# Executive Summary
# Biological Assessment for Gifford Pinchot National Forest and Columbia River Gorge National Scenic Area (Washington side) Invasive Plant Treatment Program

The enclosed Biological Assessment (BA) documents the effects to proposed and threatened fish and wildlife species from the Gifford Pinchot National Forest (GPNF) and Columbia Rive Gorge National Scenic Area, Washington side, (CRGNSA) Invasive Plant Treatment Project. The Forest Service proposes to use manual, mechanical, and herbicide methods to eradicate, control or contain invasive plants and restore sites using passive and active techniques such as seeding, mulching and planting native vegetation. A variety of invasive plant species would be treated, including but not limited to bull and Canada thistle, knapweed, hawkweed, knotweed, and reed canarygrass.

Currently, invasive plants are degrading habitat for native plant communities in or near special places such as the Columbia River Gorge National Scenic Area, Mount St. Helens National Volcanic Monument, Glacier View, Trapper Creek, Indian Heaven, Tatoosh, Goat Rocks, William O. Douglas, Mount Adams Wilderness; as well as Botanical and Wildlife Special Areas, Research Natural Areas, areas with sensitive plant and animal populations, the Pacific Coast Trail, and a host of other trails, campgrounds, and other popular recreation areas.

Without treatment, invasive plants will continue to spread within these and other special areas on and adjacent to the National Forest. Invasive plants on National Forest system lands also have the potential to spread to neighboring lands including Mount Rainier National Park, and other federal, state, tribal lands, and private properties.

**The Proposed Action**

Under the Proposed Action, the Forest Service would respond to existing and new infestations of invasive plants with a variety of treatment methods appropriate to a range of site conditions found on the GPNF and CRGNSA. The most ambitious conceivable treatment scenario would eradicate, control, or contain the estimated 2,710 acres of invasive plants on the Forest within five years, with a small amount of residual site maintenance likely to be needed thereafter.

The most ambitious conceivable treatment scenario forms the basis for effects analysis but is unlikely to actually occur. Thus, the project may take10 to 15 years or more to fully accomplish. The fewer acres treated annually, the longer the project will likely last. The Proposed Action would guide treatment until the analysis was no longer valid because the job was completed or conditions otherwise changed enough to warrant supplemental investigation.

Many variables influence the site-specific treatment prescription at any point in time. The size and location of the infestation, the growth habits of the target species, and the potential adverse impacts of treatment factor into the final prescription. Herbicide application would likely be part of the treatment prescription for known sites; however, use of herbicides would be expected to decline in subsequent entries as population size is decreased and non-herbicide methods to the point where herbicide is no longer needed.

About 2,000 acres (85%) of the estimated 2,710 currently infested acreage occurs within roadside treatment areas. There are about 943 infested acres along roads that have been identified as having high potential to deliver herbicide to streams channels.

The foundation for the Proposed Action is a 2004 Data Base (GPNF and CRGNSA DEIS Appendix A). Vectors of invasive plant spread were surveyed in the field and results were documented in the data base. The Common Control Measures document was used to categorize treatment prescriptions (mainly combinations of herbicide with manual (pulling by hand or with non-motorized tools) and mechanical methods (mowing, edge trimming, or using a chainsaw to cut or girdle woody target species).

The treatment areas that were analyzed are much larger than the currently infested sites and include areas where invasive plant spread could be predicted (they include entire road systems). Based on the surveys, anecdotal information, and predicted rates of spread during the analysis period, invasive plants were estimated to cover about 2,710 acres, approximately 4.75 percent of the gross treatment area acreage (about 57,000 acres of National Forest system lands).

The rate, direction, distance and relative importance of invasive plant spread varies by species and situation and is unpredictable. Existing infestations may spread in unpredictable ways and new infestations are likely to occur. To accommodate this uncertainty, the analysis was broadened to consider a range of treatment methods applied to a variety of site conditions that were found throughout the treatments areas.

The Early Detection/Rapid Response process under the Proposed Actions allows for treatment "within the scope of the EIS" to occur on new, unknown, and unpredicted infestations found over the next five to fifteen years. This is known as the programmatic nature of the Proposed Action. The analysis for the Proposed Action considered treatment of 2,710 acres estimated as the current inventory. However, invasive plants are likely to spread to additional acreage beyond the current inventory within and outside mapped treatment areas.

An Implementation Planning Process was developed to ensure that the treatments of unpredictable infestations are similar to those analyzed and that PDCs are appropriately applied. This process would ensure that treatments of new or unpredictable infestations would have effects within the scope of those disclosed in this BA.

**Summary of Effects Determinations for Federally Listed Species**

Twelve fish species and 5 wildlife species listed as threatened or proposed for listing under the Endangered Species Act are included in this BA. The Proposed Action may affect, and is likely to adversely affect the Lower Columbia River Steelhead, Lower Columbia River Chinook, Lower Columbia River Coho, Columbia River chum, and Columbia River bull trout. The Proposed Action may affect, but is not likely to adversely affect Coastal Puget Sound bull trout, Middle and Upper Columbia River Steelhead, Snake River Spring/Summer-run Chinook, Snake River Fall-run Chinook, Upper Columbia River Spring-run Chinook, and Snake River Sockeye salmon.

