronted goose	*Anser albifrons*	open wetlands, marshes	+	=	=	=
Wood duck	*Aix sponsa*	riparian-wetland, mature forest	+	+	+	+
Green-winged teal	*Anas crecca*	riparian-wetland	+	=	=	=
Mallard	*Anas platyrhynchos*	riparian-wetland	+	=	=	=
Northern pintail	*Anas acuta*	lakes, wetlands	+	=	=	=
Blue-winged teal	*Anas discors*	lakes, wetlands	+	=	=	=
Cinnamon teal	*Anas cyanoptera*	lakes, wetlands	+	=	=	=
Northern shoveler	*Anas clypeata*	riparian-wetland	+	=	=	=

[1] See page A-18 for a complete definition of column headings.

Table A-1. Continued.

SPECIES	SCIENTIFIC NAME	HABITAT	EFFECTS OF THE HCP AMENDMENT[1]			
			RR	LS	SL	OD
BIRDS (Continued)						
Gadwall	*Anas strepera*	lakes, wetlands	+	=	=	=
American wigeon	*Anas americana*	lakes, wetlands	+	=	=	=
Canvasback	*Aythya valisineria*	lakes	+	=	=	=
Ring-necked duck	*Aythya collaris*	lakes	+	=	=	=
Lesser scaup	*Aythya affinis*	lakes	+	=	=	=
Harlequin duck	*Histrionicus histrionicus*	rivers, closed-canopy forest	+	+	+	+
Common goldeneye	*Bucephala clangula*	lakes, rivers	+	=	=	=
Barrow's goldeneye	*Bucephala islandica*	lakes, ponds, rivers	+	=	=	=
Bufflehead	*Bucephala albeola*	lakes, ponds, rivers	+	=	=	=
Hooded merganser	*Lophodytes cucullatus*	riparian, mature forest	+	+	+	+
Common merganser	*Mergus merganser*	lakes, rivers, mature forest	+	+	+	+
Ruddy duck	*Oxyura jamaicensis*	riparian-wetland	+	=	=	=
Turkey vulture	*Cathartes aura*	cliff-talus, meadows, open forest	=	=	+	-
Osprey	*Pandion haliaetus*	riparian-wetland mature forest	+	+	+	=
Black-shouldered kite	*Elanus caeruleus*	open grasslands, marshes	=	=	=	=
Bald eagle	*Haliaeetus leucocephalus*	riparian mature forest	+	+	+	=
Northern harrier (marsh hawk)	*Circus cyaneus*	wetland, meadows, grass/shrub edge	+	=	+	-

[1] See page A-18 for a complete definition of column headings.

Table A-1. Continued.

SPECIES	SCIENTIFIC NAME	HABITAT	EFFECTS OF HCP AMEDNMENT[1]			
			RR	LS	SL	OD
BIRDS (Continued)						
Sharp-shinned hawk	*Accipiter striatus*	closed-canopy forest	+	+	+	+
Cooper's hawk	*Accipiter cooperii*	mature closed-canopy forest	+	+	+	+
Northern goshawk	*Accipiter gentilis*	mature and old-growth forest	+	+	+	+
Red-tailed hawk	*Buteo jamaicensis*	forest edge, open mature forest	+	+	+	+
Rough-legged hawk	*Buteo lagopus*	marshes, tundra, cliff-talus	+	=	+	-
Golden eagle	*Aquila chrysaetos*	cliff-talus, tundra, open forest, grass	=	+	+	-
American kestrel	*Falco sparverius*	grass, meadows, open forest	=	+	+	-
Merlin	*Falco columbarius*	marshes, meadows, grass/forest edge	=	=	+	-
Harlequin duck	*Histrionicus histrionicus*	rivers, closed-canopy forest	+	+	+	+
Ring-necked pheasant	*Phasianus colchicus*	grass-shrub edge	=	-	=	-
Spruce grouse	*Dendragapus canadensis*	grass-shrub/forest edge	=	=	+	=
Blue grouse	*Dendragapus obscurus*	grass-shrub/forest edge	=	=	+	=
White-tailed ptarmigan	*Lagopus leucurus*	tundra	=	=	=	=
Ruffed grouse	*Bonasa umbellus*	riparian, shrub, young-mature forest	+	=	+	+
Wild turkey	*Meleagris gallopavo*	mature deciduous forest	=	+	=	+
Northern bobwhite	*Colinus virginianus*	grass-shrub deciduous forest openings	=	=	=	-
California quail	*Callipepla californica*	grass-shrub, forest edge	=	=	=	=

[1] See page A-18 for a complete definition of column headings.

Table A-1. Continued.

SPECIES	SCIENTIFIC NAME	HABITAT	EFFECTS OF HCP AME\NDMENT[1]			
			RR	LS	SL	OD
BIRDS (Continued)						
Mountain quail	*Oreortyx pictus*	grass-shrub, young forest edge	=	=	+	–
Virginia rail	*Rallus limicola*	wetlands	+	=	=	=
Sora	*Porzana carolina*	marshes	+	=	=	=
American coot	*Fulica americana*	open riparian-wetland	+	=	=	=
Killdeer	*Charadrius vociferus*	open riparian, meadows	+	=	=	–
Solitary sandpiper	*Tringa solitaria*	forested wetlands, ponds, marshes	+	=	=	=
Spotted sandpiper	*Actitis macularia*	open riparian	+	=	=	–
Common snipe	*Gallinago gallinago*	open riparian-wetland	+	=	=	=
Marbled murrelet	*Brachyramphus marmoratus*	riparian, old-growth forest	+	+	=	+
Rock dove	*Columba livia*	cliffs	=	=	=	=
Band-tailed pigeon	*Columba fasciata*	mature deciduous/mixed forest and grass-shrub edge	+	+	=	+
Mourning dove	*Zenaida macroura*	young-mature deciduous, mixed forest and grass-shrub edge	+	+	=	+
Common barn-owl	*Tyto alba*	meadows, grass, mature forest edge	=	+	+	+
Western screech-owl	*Otus kennicotti*	stream/deciduous forest edge	+	+	+	+
Great horned owl	*Bubo virginianus*	mature forest, grass edge	+	+	+	+

[1] See page A-18 for a complete definition of column headings.

Table A-1. Continued.