The Proposed Action may affect, but is not likely to adversely affect the bald eagle, northern spotted owl, and marbled murrelet. The Proposed Action will have no effect on designated critical habitat for the northern spotted owl and marbled murrelet. The table below displays federally listed species (and those proposed for listing) within the action area; the species effect determination, the status of critical habitat, and the effects determination on critical habitat where appropriate.

Table 1 - Federally Listed Species on GPNF and CRGNSA

| Species | Listing Status | Species Effect Determination[1] | Critical Habitat | Habitat Effect Determination |
|---|---|---|---|---|
| ***Birds*** | | | | |
| Bald eagle | Threatened | NLAA | No | N/A |
| Northern spotted owl | Threatened | NLAA | Designated | No Effect |
| Marbled Murrelet | Threatened | NLAA | Designated | No Effect |
| ***Mammals*** | | | | |
| Grizzly bear | Threatened | No effect | No | N/A |
| Gray wolf | Endangered | No effect | No | N/A |
| ***Fish*** | | | | |
| Lower Columbia River Steelhead Trout | Threatened | LAA | Designated | NLAA |
| Middle Columbia River Steelhead Trout | Threatened | NLAA | Designated | NLAA |
| Upper Columbia River Steelhead Trout | Endangered | NLAA | Designated | No Effect |
| Snake River Spring/Summer-run Chinook Salmon | Threatened | NLAA | Designated | No Effect |
| Snake River Fall-run Chinook Salmon | Threatened | NLAA | Designated | No Effect |
| Upper Columbia River Spring-run Chinook Salmon | Endangered | NLAA | Designated | No Effect |
| Lower Columbia River Chinook Salmon | Threatened | LAA | Designated | NLAA |
| Lower Columbia River Coho Salmon | Threatened | LAA | No | N/A |
| Columbia River Chum Salmon | Threatened | LAA | Designated | NLAA |
| Coastal Puget Sound Bull Trout | Threatened | No Effect | Designated | No Effect |
| Columbia River Bull Trout | Threatened | LAA | Designated | No Effect |
| Snake River Sockeye Salmon | Endangered | NLAA | Designated | No Effect |

NLAA (Not Likely to Adversely Affect); LAA (Likely to Adversely Affect), N/A (Not Applicable).
Please note that the project does not affect any listed plant species. .

The effect determination for designated critical habitat of Lower Columbia River Steelhead, Middle Columbia River Steelhead, Lower Columbia River Chinook, and Columbia River Chum is "**may affect, but not likely to adversely affect**." The effect determination for Upper Columbia River Steelhead, Snake River Spring/Summer Chinook, Snake River Fall Chinook, Upper Columbia River Spring-run Chinook, Snake River Sockeye, Columbia River Bull Trout, and Coastal Puget Sound Bull trout is "**no effec**t".

Effects analysis indicates that disturbance is the only likely effects to bald eagle, northern spotted owl, or marbled murrelet. The potential for disturbance during critical seasons is avoided through use of mandatory project design criteria. Therefore, the Proposed Action may affect, but is not likely to adversely affect the bald eagle, northern spotted owl and marbled murrelet.

Critical habitat is designated for the northern spotted owl and marbled murrelet. The Proposed Action will have no effect on designated critical habitat for the northern spotted owl and marbled murrelet because invasive plant treatments do not affect or remove any primary constituent elements of critical habitat.

The proposed action will have "no effect" on grizzly bears or gray wolves, so they are not included in this BA.

Rationale for the effects determination is:

1. There is no potential for federally listed birds to be exposed to harmful doses of herbicides. The PDCs avoid potential for adverse effects from disturbance by restricting the seasons and distances from nests or unsurveyed suitable habitat within which noise-producing projects may be conducted.
2. Non-herbicide treatments at sites listed in Appendix A of the GPNF and CRGNSA DEIS, and new infestations would result in negligible ground disturbance because the use of heavy machinery in riparian areas is excluded. Patches of bare ground would likely be revegetated rapidly (i.e. within one year) and sediment input would be insignificant as compared to baseline (background) levels.
3. Listed fish are not present in certain treatment areas (see Appendix G and H of this BA) and are unlikely to be present at the immediate site of treatment at sites listed in Table 33 of this BA. Future treatments of emergent invasive plants under EDRR have the potential to impact federally listed fish in small streams because there is the potential for a worker to accidentally damage a redd while wading across a stream to access the opposite streambank or island/gravel bar. The likelihood of adversely impacting fish or redds is minimal because activities would be planned and scheduled to avoid disturbance of spawning fish or damage to redds.
4. Future invasive plant treatment projects under EDRR could impact federally listed fish when treatment of emergent invasive vegetation takes place during spawning and/or if redds are accidentally stepped on. This situation introduces the possibility of a worker disturbing fish during spawning and impacting redds, especially on smaller streams, resulting in an adverse affect. The likelihood is minimized because activities would be planned and scheduled to avoid disturbance of spawning fish or damage to redds. The threshold of treatment area relative to stream size is not currently known, therefore, there is the possibility of having a greater impact on smaller streams with larger infestations.
5. The potential for herbicide treatments to reach a level of concern for fish is low. SERA Risk Assessment worksheets completed for three aquatic labeled herbicides (glyphosate, imazapyr, triclopyr) at the Cave Creek Meadows on GPNF and Hot Springs site on CRGNSA indicate that herbicide concentrations as a result of riparian treatments would be well below levels of concern for fish. However, a separate analysis for estimated peak concentrations within 1 $ft^3$ of water for the emergent vegetation did result in glyphosate and triclopyr exceeding the level of concern for fish. It is unlikely that the calculated levels of concern from the SERA risk assessment worksheets and emergent vegetation analysis would be reached because there will be vegetation interception, precise application methods that reduce drift or droplets, and herbicide degradation over time before inundation and/or immediate rainfall. These factors further reduce the potential for exposures at a level of concern. In addition, it is impossible operationally under the Proposed Action to reach herbicide concentrations calculated for

emergent vegetation treatments. Broadcast treatments would not occur within 50 feet of any stream, within any wetland with water present, or along roads having high risk of herbicide delivery. The Proposed Action's Project design criteria (PDCs) and buffers minimize or eliminate the potential for exposures calculated from the SERA Risk Assessment worksheets and emergent vegetation analysis to occur. More information about the analysis methodology, results, and how the PDCs and buffers abate risks is discussed in the BA.

6. Analysis of herbicide treatments along roadside areas may result in low levels of herbicides coming in contact with water. Herbicides identified by the R6 FEIS as a higher risk to aquatic organisms will not be used on roads that have a high potential for herbicide delivery, thereby eliminating the potential for exposure at levels calculated by the SERA Risk Assessments. In addition, broadcasting applications will not occur on roads that have a high potential for herbicide delivery. The lower and moderate risk herbicides used on roads that have a high potential for herbicide delivery are not likely to reach levels of concern because of buffers, vegetation interception, precise application methods reducing drift or droplets, and degradation over time before inundation and/or immediate rainfall.
7. Designated critical habitat for fish listed above in Table 1 is not likely to be adversely affected because manual, mechanical and herbicide methods applied within the immediate riparian area of waterbodies and along stream channels and stream banks will not result in significant ground disturbance. There will be no use of heavy equipment within Riparian Reserves outside of roads, trails and other previously disturbed areas, therefore any sedimentation would be negligible.
8. Although critical habitat for Coastal Puget Sound and Columbia River bull trout does not include National Forest lands, potential downstream effects were considered in the analysis of critical habitat. No downstream impacts are expected from treating invasive plants on National Forest lands. Therefore, treatments will have no effect on critical habitat for Coastal Puget Sound or Columbia River bull trout downstream of National Forest lands.

The known infestations currently in the GPNF and CRGNSA invasive plant inventory would fall under "may affect, not likely to adversely affect" because of the proximity, probability, and magnitude of the effects from herbicide and non-herbicide treatment methods. No tank mixtures are currently proposed for the existing sites. Non-herbicide treatment methods of future infestations are expected to have the same effect as the existing sites. Therefore, future non-herbicide treatment methods are expected to be "not likely to adversely affect". Herbicide and non-herbicide treatments for future infestations would follow the implementation and planning process outlined in the Proposed Action. Most future treatments under the proposed action will result in "no effect" or are "not likely to adversely affect" federally listed birds and fish due to the mandatory PDC's required for current and future projects. However, because EDRR sites are "unknown" infestations, there is the possibility of treating emergent invasive vegetation during spawning and/or when redds are present. Although activities would be planned and scheduled to avoid disturbance of spawning fish or damage to redds, there is a small likelihood of accidentally stepping on a redd or displacing spawning fish when needing to wade across a stream or access an island. In addition, there is a slight potential for herbicide exposure to fish during emergent vegetation treatments if fish are present. The amount of herbicide exposure is more than likely to be below levels of concern. Therefore, the programmatic nature of the proposed action may result in situations that are likely to adversely affect federally listed fish. The types of activities that are most likely to adversely affect listed fish and their habitat include:

- Herbicide applications of emergent invasive vegetation in small streams

### Terminology

The nature of this document and the analysis conducted for it necessitates the use of terminology specific to the field of toxicology, as well as the typical terminology used in ESA consultation. To assist the reader, there is a Glossary included at the end of the analysis and discussion (and before the appendices). In addition, below is a highlighted box containing terminology frequently used in the herbicide analysis sections.

**a.i. –** active ingredient.

**EEC**- *Estimated/expected environmental concentration*: The estimated or expected pesticide concentration in an environmental media based on a particular set of assumptions and/or models.

**HQ** – *Hazard Quotient*: The ratio of the estimated level of exposure to a substance from a specific pesticide application to the reference dose for that substance, or to some other index of acceptable exposure or toxicity (e.g.'toxicity index'). A HQ less than or equal to one is presumed to indicate an acceptably low level of risk for that specific application.