SPECIES	SCIENTIFIC NAME	HABITAT	EFFECTS OF HCP AMEDNMENT[1]			
			RR	LS	SL	OD
BIRDS (Continued)						
Northern pygmy-owl	*Glaucidium gnoma*	mature coniferous forest and grass-shrub edge	+	+	+	+
Spotted owl	*Strix occidentalis*	mature and old-growth forest	+	+	+	+
Barred owl	*Strix varia*	mature forest and wetland edge	+	+	+	+
Long-eared owl	*Asio otus*	grass-meadow/forest edge	+	=	+	=
Short-eared owl	*Asio flammeus*	meadows, emergent wetlands	+	–	+	–
Northern saw-whet owl	*Aegolius acadicus*	mature and old-growth forest	+	+	+	+
Common nighthawk	*Chordeiles minor*	riparian-wetland	+	=	=	=
Common poorwill	*Phalaenoptilus nuttallii*	grass-shrub	=	=	+	–
Vaux's swift	*Chaetura vauxi*	riparian, young and old-growth forest	+	+	+	+
Black swift	*Cypseloides niger*	cliffs	=	=	=	=
Rufous hummingbird	*Selaphorus rufus*	shrub/young forest edge	=	=	=	+
Belted kingfisher	*Ceryle alcyon*	rivers, streams, lakes	+	=	+	=
Red-breasted sapsucker	*Sphyrapicus ruber*	mature riparian forest	+	+	+	+
Downy woodpecker	*Picoides pubescens*	riparian, deciduous closed-canopy forest	+	+	+	+
Hairy woodpecker	*Picoides villosus*	mature and old-growth forest	+	+	+	+
Three-toed woodpecker	*Picoides tridactylus*	mature subalpine forest	=	+	+	+
Black-backed woodpecker	*Picoides arcticus*	mature subalpine forest	=	+	+	+

[1] See page A-18 for a complete definition of column headings.

Table A-1. Continued.

SPECIES	SCIENTIFIC NAME	HABITAT	EFFECTS OF THE HCP AMENDMENT[1]			
			RR	LS	SL	OD
BIRDS (Continued)						
Northern flicker	*Colaptes auratus*	mature forest and grass edge	=	+	+	+
Pileated woodpecker	*Dryocopus pileatus*	mature and old-growth forest	=	+	+	+
Olive-sided flycatcher	*Contopus borealis*	mature coniferous forest	=	+	+	+
Western wood-pewee	*Contopus sordidulus*	mature forest	=	+	=	+
Willow flycatcher	*Empidonax trailli*	mature and riparian forest	+	+	=	+
Hammond's flycatcher	*Empidonax hammondi*	mature forest	=	+	+	+
Dusky flycatcher	*Empidonax oberholseri*	shrub-open young coniferous forest	=	=	+	+
Western flycatcher	*Empidonax difficilis*	mature forest	=	+	+	+
Say's phoebe	*Sayornis saya*	shrub	=	–	=	–
Western kingbird	*Tyrannus verticalis*	shrub	=	–	=	–
Horned lark	*Eremophila alpestris*	grass	=	–	–	–
Tree swallow	*Tachycineta bicolor*	riparian, young-mature forest	+	+	+	+
Violet-green swallow	*Tachycineta thalassina*	riparian, young-mature forest	+	+	+	+
Northern rough-winged swallow	*Stelgidopteryx serripennis*	open riparian	+	=	=	=
Cliff swallow	*Hirundo pyrrhonota*	open riparian/wetlands	+	=	=	=
Barn swallow	*Hiruno rustica*	riparian/wetlands	+	=	=	=
Gray jay	*Perisoreus canadensis*	mature coniferous forest	=	+	=	+

[1] See page A-18 for a complete definition of column headings.

Table A-1. Continued.

SPECIES	SCIENTIFIC NAME	HABITAT	EFFECTS OF THE HCP AMENDMENT[1]			
			RR	LS	SL	OD
BIRDS (Continued)						
Steller's jay	*Cyanocitta stelleri*	closed-canopy forest and shrub edge	=	+	=	+
Clark's nutcracker	*Nucifraga columbiana*	subalpine meadow-shrub-forest	=	+	=	+
American crow	*Corvus brachyrhynchos*	riparian and upland	+	=	=	=
Common raven	*Corvus corax*	upland and subalpine	=	=	=	=
Black-capped chickadee	*Parus atricapillus*	closed-canopy deciduous/mixed forest	=	+	+	+
Mountain chickadee	*Parus gambeli*	closed-canopy coniferous and subalpine forest	=	+	+	+
Chestnut-backed chickadee	*Parus rufescens*	closed-canopy forest	=	+	+	+
Bushtit	*Psaltriparus minimus*	mixed forest	=	=	=	=
White-breasted nuthatch	*Sitta carolinensis*	open forest	=	=	=	=
Red-breasted nuthatch	*Sitta canadensis*	closed-canopy mature and old-growth coniferous forest	=	+	+	+
Brown creeper	*Certhia americana*	mature forest	=	+	+	+
Rock wren	*Salpinctes obsoletus*	cliff-talus, grass-shrub	=	-	=	-
Bewick's wren	*Thryomanes bewickii*	grass-shrub	=	=	=	=
House wren	*Troglodytes aedon*	shrub/forest edge	=	=	+	=
Winter wren	*Troglodytes troglodytes*	mature coniferous forest	=	+	=	+
Marsh wren	*Cistothorus palustris*	emergent wetland	+	=	=	=

[1] See page A-18 for a complete definition of column headings.

Table A-1. Continued.

SPECIES	SCIENTIFIC NAME	HABITAT	EFFECTS OF THE HCP AMENDMENT[1]			
			RR	LS	SL	OD
BIRDS (Continued)						
American dipper	*Cinclus mexicanus*	streams-rivers	+	=	=	=
Golden-crowned kinglet	*Regulus satrapa*	closed-canopy forest	=	+	=	+
Ruby-crowned kinglet	*Regulus calendula*	shrub-young-mature forest	=	+	=	+
Western bluebird	*Sialia mexicana*	grass-shrub/forest edge	=	=	+	=
Mountain bluebird	*Sialia currucoides*	subalpine grass/forest edge	=	=	+	=
Townsend's solitaire	*Myadestes townsendi*	closed-canopy coniferous and subalpine forest	=	+	=	+
Swainson's thrush	*Catharus ustulatus*	closed-canopy forest	=	+	=	+
Hermit thrush	*Catharus guttatus*	young and mature coniferous forest	=	+	=	+
American robin	*Turdus migratorius*	shrub-young forest and shrub edge	=	=	=	+
Varied thrush	*Ixoreus naevius*	mature coniferous forest and shrub edge	=	+	=	+
Water pipit	*Anthus rubescens*	subalpine/alpine grass-shrub	=	=	=	=
Bohemian waxwing	*Bombycilla garrulus*	shrub, forest and shrub edge	=	+	=	+
Cedar waxwing	*Bombycilla cedrorum*	shrub, forest and shrub edge	=	+	=	+
Northern shrike	*Lanius excubitor*	grass/shrub edge	=	–	=	–
Loggerhead shrike	*Lanius ludovicianus*	deciduous grass-shrub-open pole forest	=	–	=	+
European starling	*Sturnus vulgaris*	grass, mature forest edge	=	+	+	+

[1] See page A-18 for a complete definition of column headings.