**LOC –** *Level of Concern*: The concentration in media or some other estimate of exposure above which there may be effects.

**LOAEL or LOAEC** – *Lowest-observed-adverse-effect level or lowest-observed-adverse-effect-concentration*: The lowest dose associated with an adverse effect.

**NOAEL or NOAEC** – *No-observed-adverse-effect level/concentration*: An exposure level at which there are no statistically or biologically significant increases in the frequency or severity of adverse effects between the exposed population and its appropriate control; some effects may be produced at this level, but they are not considered as adverse, or as precursors to adverse effects. In an experiment with several NOAELs, the regulatory focus is primarily on the highest one, leading to the common usage of the term NOAEL as the highest exposure without adverse effects.

**NOEL or NOEC** - *No-observed-effect-level/concentration*: exposure level at which there are no statistically or biological significant differences in the frequency or severity of adverse effects between the exposed population and its appropriate control.

**Toxicity index:** The benchmark dose used in this analysis to determine a potential adverse effect when it is exceeded. Usually a NOAEL, but when data are lacking other values may be used.

# Fisheries and Wildlife
# BIOLOGICAL ASSESSMENT
# FOR THE
# USDA FOREST SERVICE

# GIFFORD PINCHOT NATIONAL FOREST
# COLUMBIA RIVER GORGE NATIONAL SCENICE AREA, WASHINTON SIDE
# INVASIVE PLANT TREATMENT PROJECT


**Prepared by:** **Diana Perez Rose, Fish Biologist, USDA Forest Service**
**Shawna Bautista, Wildlife Biologist, USDA Forest Service**

**Supporting information by:** **Carol Thornton, Hydrologist, USDA Forest Service**

**Edited by:** **Rochelle Desser, Environmental Specialist, USDA Forest Service**

**Reviewed by:** **Rachel Friedman, Fish Biologist, NOAA Fisheries**
**Patty Walcott, Biologist, US Fish and Wildlife Service**



**Submitted to:** **NOAA Fisheries and US Fish and Wildlife Service**

**Lacy Office, Washington**

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# I. INTRODUCTION

## A. Background and Purpose

### *The Threat of Invasive Plants*

Invasive plants are displacing native plants, and have the potential to destabilize streams, reducing the quality of fish and wildlife habitat and degrading natural areas in the Gifford Pinchot National Forest and Columbia River Gorge National Scenic Area, Washington side (GPNF and CRGNSA). Invasive plants found growing adjacent to or within aquatic influence areas can invade, occupy, and dominate riparian areas and indirectly impact aquatic ecosystems and fish habitat. Target species such as knotweed and blackberry can choke streams, become sediment traps, and block fish access. For example, invasive blackberries may dominate small streams or spread their thick root systems within and across streams, blocking fish access.

Invasive plants can change stand structure and alter future inputs of wood and leaves that provide the basic foundation of the aquatic ecosystem food webs. Native vegetation growth may change as a result of infestation, and the type and quality of litter fall, and quality of organic matter may decline, which can alter or degrade habitat for aquatic organisms. For example, native vegetation regeneration was reduced as a result of knotweed infestations (Lauren Urgenson, pers. Comm.). The amount of nitrogen to aquatic ecosystems through riparian litter fall may be compromised because knotweed retains more nitrogen than native species. The availability of nitrogen to aquatic biota and native vegetation may be significantly reduced because knotweed can uptake or hold on to 75 percent of leaf nitrogen in the root system (ibid). Primary and secondary consumers that form the basic food source for fish and other aquatic organisms may be indirectly affected.

Invasive species were identified by the Chief of the Forest Service as one of the four top threats to forest health (for more information see http://www.fs.fed.us/projects/four-threats). In response to increasing infestations, the USDA Forest Service, Pacific Northwest Region, GPNF and CRGNSA have prepared a Draft Environmental Impact Statement (DEIS) that analyzes the effects of treating existing and future infestations of invasive plants in the Forest. Existing infestations are identified, grouped into treatment areas, and methods proposed to treat these infestations are identified. Future infestations will be treated using an Early Detection/Rapid Response protocol.

Approximately 2,710 acres are currently estimated to need treatment, including but not limited to knapweeds, hawkweeds, knotweeds, and reed canarygrass. Under the Proposed Action, infested areas would be treated with an initial prescription and retreated in subsequent years until the site was restored with desirable vegetation. Herbicide treatments would be part of the initial prescription for most sites; however, use of herbicides would be expected to decline in subsequent entries as a result of effective treatment. Ongoing inventories would confirm the location of specific invasive plants and effectiveness of past treatments. Treatment prescriptions would be strict enough to ensure that adverse effects are minimized, while flexible enough to adapt to changing conditions over time.

The DEIS has been prepared to consider the site-specific environmental consequences of treating invasive plants over the next 5 to 15 years (until invasive plant objectives are met or until changed conditions or new information warrants the need for a new decision).  This EIS is tiered to a broader scale analysis (the Pacific Northwest Region Final Environmental Impact Statement for the Invasive Plant Program, USDA 2005a, hereby referred to as the R6 2005 FEIS).