Table A-1. Continued.

SPECIES	SCIENTIFIC NAME	HABITAT	EFFECTS OF THE HCP AMENDMENT[1]			
			RR	LS	SL	OD
BIRDS (Continued)						
Solitary vireo	*Vireo solitarius*	open young deciduous forest, mature coniferous forest	=	+	=	+
Warbling vireo	*Vireo gilvus*	open young deciduous forest	=	–	=	+
Hutton's vireo	*Vireo huttoni*	open young deciduous forest	=	–	=	+
Orange-crowed warbler	*Vermivora celata*	open young mixed forest, shrub edge	=	–	=	+
Nashville warbler	*Vermivora ruficapilla*	open young mixed forest, shrub edge	=	–	=	+
Yellow warbler	*Dendroica petechia*	shrub/young deciduous forest edge	=	–	=	+
Yellow-rumped warbler	*Dendroica coronata*	young-mature forest, shrub edge	=	+	=	+
Black-throated gray warbler	*Dendroica nigrescens*	young-mature forest, shrub edge	=	+	=	+
Townsend's warbler	*Dendroica townsendi*	closed-canopy coniferous forest	=	+	=	+
Hermit warbler	*Dendroica occidentalis*	closed-canopy coniferous forest	=	+	=	+
MacGillivray's warbler	*Oporornis tolmiei*	shrub-edge and open forest	=	=	=	=
Common yellowthroat	*Geothlypis trichas*	wetlands and shrub-edge	+	=	=	=
Wilson's warbler	*Wilsonia pusilla*	mature mixed forest, shrub edge	=	+	=	+
Yellow-breasted chat	*Icteria virens*	riparian shrub/forest edge	=	=	=	+
Western tanager	*Piranga ludoviciana*	mature forest, shrub edge	=	+	=	+
Black-headed grosbeak	*Pheucticus melanocephalus*	shrub-open deciduous/mixed young forest	=	–	=	+

[1] See page A-18 for a complete definition of column headings.

Table A-1. Continued.

SPECIES	SCIENTIFIC NAME	HABITAT	EFFECTS OF THE HCP AMENDMENT[1]			
			RR	LS	SL	OD
BIRDS (Continued)						
Lazuli bunting	*Passerina amoena*	riparian grass-shrub	–	–	=	–
Rufous-sided towhee	*Pipilo erythropthalmus*	shrub-open deciduous/mixed young forest	=	–	=	+
Chipping sparrow	*Spizella passerina*	open forest	–	–	–	–
Vesper sparrow	*Pooecetes gramineus*	grass-shrub	=	–	=	–
Savannah sparrow	*Passerculus sandwichensis*	wet meadows-grass	=	–	=	–
Fox sparrow	*Passerella iliaca*	shrub/open young forest edge	=	–	=	+
Song sparrow	*Melospiza melodia*	grass, young mixed/deciduous forest	=	–	=	+
Lincoln's sparrow	*Melospiza lincolnii*	springs, wet meadows grass-shrub	+	–	=	–
Golden-crowned sparrow	*Zonotrichia atricapilla*	deciduous shrub	=	–	=	–
White-crowned sparrow	*Zonotrichia leucophrys*	shrub-open young deciduous forest	=	–	=	+
Dark-eyed junco	*Junco hyemalis*	shrub edge, young forest	=	–	=	+
Red-winged blackbird	*Agelaius phoeniceus*	open riparian-wetland	+	–	=	–
Western meadowlark	*Sturnella neglecta*	dry grass hillsides	=	–	=	–
Yellow-headed blackbird	*Xanthocephalus xanthocephalus*	open riparian-wetland	+	–	=	–
Brewer's blackbird	*Euphagus cyanocephalus*	grass-shrub, marshes-swamps	+	–	=	–
Brown-headed cowbird	*Molothrus ater*	grass/young forest edge	=	–	=	+
Northern oriole	*Icterus galbula*	mature deciduous forest	=	+	=	+

[1] See page A-18 for a complete definition of column headings.

Table A-1. Continued.

SPECIES	SCIENTIFIC NAME	HABITAT	EFFECTS OF THE HCP AMENDMENT[1]			
			RR	LS	SL	OD
BIRDS (Continued)						
Rosy finch	*Leucosticte arctoa*	talus, tundra	=	=	=	=
Pine grosbeak	*Pinicola enucleator*	mature and old-growth coniferous forest	=	+	=	+
Purple finch	*Cardodacus purpureus*	mature deciduous/mixed forest	=	+	=	+
Cassin's finch	*Carpodacus cassinii*	high elevation forest	=	=	=	=
House finch	*Carpodacus mexicanus*	grass-shrub, young forest edge	=	–	+	+
Red crossbill	*Loxia curvirostra*	mature and old-growth coniferous forest	=	+	=	+
White-winged crossbill	*Loxia leucoptera*	mature and old-growth coniferous forest	=	+	=	+
Common redpoll	*Carduelis flammea*	grass-shrub	=	=	=	=
Pine siskin	*Carduelis pinus*	coniferous forest	=	=	=	=
American goldfinch	*Carduelis tristis*	young deciduous forest, grass-shrub	=	–	=	+
Evening grosbeak	*Coccothraustes vespertinus*	closed-canopy coniferous forest, shrub	=	+	=	+
MAMMALS						
Virginia opossum	*Didelphis virginiana*	riparian, shrub, deciduous/mixed forest	+	=	+	=
Pacific water shrew	*Sorex benderii*	riparian-wetland/forest edge	+	=	+	=
Masked shrew	*Sorex cinereus*	coniferous forest and edge	=	+	+	+
Dusky shrew	*Sorex monticolus*	mature coniferous and subalpine forest	=	+	+	+
Water shrew	*Sorex palustris*	riparian forest edge	+	=	+	=

[1] See page A-18 for a complete definition of column headings.

Table A-1. Continued.

SPECIES	SCIENTIFIC NAME	HABITAT	EFFECTS OF THE HCP AMENDMENT[1]			
			RR	LS	SL	OD
MAMMALS (Continued)						
Trowbridge's shrew	*Sorex trowbridgii*	coniferous closed-canopy forest	=	+	+	+
Vagrant shrew	*Sorex vagrans*	riparian-wetland, grass-shrub	+	–	+	–
Shrew-mole	*Neurotrichus gibbsi*	riparian-wetland, grass	+	–	+	–
Coast mole	*Scapanus orarius*	wet meadows, shrub, young forest	+	–	+	+
Townsend's mole	*Scapanus townsendii*	wet meadows, grass-shrub	+	–	+	–
Big brown bat	*Eptesicus fuscus*	cliffs-caves, riparian old-growth forest, grass, wet meadows	+	+	+	+
Silver-haired bat	*Lasionycteris noctivagans*	mature and old-growth forest	=	+	+	+
Hoary bat	*Lasiurus cinereus*	riparian mature and old-growth forest	+	+	=	+
California myotis	*Myotis californicus*	cliffs-caves, riparian-wetland, old-growth forest	+	+	+	+
Long-eared myotis	*Myotis evotis*	riparian-wetland, old-growth forest	+	+	+	+
Keen's myotis	*Myotis keenii*	riparian-wetland, forest	+	+	+	+
Little brown myotis	*Myotis lucifugus*	caves, riparian-wetland, old-growth forest	+	+	+	+
Long-legged myotis	*Myotis volans*	riparian-wetland, mature and old-growth forest, cliff-caves	+	+	+	+
Yuma myotis	*Myotis yumanensis*	cliffs-caves, riparian-wetland, grass-shrub-young forest	+	–	+	+
Townsend's big-eared bat	*Plecotus townsendii*	caves, open young forest	=	–	=	+

[1] See page A-18 for a complete definition of column headings.