The R6 2005 FEIS culminated in a Record of Decision (USDA 2005b, hereby referred to as the R6 2005 ROD), which added management direction relative to invasive plants to the GPNF Plan. The management direction applied to the broader Forest invasive plant program, establishing goals, objectives and standards for public education and coordination, prevention of the spread of invasive plants during land uses and activities, reducing reliance on herbicides over time, and treatment and restoration.

### *Purpose of the Biological Assessment*

The purpose of this biological assessment (BA) is to determine and document how the proposed action (GPNF and CRGNSA Invasive Plant Treatment Project) affects fish and wildlife species listed under the Endangered Species Act of 1973 (ESA), as amended, or their designated critical habitats.  This treatment project will improve the ability of the National Forests to manage and reduce infestations of invasive plant species.  This action will adhere to the current rules and regulations, and existing planning documents established by Region Six, including the Northwest Forest Management Plan (NWFP) (USDA and USDI, 1994), GPNF Land and Resource Management Plan, as amended by the NWFP, and PACFISH (USDA and USDI 1995a).

Species included in this BA are bald eagle, northern spotted owl, marbled murrelet, Lower Columbia River Steelhead, Middle Columbia River Steelhead, Upper Columbia River Steelhead, Snake River Spring/Summer-run Chinook, Snake River Fall-run Chinook, Upper Columbia River Spring-run Chinook, Lower Columbia River Chinook, Lower Columbia River Coho, Columbia River Chum, Coastal Puget Sound Bull Trout, Columbia River Bull Trout, Snake River Sockeye, see Table 1.

Critical habitat is designated for the northern spotted owl, marbled murrelet, Lower Columbia River Steelhead, Middle Columbia River Steelhead, Upper Columbia River Steelhead, Snake River Spring/Summer-run Chinook, Snake River Fall-run Chinook, Upper Columbia River Spring-run Chinook, Lower Columbia River Chinook, Columbia River Chum, and Snake River Sockeye.

The Proposed action will have “no effect” on grizzly bear or gray wolves, so they are not included in this BA.

Table 1 - Listed species on GPNF and CRGNSA, Washington side

| Common Name | Scientific Name | Status | Critical Habitat |
|---|---|---|---|
| ***Wildlife*** | | | |
| Bald eagle | *Haliaeetus leucocephalus* | Threatened | No |
| Northern spotted owl | *Strix occidentalis caurina* | Threatened | Designated |
| Marbled Murrelet | *Brachyramphus marmoratus* | Threatened | Designated |
| ***Fish*** | | | |
| Lower Columbia River Steelhead Trout | *Oncorhynchus mykiss* | Threatened | Designated |
| Middle Columbia River Steelhead Trout | *O. mykiss* | Threatened | Designated |
| Upper Columbia River Steelhead Trout | *O. mykiss* | Endangered | Designated |
| Snake River Spring/Summer-run Chinook Salmon | *O. tshawytscha* | Threatened | Designated |
| Snake River Fall-run Chinook Salmon | *O. tshawytscha* | Threatened | Designated |
| Upper Columbia River Spring-run Chinook Salmon | *O. tshawytscha* | Endangered | Designated |
| Lower Columbia River Chinook Salmon | *O. tshawytscha* | Threatened | Designated |
| Lower Columbia River Coho Salmon | *O. kisutch* | Threatened | No |
| Columbia River Chum Salmon | *O. keta* | Threatened | Designated |
| Coastal Puget Sound Bull Trout | *Salvelinus confluentus* | Threatened | Designated |
| Columbia River Bull Trout | *S. confluentus* | Threatened | Designated |
| Snake River Sockeye Trout | *O. nerka* | Endangered | Designated |

This BA tiers to the Fisheries BA, Wildlife BA, and Biological Opinions prepared for the Region Six Invasive Plant Program (USDA 2005), which contains species account information. Specific species distribution and life history information found on the GPNF and CRGNSA is included in Appendix C of the GPNF and CRGNSA DEIS. Maps of fish distribution, critical habitat extent, and treatment area location have been hand-delivered to Rachel Friedman, NOAA Fisheries, and Patty Walcott, US Fish and Wildlife Service on July 26, 2006. Therefore, fish distribution maps are not included in this document.

## B. Consultation To Date

The Forest Service (FS) initiated informal discussions with NOAA Fisheries and U.S. Fish and Wildlife Service (USFWS) regarding the Proposed Action by submitting a written letter dated August 8, 2005. The letter briefly describing the Proposed Action and requested a species list for the action area and identification of appropriate contacts for the consultation. This was followed by personal contacts via phone call and email between various NOAA Fisheries and FS personnel and have continued to the present. Level 1 team members were assigned to the consultation for the Invasive Plant Treatment Project. The Level 1 team members assigned to the consultation workgroup for the Invasive Plant Treatment Project are Rachel Friedman, Patty Walcott, Shawna Bautista, and Diana Perez. Currency of the species list for this BA was maintained via communication with Level 1 team members throughout the consultation process

Level 1 meetings to date have helped provide a framework for the analysis provided in the BA. Rachel Friedman and Rick Golden of NOAA Fisheries, along with Patty Walcott and Marc Whisler of USFWS have participated in a couple of interdisciplinary team meetings. A Level 2 meeting was held on June 27, 2006 to address timelines and consultation process. Although a signed consultation agreement was not reached, the Level 2 members verbally agreed to adhere to the consultation agreement drafted for signatures.

The Level 1 ESA workgroup was given direction by Level II on August 31, 2006 to jointly clarify the proposed action and complete additional analysis in order to facilitate completion of the Invasive Plant BA. The Level 1 ESA workgroup met on September 26-28, 2006 and successfully addressed all issues identified by NOAA Fisheries and USFWS in the August 31, 2006 Level II meeting. The Level 1 ESA workgroup proposed the use of a "tiered consultation approach" for future unknown infestations (EDRR) that are determined as "may affect, likely to adversely affect" through the implementation and planning process.

Copies of all correspondence between the FS and USFWS and/or NOAA Fisheries are located in the project record.

Tiered Consultation Approach for Future Unknown Infestations (EDRR)

A two step process has been developed by the Level 1 team to facilitate section 7 compliance for projects implemented under the "programmatic" nature of the Proposed Action (i.e., treatments of future unknown infestations). The first step of the process is the GPNF and CRGNSA receiving a BO and letter of concurrence to ensure that the overall proposed project is in compliance with section 7 of ESA. The second step of the process involves individual project review and evaluation to ensure consistency with the proposed project activities and project design criteria in this BA or respective BO. The GPNF and CRGNSA will review each invasive plant treatment project and complete a project consistency evaluation form (PCEF) for each treatment project that includes new infestations that were not included in the 2004 inventory of invasive plant infestations on the GPNF and CRGNSA (DEIS, Appendix A).

For treatments implemented under EDRR there are three possible effect determinations for federally listed species: "No Effect" (NE), "May Affect, Not Likely to Adversely Affect" (NLAA), and "May Affect, Likely to Adversely Affect" (LAA).

For NE treatments that are consistent with the project activities and PDFs, the GPNF and CRGNSA will document the NE in the PCEF. Notification or concurrence from NOAA Fisheries or USFWS is not required for NE treatments.

For treatments that are consistent with the project activities and PDCs in this BA and that the GPNF and CRGNSA, NOAA Fisheries, and USFWS agree would always result in a NLAA determination, the GPNF and CRGNSA will document the NLAA determination in the PCEF and keep in the project file. Notification or concurrence from NOAA Fisheries or USFWS is not required because concurrence for NLAA activities would be provided through a letter of concurrence from NOAA Fisheries or USFWS.

Projects that are consistent with the project activities and project design criteria in this BA, and that do not result in a NE determination, and do not fit within the criteria that the GPNF and CRGNSA, NOAA Fisheries, and USFWS agree as always a NLAA determination will be reviewed by the Level I team to determine whether the project is NLAA or LAA. Projects that are determined as LAA would proceed through a modified formal consultation process. The GPNF and CRGNSA will submit a copy of the PCEF along with any supporting site-specific project description information to either NOAA Fisheries and/or USFWS. NOAA Fisheries and/or USFWS will use the information provided to evaluate the impacts of the treatment plan and determine the level of incidental take, as appropriate. Within 14 calendar days of receipt of the PCEF from GPNF and CRGNSA, NOAA Fisheries and/or USFWS will provide the GPNF and CRGNSA with a letter or e-mail acknowledging receipt of the PCEF, and if necessary, a list of additional information needed to complete an individual BO ("mini" BO). The individual BO will be tiered to the parent BO provided for the proposed action. Every attempt will be made to complete the "mini" BO within 30 calendar days of the receipt of notification.

Project Consistency Evaluation Form (PCEF)

A draft PCEF (Appendix A of this BA) has been sent to the Services and staff at GPNF and CRGNSA for review and is expected to be finalized at the completion of the BO. In addition, the definition of treatment activities that would always result in a NLAA effect determination is expected to be finalized at the completion of consultation.

## C. Description of the Proposed Action

### *Purpose and Need*

The purpose of this project is to control invasive plants in a cost-effective manner that complies with environmental standards. Proposed treatment methods include herbicide application mainly along roadsides and other previously disturbed areas in combination with manual and mechanical treatments.

With this project, the Forest Service is responding to the need for timely containment, control, and/or eradication of invasive plants, including those that are currently known and those discovered in the future. Approximately 30,000 acres of National Forest system lands were aggregated into treatment areas. The treatment areas incorporate known and suspected vectors for invasive plant spread. About 2,700 acres within the treatment areas are proposed for treatment. This estimate incorporates predicted rates of spread of known invaders within treatment areas.