Table A-1. Continued.

SPECIES	SCIENTIFIC NAME	HABITAT	EFFECTS OF THE HCP AMENDMENT[1]			
			RR	LS	SL	OD
MAMMALS (Continued)						
Fringed mytois	*Myotis thysanodes*	Caves-cliffs, grass-shrub, riparian-wetland	+	=	=	=
Coyote	*Canis latrans*	riparian-wetland,grass-shrub, young forest	+	–	+	+
Gray wolf	*Canis lupus*	wilderness areas	=	=	+	=
Red fox	*Vulpes vulpes*	grass-shrub, subalpine young forest	=	=	+	+
Black bear	*Ursus americanus*	riparian wetland, shrub, closed-canopy forest	+	+	+	+
Grizzly bear	*Ursus arctos*	alpine meadows, subalpine forests, wilderness areas	=	+	=	+
Raccoon	*Procyon lotor*	riparian-wetland, shrub, forest	+	+	+	+
California wolverine	*Gulo gulo*	closed-canopy subalpine forest	=	+	=	+
River otter	*Lutra canadensis*	riparian/forest edge	+	=	=	=
Marten	*Martes americana*	mature and old-growth coniferous forest	=	+	+	+
Pacific fisher	*Martes pennanti*	mature and old-growth coniferous forest	+	+	+	+
Striped skunk	*Mephitus mephitus*	riparian-wetland grass-shrub	+	–	=	–
Ermine	*Mustela erminea*	grass-shrub, closed-canopy forest	=	+	+	+
Long-tailed weasel	*Mustela frenata*	open young forest, shrub	=	–	+	+
Mink	*Mustela vison*	riparian forest and grass-shrub	+	+	+	+

[1] See page A-18 for a complete definition of column headings.

Table A-1. Continued.

SPECIES	SCIENTIFIC NAME	HABITAT	EFFECTS OF THE HCP AMENDMENT[1]			
			RR	LS	SL	OD
MAMMALS (Continued)						
Spotted skunk	*Spilogale putorius*	riparian, shrub-young forest	+	–	+	+
Mountain lion	*Felis concolor*	young-mature forest, shrub	+	+	+	+
Bobcat	*Lynx rufus*	young-mature forest, shrub	+	+	+	+
Elk	*Cervus elaphus*	riparian-wetland, shrub, closed-canopy forest	+	+	=	+
Mule or black-tailed deer	*Odocoileus hemionus*	wet meadows, shrub, young-mature forest	+	+	=	+
Mountain goat	*Oreamnos americanus*	cliff-talus, subalpine grass-shrub, tundra	=	–	=	–
Mountain beaver	*Aplodontia rufa*	shrub-young forest	=	–	+	+
Northern flying squirrel	*Glaucomys sabrinus*	mature and old-growth forest	=	+	+	+
Hoary marmot	*Marmota caligata*	subalpine grass-shrub, talus	=	–	=	–
Yellow-billied Marmot	*Marmota flaviventris*	subalpine grass-schrub, talus	=	–	=	–
Western gray squirrel	*Sciurus griseus*	closed-canopy deciduous forest	=	+	+	+
Townsend's chipmunk	*Tamias townsendii*	conifer forest, shrub	=	=	+	+
Cascade golden-mantled ground squirrel	*Spermophilus saturatus*	shrub-coniferous forest	=	=	+	+
Yellow-pine chipmunk	*Eutamias ameonus*	open forest, forest edge	+	+	+	+
Douglas' squirrel	*Tamiasciurus douglasii*	closed-canopy coniferous forest	=	+	+	+
Beaver	*Castor canadensis*	riparian-wetland deciduous forest	+	=	=	=
Bushy-tailed woodrat	*Neotoma cinerea*	cliff-talus, closed-canopy forest	=	+	+	+

[1] See page A-18 for a complete definition of column headings.

Table A-1. Continued.

SPECIES	SCIENTIFIC NAME	HABITAT	EFFECTS OF THE HCP AMENDMENT[1]			
			RR	LS	SL	OD
MAMMALS (Continued)						
Deer mouse	*Peromyscus maniculatus*	shrub-young forest	=	-	+	+
Southern red-backed vole	*Clethrionomys gapperi*	mature forest	+	+	+	+
Long-tailed vole	*Microtus longicaudus*	wet meadows	+	-	-	-
Creeping vole	*Microtus oregoni*	moist meadow and forest	+	+	+	+
Water vole	*Microtus richardsoni*	streams, riparian-wetland	+	-	-	-
Townsend's vole	*Microtus townsenddii*	grass-shrub	=	=	=	=
Muskrat	*Ondatra zibethicus*	riparian-wetland	+	=	=	=
Heather vole	*Phenacomys intermedius*	subalpine grass-shrub	=	-	+	-
Pacific jumping mouse	*Zapus trinotatus*	grass-shrub	=	-	+	-
Porcupine	*Erethizon dorsatum*	shrub-forest	=	=	+	=
Pika	*Ochotona princeps*	talus, grass-shrub	=	-	=	-
Snowshoe hare	*Lepus americanus*	grass-shrub	=	-	+	-

[1]footnotes:

RR = **Riparian reserves** - Refers to additional benefits provided by larger riparian buffer zones in HCP amendment. This will result in protection/cover from flood runoff, weather, sun, and predators. Other benefits to life history requirements may include improved water quality, increase large woody debri, pool and stream channel improvement, improved aquatic food chain, enhanced fishing success, and increased forage and prey abundance.
LS = **Late-successional forest features** - Retention and increase of individual trees and mature forest stands over time due to riparian and upland reserves and increased green tree leave quotas.
SL = **Snags/downed logs** - Retention and increase in these features over time due to riparian and upland reserves and increased green tree/snag leave quotas.
OD = **Owl dispersal habitat** - An increase in acreage will occur throughout the life of the amendment due to riparian and upland reserves and green tree leave quotas.
\+ Feature expected to benefit species compared to original owl HCP.
= Feature not expected to benefit or impact species compared to original owl HCP.
\- Feature expected to be detrimental to species compared to original owl HCP.

AMENDMENT TO IMPLEMENTATION AGREEMENT

THIS AGREEMENT ("Amended Agreement") is made and entered into as of the 26 day of JUNE, 1995, by and between the UNITED STATES FISH & WILDLIFE SERVICE ("FWS"), an agency of the federal government, the NATIONAL MARINE FISHERIES SERVICE ("NMFS"), an agency of the federal government (FWS and NMFS may be referred to individually as "Agency" and collectively as "Agencies"), and MURRAY PACIFIC CORPORATION ("Murray Pacific"), a Washington corporation.

I.
RECITALS

WHEREAS, FWS and Murray Pacific entered into an agreement captioned "IMPLEMENTATION AGREEMENT - MURRAY PACIFIC CORPORATION - NORTHERN SPOTTED OWL - HABITAT CONSERVATION PLAN," ("Original Agreement"), dated September 24, 1993, a copy of which is attached hereto, marked Exhibit 1, and incorporated herein by this reference; and

WHEREAS, on the basis of the Original Agreement and the HABITAT CONSERVATION PLAN FOR THE NORTHERN SPOTTED OWL ("Original HCP"), FWS has issued to Murray Pacific Incidental Take Permit No. 777837 ("the Incidental Take Permit") which authorizes incidental take of the northern spotted owl (Strix occidentalis caurina) for a period of 100 years; and

WHEREAS, Murray Pacific, with the cooperation and assistance of the Agencies, has prepared an AMENDMENT to the Original HCP and ADDENDUM TO THE AMENDMENT ("Amended HCP"), which Amended term "Amended HCP" hereafter includes the terms and provisions of the Original HCP as modified by the Amended HCP. The terms of the Amended HCP shall be interpreted as supplementary to this Amended Agreement, but in the event of any direct contradiction the terms of this Amended Agreement will control.

B. **Purposes.** The purposes of this Amended Agreement are to insure implementation of the Amended HCP; to contractually bind the parties to the terms of the Amended HCP; to describe the remedies and recourse in the event of a breach of the terms hereof, and to obtain assurances that in accordance with the provisions of the ESA and Section I of this Amended Agreement, the Incidental Take Permit will be amended to add all species addressed in the Amended HCP which are listed as threatened or endangered after the effective date of this Amended Agreement, except as provided below in Section H and I.

C. **Definitions.** Terms used in the Amended HCP and in the ESA, shall have the same meaning when used in this Amended Agreement, except as may be otherwise noted. The term "threatened or endangered species" includes any species now or hereafter listed and defined as such under the Endangered Species Act and any other species afforded similar status or protection by federal law or regulation at any time applicable to the Permit Area. The term "species addressed in the Amended HCP" includes all listed and unlisted species that may now or hereafter use the types of habitats which occur on the Permit Area.

D. **Permit Area.** The Murray Pacific land exchanges with the United States Forest Service and State of Washington Department of Natural

Agreement, the Amended HCP, and the Incidental Take Permit, they will not suspend or revoke the Incidental Take Permit, excepting only to the extent that suspension or revocation of the Incidental Take Permit is governed by the provisions of 50 CFR §13.27 - 13.29 and the terms of this Amended Agreement.

I. **Adequacy, Certainty & Modification.** Within the context of commercial forest management by Murray Pacific of its tree farm, the Amended HCP promotes habitat conservation for all species addressed in the Amended HCP. This Amended HCP will contribute to the long-term conservation of federally listed and unlisted species, while providing certainty and stability for Murray Pacific and the Agencies. In exchange for adherence to its long-term commitments herein, Murray Pacific is assured that its management can continue despite any incidental taking of protected species, subject only to the provisions of the ESA and these documents, and the Agencies are assured the enhanced habitat and other fish and wildlife measures described in the Amended HCP will be provided throughout the term of this Amended Agreement. Where the terms of the Amended HCP are determined through the operation of existing state law and regulation, such as the provisions of WAC Chapter 222-22, the parties find the resulting prescriptions, based upon current standards and practices, are adequate and necessary for the purposes of this Agreement and the parties expect a comparable level of protection to be provided through the term of this Agreement. The Agencies and Murray Pacific, based upon the best scientific and commercial data available and the terms and provisions of this Amended Agreement and the Amended HCP, have found that with respect to all species addressed in the Amended HCP:

listed and which may be listed subsequent to the signing of this Amended Agreement; and

(9) The habitat enhancement and species specific mitigation and minimization measures in the Amended HCP, provide adequate protection of all habitat types in the Permit Area and thereby provide adequate protection for all species that may use the habitat types found in the Permit Area.

The Incidental Take Permit for currently listed species addressed in the Amended HCP has been issued contemporaneously with the signing of this Amended Agreement. Thereafter, each species that may use the types of habitats which occur on the Permit Area and which is listed as threatened or endangered under the ESA during the term of this Amended Agreement, shall be added to the Incidental Take Permit within 60 days of receipt by FWS and NMFS of a written request from Murray Pacific, unless within said 60-day period FWS or NMFS determines that adding such species to the Incidental Take Permit would appreciably reduce the likelihood of its survival and recovery in the wild because FWS or NMFS reasonably finds that relevant factors exist, including: (1) the size of the species' population or range is very small in relation to the Permit Area, (2) the percentage of the species' population or range adversely affected by the Amended HCP and Incidental Take Permit applicable to the Permit Area is very large in relation to the entire population or range of the species, (3) the ecological importance of the affected population or range is very significant, and (4) the adverse effects of the Amended HCP and Incidental Take Permit to the affected population or range would be very severe. If the relevant factors are found to exist, the responsible Agency in addition will determine which change is of substantial benefit to a species, and of little or no additional cost to Murray Pacific, then Murray Pacific may agree to the change. If the cost is significant to Murray Pacific, then the parties may find further or different voluntary adjustments that will avoid or minimize the cost to Murray Pacific. In negotiating, the Agencies shall not seek a commitment of additional land, operating requirements, or financial undertaking beyond the level of mitigation which is provided under the terms of the Amended HCP (provided Murray Pacific has adhered to the terms of the Amended HCP, this Amended Agreement, and the Incidental Take Permit). The Requesting Party shall bear the burden of demonstrating that significant unforeseen circumstances have arisen, and any request for consultation must emanate from someone in a position comparable to (or higher than) that of the current positions of Assistant Regional Directors of the Agencies, or Resource Manager for Murray Pacific, unless the parties agree otherwise in writing. If the Responding Party, after consultation and in its unfettered discretion, does not agree voluntarily to implement requested changes, then the Requesting Party must look to Section K, below, regarding Extraordinary Circumstances, if it wishes to continue to pursue changes, and must satisfy the provisions of Section K regarding such desired changes. The Agencies agree that so long as Murray Pacific continues to fully implement the provisions of this Amended Agreement, the Amended HCP, and the Incidental Take Permit, they will not impose on Murray Pacific any non-consensual additional land use restrictions or financial obligations for any species addressed in the Amended HCP during the duration of this Amended Agreement.