High priority target invasive species include knapweed, hawkweed, knotweed, Canada thistle, and reed canarygrass. (Appendix A of DEIS provides maps and data tables indicating treatment area type, target species currently present, and priority for treatment within each treatment area). More common invasives such as scotch broom and Himalayan blackberry may also be treated. Very widespread species such as tansy ragwort and oxeye daisy would only be treated in limited, specific situations.[1] The priority and intensity of treatment needed varies widely based on site conditions, values at risk from invasion, and the range and aggressiveness of individual target species.

These infestations are degrading habitat for native plant communities in or near special places such as; Columbia River Gorge National Scenic Area; Mount St. Helens National Volcanic

[1] Some invasive species are too widespread to treat affordably using the methods considered in this BA. The BA is focused on infestations where herbicide use is proposed in combination with other methods. This would not be an appropriate treatment for thousands of acres of daisy and tansy known on the Forest. Such species may be treated in certain situations (e.g. tansy ragwort moving into Klickitat County, where it is basically a new invader). Biological controls have been released in the counties and continue to be an effective method for containing widespread, established invasive populations such as tansy ragwort. NEPA for these releases is completed by APHIS, and implementation is coordinated at the state and county levels.

Monument; Glacier View, Trapper Creek, and Indian Heaven; also Tatoosh, Goat Rocks, William O Douglas, and Mount Adams Wilderness; Botanical and Wildlife Special Areas, Research Natural Areas, and areas with sensitive plant and animal populations; the Pacific Crest Trail and other trails, campgrounds, and popular recreation areas. Existing populations of invasive plants also threaten neighboring areas such as Mount Ranier National Park, and other federal, State, tribal, and private properties.

Without effective treatment, invasive plants would continue to spread within these and other special areas on and adjacent to the National Forest. The R6 2005 ROD provided increased options for treatment intended to increase treatment effectiveness. The Forest Service has treated invasive plants with limited use of herbicides for many years and has not fully eradicated, controlled or contained invasive plants. Invasive plants are currently spreading at a rate of 8 to 12 percent annually (R6 2005 FEIS, Section 4.2.3). This rate is predicted to be reduced by half through prevention, early detection and rapid response, treatment and restoration. Partnerships between the Forest Service, Counties and others have resulted in effective manual treatment exceeding 1,000 acres over the past three years. However, manual treatment alone would not result in effective treatment of some 2,700 acres that have been identified across the Gifford Pinchot National Forest and the Washington side of the Columbia River Gorge National Scenic Area.

Thus, the need for action applies to known/predicted infestations based on the 2004 Inventory,[2] along with new detections that are discovered during the life of the project. The extent of new detections, by definition, cannot be predicted.

Not all invasive plants are equally threatening to environmental and social values; priority for treatment and treatment strategy[3] varies depending on the biology of the invasive species, size of the infestation, and the values at risk from the infestation now and in the future. Treatment intensity and restoration requirements are highly variable. As a result, the need for action is multi-faceted and more complex than simply “killing weeds.” The need for flexibility is important to the success of this project, which contributes to the complex analytical approaches herein.

The purpose of the Forest Service Proposed Action is to increase the range of invasive plant treatment options available within National Forest system lands in the Project Area in compliance with new management direction approved in the R6 2005 ROD (USDA 2005). The Proposed Action would also amend the Gifford Pinchot National Forest Plan to allow herbicide use within Riparian Reserves in accordance with management direction in the R6 2005 ROD (ibid.), and eliminate a standard regarding visual effects of herbicide treatments on roads.

Approximately 2,710 acres would be treated with a combination of herbicide and non-herbicide treatment methods. About 66 percent of the treatment area would be off-limits to broadcast

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[2] The 2004 Inventory refers to a Map and Database depicting the current distribution of target species. The acreage estimates for the Proposed Action and action alternatives are based on the 2004 Inventory, however the acreage has been adjusted based on likely spread during the life of the project, anecdotal information, and extrapolations into uninventoried areas.

[3] Definitions of these treatment strategies are as follows:

**Eradicate**: Totally eliminate an invasive plant species from a site. This strategy generally applies to the hardest to control invasive species and highest-valued sites over about 44 percent of the infested acreage.

**Control**: Reduce the acreage of the infestation over time. This strategy applies to about 48 percent of the project area.

**Contain**: No increase in acreage infested. This objective applies to about 8 percent of the infested acreage.

herbicide application method. The Proposed Action would replace existing direction for 400 acres already approved for herbicides under No Action. Herbicide use would also be approved on an additional 2,310 acres of invasive plants estimated as needing such treatment. Appendix A of the GPNF and CRGNSA DEIS lists the treatment areas, invasive species, and general prescription for each areas. The Proposed Action would approve a combination of herbicide and non-herbicide treatments based on Common Control Measures (see Table 6). Any of ten herbicides would be used according to Project Design Criteria (Table 8) and buffers listed in Tables 9, 10, 11.

The Proposed Action would be implemented over several years as funding allows, until treatments were no longer needed or until conditions otherwise changed sufficiently to warrant this BA outdated. Site-specific conditions are expected to change within the life of the project, without necessitating further analysis: for instance, treated infestations would be reduced in size, untreated infestations would continue to spread and/or new invasive plants could become established within the project area. The effects analysis considers a range of treatments applied to a range of site conditions to accommodate the uncertainty associated with the project implementation schedule. Treatment prescriptions would be strict enough to ensure that adverse effects are minimized, while flexible enough to adapt to changing conditions.