(2) the percentage of range adversely affected by the Amended HCP;

(3) the percentage of range conserved by the Amended HCP;

(4) the ecological significance of that portion of the range affected by the Amended HCP;

(5) the level of knowledge about the affected species and the degree of specificity of the species' conservation program under the Amended HCP;

(6) whether the Amended HCP was originally designed to provide an overall net benefit to the affected species and contained measurable criteria for assessing the biological success of the Amended HCP; and

(7) whether failure to adopt additional conservation measures would appreciably reduce the likelihood of survival and recovery of the particular affected species in the wild.

Any additional mitigation measures shall change the original terms of the Amended HCP only to the minimum extent necessary and shall be limited to modifications in reserve areas or to adjustments to the Amended HCP's operating program for the particular species affected by the Extraordinary Circumstances. Additional mitigation requirements shall not involve additional financial undertakings by Murray Pacific, nor apply additional restrictions or requirements to parcels of land available for forest practices operations in the Permit Area, including without limitation activities such as

O. Covenant Running With Land. This Amended Agreement and the Amended HCP shall constitute covenants against all of the land owned by Murray Pacific within the Permit Area. These covenants shall run with said lands, shall constitute covenants against them, and shall be binding upon and inure to the benefit of each successor in interest to said lands.

P. Notice. Notices under this Amended Agreement shall be delivered personally as set forth below or shall be deemed delivered five (5) days after deposit in the United States mail, certified and postage prepaid, return receipt requested and addressed as follows (or at such other address as directed from time to time by either party to the other in writing):

Murray Pacific Corporation
3502 Lincoln Avenue East
Tacoma, WA 98421

United States Fish and Wildlife Service
3704 Griffin Lane Southeast, Suite 102
Olympia, WA 98501-2192

National Marine Fisheries Service
525 NE Oregon Street, Suite 500
Portland, OR 92732-2737

Q. Duplicate Originals. This Amended Agreement may be executed in any number of duplicate originals. A complete original of this Amended Agreement shall be maintained in the official records of each of the parties hereto.

R. Venue. In the event of any dispute arising hereunder involving court action, the Parties agree to venue in the United States District Court, Western District of Washington at Tacoma, Washington.

STATE OF WASHINGTON)
)ss.
County of Pierce)

I certify that I know or have satisfactory evidence that L. T. MURRAY, III, is the person who appeared before me, and said person acknowledged that they signed this instrument, on oath stated that they are authorized to execute the instrument and acknowledged it as the Vice President and Genereal Manager of **MURRAY PACIFIC CORPORATION** to be the free and voluntary act of such party for the uses and purposes mentioned in the instrument.

Dated: June 26, 1995

Signature ____________
Type/Print Name DAWN R. PLASTER
Notary Public in and for the State of Washington, residing at AUBURN.
My appointment expires: 1-11-98.

STATE OF WASHINGTON)
)ss.
County of Pierce)

I certify that I know or have satisfactory evidence that THOMAS J. DWYER is the person who appeared before me, and said person acknowledged that they signed this instrument, on oath stated that they are authorized to execute the instrument and acknowledged it as the Deputy Regional Director, Region 1, of **UNITED STATES FISH AND WILDLIFE SERVICE** to be the free and voluntary act of such party for the uses and purposes mentioned in the instrument.

Dated: June 26, 1995

Signature ____________
Type/Print Name DAWN R. PLASTER
Notary Public in and for the State of Washington, residing at AUBURN
My appointment expires: 1-11-98

IMPLEMENTATION AGREEMENT
MURRAY PACIFIC CORPORATION
NORTHERN SPOTTED OWL
HABITAT CONSERVATION PLAN

THIS AGREEMENT is made and entered into as of the 24th day of September 1993, by and between the United States Fish and Wildlife Service (Service), and Murray Pacific Corporation (Murray Pacific), a Washington Corporation.

I.
RECITALS

WHEREAS, Murray Pacific owns approximately 55,000 acres of forest land in eastern Lewis County upon which Murray Pacific desires to continue to conduct forest practices including harvesting, and upon which at any given time Northern Spotted Owls *(Strix occidentalis caurina)* may reside or visit; and

WHEREAS, the Northern Spotted Owl (Owl) is listed as threatened under the Federal Endangered Species Act, 16 U.S.C. 1531, *et. seq.*, as amended, (ESA), and any taking, as that term is used in the ESA, of Owls is prohibited, except for incidental takings authorized by the Service in connection with approval of a Habitat Conservation Plan (HCP); and

WHEREAS, an Owl HCP has been prepared by Murray Pacific for its lands in Lewis County, Washington through the cooperation and assistance of the Service the Washington State Department of Wildlife and many others, after lengthy study and discussion;

NOW, THEREFORE, in consideration of the mutual covenants and conditions contained herein, the parties hereby agree as follows:

II.
AGREEMENT

A. **Incorporation of HCP.** The HCP and its terms are incorporated by this reference. The terms of this Agreement and those of the HCP shall be interpreted as supplementary to each other, but in the event of any direct contradiction the terms of this Agreement will control.

B. **Legal Requirements.** The HCP provides measures intended to assure that any take occurring within the HCP and Incidental Take Permit area will be incidental; that the impacts of the take will to the maximum extent practicable be minimized and mitigated; that adequate funding for the HCP will be provided; and that the take will not appreciably reduce the likelihood of the survival and recovery of the owl.

C. **Purposes.** The purposes of this Agreement are to insure implementation of the HCP; to contractually bind the parties to the

EXHIBIT 1

IV.
MISCELLANEOUS PROVISIONS

K. **Amendments.** Except as otherwise required by law, this Agreement may be amended only with the written consent of each of the parties. This amendment process will be used to address unforeseen circumstances.

L. **Successors and Assigns.** This Agreement, the HCP and the Incidental Take Permit shall be binding upon and shall inure to the benefit of the parties and their respective successors and assigns.

M. **Covenant Running with Land.** This Agreement, the HCP and the Incidental Take Permit shall constitute covenants against all of that land within the plan area. These covenants shall run with said lands, shall constitute covenants against them, and shall be binding upon and inure to the benefit of each successor in interest to said lands.

N. **Notice.** Notices under this Agreement shall be delivered personally as set forth below or shall be deemed delivered five (5) days after deposit in the United States mail, certified and postage prepaid, return receipt requested and addressed as follows (or at such other address as directed from time to time by either party to the other in writing):

Murray Pacific Corporation
3502 Lincoln Avenue East
Tacoma, Washington 98421

United States Fish and Wildlife Service
3704 Griffin Lane Southeast, Suite 102
Olympia, Washington 98501-2192

O. **Duplicate Originals.** This Agreement may be executed in any number of duplicate originals. A complete original of this Agreement shall be maintained in the official records of each of the parties hereto.

P. **Third Party Beneficiaries.** This Agreement is not intended to create, and does not create, any third party beneficiary interest herein in the public or in any member thereof, nor shall it authorize anyone not a party to this Agreement to maintain a suit for personal injuries or property damages under the provisions hereof.

THIS AGREEMENT has been executed on the dates indicated below and shall become effective on the day and year first above written.

EXHIBIT 1

Judith M Grover
NOTARY PUBLIC in and for the
State of Oregon
My commission expires: 10/15/96

OFFICIAL SEAL
JUDITH M. GROVER
NOTARY PUBLIC-OREGON
COMMISSION NO. 019130
MY COMMISSION EXPIRES OCT. 15, 1996

EXHIBIT 1

Parcel	Tax Number	Description
16	33969	The southeast quarter of Section 12, Township 13 North, Range 4 East, W.M., Lewis County, WA.
17	33973	All of Section 13, Township 13 North, Range 4 East, W.M., Lewis County, WA.
18	33977	The north half and the southeast quarter of Section 14, Township 13 North, Range 4 East, W.M., Lewis County, WA.
19	33979	The southwest quarter of Section 14, Township 13 North, Range 4 East, W.M., Lewis County, WA.
20	33981	The north half and the north half of the southeast quarter of Section 15, Township 13 North, Range 4 East, W.M., Lewis County, WA.
21	33983	The southwest quarter and the south half of the southeast quarter of Section 15, Township 13 North, Range 4 East, W.M., Lewis County, WA.
22	33986	All of Section 17, Township 13 North, Range 4 East, W.M., Lewis County, WA.
23	34003	All of Section 21, Township 13 North, Range 4 East, W.M., Lewis County, WA.
24	34007	All of Section 22, Township 13 North, Range 4 East, W.M., Lewis County, WA.
25	34011	All of Section 23, Township 13 North, Range 4 East, W.M., Lewis County, WA.
26	34015-1	The southwest quarter of the northeast quarter of Section 24, Township 13 North, Range 4 East, W.M., Lewis County, WA.
27	34016	The northwest quarter and the north half of the southwest quarter of Section 24, Township 13 North, Range 4 East, W.M., Lewis County, WA.
28	34021-2	The west half of the northeast quarter of the southeast quarter of Section 24, Township 13 North, Range 4 East, W.M., Lewis County, WA.
29	34022	The northwest quarter of the southeast quarter of Section 24, Township 13 North, Range 4 East, W.M., Lewis County, WA.
30	34040	The northwest quarter and the north half of the northeast quarter and the southwest quarter of the northeast quarter of Section 26, Township 13 North, Range 4 East, W.M., Lewis County, WA.

Parcel	Tax Number	Description
45	34387	The north half of the northeast quarter and the southwest quarter of the northeast quarter and the northwest quarter and the south half of Section 15, Township 13 North, Range 5 East, W.M., Lewis County, WA.
46	34427-4	That portion of the east half of the southwest quarter lying West of State Highway 7 and lying northeast of the Tilton River in Section 18, Township 13 North, Range 5 East, W.M., Lewis County, WA.
47	34428-2	That portion of the east half of the southeast quarter and that portion of the northwest quarter of the southeast quarter lying east of the Chicago, Milwaukee, St. Paul and Pacific Railway right of way PLUS that portion of the southwest quarter of the southeast quarter lying west of the Chicago, Milwaukee, St. Paul and Pacific Railway right of way and lying east of a line described as follows: beginning at an iron bolt 1877.77 feet west of the southeast corner of Section 18, Township 13 North, Range 5 East; then west for 100.0 feet, then north for 660.0 feet, then east for 366.7 feet, more or less, to the west boundary of the Ladd Logging Company's right of way, then following the west boundary of said right of way to the north line of said subdivision PLUS that portion of the northwest quarter of the southeast quarter lying east of the Tilton River and west of the Tacoma Eastern Railway r right of way and north of a line descibed as follows: beginning at a point 180.1 feet west of the southeast corner of the northwest quarter of the southeast quarter of Section 18, Township 13 North, Range 5 East, then North 2^30' East 370.3 feet, then west to the Tilton River on a bearing parallel to the south line of said subdivision all in Section 18, Township 13 North, Range 4 East, W.M., Lewis County, WA.
48	34428-3	The southwest quarter of the northwest quarter and the east half of the northwest quarter lying west of State Highway 7 in Section 18, Township 13 North, Range 5 East, W.M., Lewis County, WA.
49	34428-4	That portion of the northeast quarter lying west of State Highway 7 in Section 18, Township 13 North, Range 5 East, W.M., Lewis County, WA.
50	34432	The west half of the southwest quarter of Section 18, Township 13 North, Range 5 East, W.M., Lewis County, WA.

EXHIBIT 1

Parcel	Tax Number	Description
60	34483	The north half and the southwest quarter and the north half of the southeast quarter of Section 22, Township 13 North, Range 5 East, W.M., Lewis County, WA.
61	34496	All of Section 23, Township 13 North, Range 5 East, W.M., Lewis County, WA.
62	34512	The northeast quarter and the southwest quarter and the north half of the northwest quarter and the southwest quarter of the northwest quarter and the southwest quarter of the southeast quarter of Section 24, Township 13 North, Range 5 East, W.M., Lewis County, WA.
63	34524	All of Section 25, Township 13 North, Range 5 East, W.M., Lewis County, WA.
64	34537	The east half of Section 26, Township 13 North, Range 5 East, W.M., Lewis County, WA.
65	34545	The east half of Section 27, Township 13 North, Range 5 East, W.M., Lewis County, WA.
66 and 67	34591-3 and 34592-1	That portion of the west half of the southwest quarter of the northeast quarter lying south of the East Fork of the Tilton River in Section 30, Township 13 North, Range 5 East, W.M., Lewis County, WA.
68 and 69	34593-1-2 and 34593-1-4	That portion of the southeast quarter of the northeast quarter lying south of the East Fork of the Tilton River and lying southwesterly of the South Fork of the Tilton River in Section 30, Township 13 North, Range 5 East, W.M., Lewis County, WA.
70 and 71	34594-2 and 34596	The Northwest quarter EXCEPT the Tacoma Eastern Railroad right of way ALSO EXCEPT the Murray Road ALSO EXCEPT the West 544.75 feet lying North of the Murray Road in Section 30, Township 13 North, Range 5 East, W.M., Lewis County, WA.
72	34598	The South half of Section 30, Township 13 North, Range 5 East, W.M., Lewis County, WA.
73	34654	The north half of the north half and the south half of the northeast quarter and the northeast quarter of the southeast quarter and the south half of the south half of Section 34, Township 13 North, Range 5 East, W.M., Lewis County, WA.
74	34673	The north half of the northwest quarter and the northwest quarter of the northeast quarter of Section 35, Township 13 North, Range 5 East, W.M., Lewis County, WA.
75	34683	All of Section 1, Township 13 North, Range 6 East, W.M., Lewis County, WA.

Parcel	Tax Number	Description
92	34776	All of Section 19, Township 13 North, Range 6 East, W.M., Lewis County, WA.
93	34780	The north half of the northwest quarter and the west half of the southwest quarter and the east half of Section 20, Township 13 North, Range 6 East, W.M., Lewis County, WA.
94	34781	The south half of the northwest quarter and the east half of the southwest quarter of Section 20, Township 13 North, Range 6 East, W.M., Lewis County, WA.
95	34784	All of Section 21, Township 13 North, Range 6 East, W.M., Lewis County, WA.
96	34788	The north half of the northeast quarter and the southeast quarter of the northeast quarter and northeast quarter of northwest quarter of Section 22, Township 13 North, Range 6 East, W.M., Lewis County, WA.
97	34792	The south half and the southwest quarter of the northeast quarter and the northwest quarter of the northwest quarter and the south half of the northwest quarter of Section 22, Township 13 North, Range 6 East, W.M., Lewis County, WA.
98	34793	All of Section 23, Township 13 North, Range 6 East, W.M., Lewis County, WA.
99	34809	The east half and the northwest quarter of Section 24, Township 13 North, Range 6 East, W.M., Lewis County, WA.
100	34817	The southwest quarter of Section 24, Township 13 North, Range 6 East, W.M., Lewis County, WA.
101	34825	All of Section 25, Township 13 North, Range 6 East, W.M., Lewis County, WA.
102	34841	All of Section 26, Township 13 North, Range 6 East, W.M., Lewis County, WA.
103	34857	All of Section 27, Township 13 North, Range 6 East, W.M., Lewis County, WA.
104	34860-1	All of Section 28, Township 13 North, Range 6 East, W.M., Lewis County, WA.
105	34861	All of Section 29, Township 13 North, Range 6 East, W.M., Lewis County, WA.
106	34866-1	All of Section 30, Township 13 North, Range 6 East, W.M., Lewis County, WA.
107	34867	All of Section 31, Township 13 North, Range 6 East, W.M., Lewis County, WA.

Parcel	Tax Number	Description
125	34998	All of Section 29, Township 13 North, Range 7 East, W.M., Lewis County, WA.
126	35013-1	All of Section 30, Township 13 North, Range 7 East, W.M., Lewis County, WA.
127	35014	All of Section 31, Township 13 North, Range 7 East, W.M., Lewis County, WA.
128	36862-1	The southwest quarter of Section 25, Township 14 North, Range 4 East, W.M., Lewis County, WA.
129	36880-1	The south half of the north half and the south half of Section 26, Township 14 North, Range 4 East, W.M., Lewis County, WA.
130	36923	All of Section 33, Township 14 North, Range 4 East, W.M., Lewis County, WA.
131	36927	The northeast quarter and the south half of Section 34, Township 14 North, Range 4 East, W.M., Lewis County, WA.
132	36931	The northwest quarter of Section 34, Township 14 North, Range 4 East, W.M., Lewis County, WA.
133	36940	All of Section 35, Township 14 North, Range 4 East, W.M., Lewis County, WA.
134	36960	The west half of the southwest quarter of Section 36, Township 14 North, Range 4 East, W.M., Lewis County, WA.
135	38044-2	The south half of Section 31, Township 14 North, Range 7 East, W.M., Lewis County, WA.

Rec'd 5/10/95
[illegible]

FILED FOR RECORD AT REQUEST OF:

DANIEL D. ZENDER
SIMONARSON, VISSER,
ZENDER & THURSTON
P. O. BOX 5226
BELLINGHAM, WASHINGTON 98227

AMENDED DECLARATION OF COVENANT

Know all persons by these presents that MURRAY PACIFIC CORPORATION ("MURRAY"), a Washington Corporation, by and through L.T. MURRAY, III, its VICE PRESIDENT, hereby declares and establishes this covenant and places the same on record as binding against all the land described herein.

Reference is made to that certain DECLARATION OF COVENANT ("Original Covenant") dated September 20, 1993, against certain lands owned by MURRAY as described therein, and filed in the real property records of the Lewis County Auditor on September 21, 1993 in Volume 568 at pages 168 through 179. The Original Covenant is incorporated by reference and made a part hereof. The terms and provisions of the Original Covenant remain effective to the extent they do not contradict this AMENDED DECLARATION OF COVENANT ("Amended Covenant"), in which case this Amended Covenant will control.

MURRAY has acquired certain land ("New Land") since the filing of the Original Covenant, which is not included in the legal description attached to the Original Covenant. The New Land is described in the attached Exhibit A, which is incorporated by reference. The Original Covenant and its Exhibit A are hereby amended to include the New Land within the area covered by the Original Covenant, and to declare all such land, New Land and that described in the Original Covenant, subject to this Amended Covenant. All of such land, in total, shall hereinafter be referred to as the "HCP Plan Area".

The Original Covenant resulted from the approval by the United States Fish & Wildlife Service of a Habitat Conservation Plan ("Original HCP") for the Northern Spotted Owl prepared by MURRAY, Fish & Wildlife Service issued an Incidental Take Permit ("Original Take Permit"), pursuant to Section 10 of the Federal Endangered Species Act, to MURRAY. As a result of the Amended HCP and Amended Agreement the Original Take Permit has been amended, and may be further amended in the future from time to time, to cover other species of fish and wildlife (the "Amended Take Permit"). The Amended Take Permit is not transferrable or assignable to any new owner of any portion of the HCP Plan Area. Any successor in interest must obtain a similar Incidental Take Permit from the United States Fish & Wildlife Service and/or the National Marine Fisheries Service prior to continuing the activities permitted by MURRAY. See, e.g., 50 CFR Ch. 1, Section 13.25.

WITNESS my hand this _____ day of January, 1995.

MURRAY PACIFIC CORPORATION

____
L.T. MURRAY, III, Vice President

STATE OF WASHINGTON)
) ss
County of)

I certify that I know or have satisfactory evidence that L.T. MURRAY, III is the person who appeared before me, and said person acknowledged that he signed this instrument, on oath stated that he was authorized to execute the instrument and acknowledged it as the Vice President of MURRAY PACIFIC CORPORATION to be the free and voluntary act of such party for the uses and purposes mentioned in the instrument.

Dated:________________

____
NOTARY PUBLIC in and for the
State of Washington. My
commission expires: ________