Additional invasive species are known to exist on the GPNF and CRGNSA that are not included in the treatment estimates. These species include tansy ragwort and oxeye daisy. These species are associated with a treatment objective of “tolerate” at this time, because they are so widespread as to be considered naturalized. Although these species are not the focus of this analysis, they may be treated in the course of implementation – such species would not be considered non-target species and thus, would not be especially protected. In certain high-valued areas (such as Wilderness, RNA and Botanical Areas), small, isolated populations of these target species may be treated.

An Implementation Planning process would be applied to new infestations to ensure that treatments are within the scope of the analysis and eventual decision. The Project Design Criteria were developed to minimize the potential for adverse effects no matter how many acres may be selected for treatment in a given season.

Under the most ambitious conceivable treatment scenario, approximately 2,710 acres of current infestations would be treated within the next 5 years. Infested areas would be treated with an initial prescription, and retreated in subsequent years, depending on the results, until control objectives were met. Many variables could affect invasive plant treatments, including treatment effectiveness, timing, weather, soil type, conditions on neighboring non-federal lands, and available funding and personnel.

Several broad federal policies require the control of invasive plants. Executive Order 13112 (1999) directs federal agencies to reduce the spread of invasive plants. The Forest Service Pesticide Use Handbook (FSH 2109.14) provides agency guidance on planning, implementation, and reporting of projects that include herbicide (see the GPNF and CRGNSA for more information).

## Proposed Action

The following description of the Proposed Action focuses on elements of the proposal important to the analysis in the BA. A detailed description including additional elements of the action (that are not relevant to the analysis in this BA) is in the GPNF and CRGNSA DEIS. A total of 2,710 acres on GPNF and CRGNSA has been identified as needing treatment under the proposed action. This represents about 0.1 percent of National Forest system lands within the analysis area. Estimated treatment acreage is based on the November 2004 Inventory and anecdotal information, modified to account for predictable rates of spread. About 65 percent of the treatment area would be off-limits to broadcast herbicide application method.

The Proposed Action (Alternative B) was developed to respond to the need for action by approving herbicide and non-herbicide treatments to eradicate, contain, and/or control the spread of invasive plants on GPNF and CRGNSA. The Proposed Action would approve treatments based on common control measures (see Appendix B of the FEIS, summarized in Table 6 below). Any of ten herbicides would be used according to Project design criteria and buffers listed in section 2.5.8 of the GPNF and CRGNSA DEIS.

Treatment areas are geographic assemblages of inventoried and anecdotal invasive plant sites that have been prioritized and prescribed for treatment. About 110 treatment areas are mapped; the majority of the infestations are along roadsides and other disturbed areas. Appendix A of the GPNG and CRGNSA DEIS provides data tables showing the description for each treatment area. Table 2 displays treatment area acres that may be broadcast-sprayed for each administrative unit. Table 3 and Table 4 provide some details for that information. The data bases for the GPNF and CRGNSA were developed independently and the treatment area description terminology has not been consistently applied between the two units. For instance, clearings and/or wetlands on the CRGNSA include conditions described as meadows on the GPNF.

Table 2. Proposed Action Treatment Acres

| Administrative Unit | Total Acres All Treatment Options Available, Including Herbicide | Proportion of Estimated Herbicide Acres that May be Broadcast |
|---|---|---|
| **Columbia River Gorge National Scenic Area (Washington side)** | 360 | 26% or 95 acres |
| **Gifford Pinchot National Forest** | 2,350 | 35% - 814 acres |
| **Total** | **2,710** | **34% - 909 acres** |

**Table 3**. Infested Acres by Treatment Area Description, Columbia River Gorge NSA, Washington Side

| Treatment Area Description | Total Acres All Treatment Options Available, Including Herbicide | Proportion of Estimated Herbicide Acres that May be Broadcast |
|---|---|---|
| **Clearings, Fields and Grasslands** | 180 | 25% or approx. 45 acres (Mount Pleasant area) |
| **Recreation Areas** | 162 | 31% or approx. 50 acres<br>(Balfour Day Use Site) |
| **Forested Areas** | 13 | 0% - no broadcasting is proposed for the Collins Slide forested site |
| **Wetlands** | 5 | 0% - no broadcasting would be proposed in wetlands |
| **Total Acres** | 360 | 26% or approx. 95 acres |

**Table 4.** Infested Acres by Treatment Area Description, Gifford Pinchot NF

| Treatment Area Description | Total Acres All Treatment Options Available, Including Herbicide | Proportion of Estimated Herbicide Acres that May be Broadcast |
|---|---|---|
| **Roadside** | 2,000 | 37% or appx. 740 acres |
| **Quarries** | 29 | 34% or appx. 10 acres |
| **Meadow** | 104 | 0% - no broadcasting would be proposed in meadows |
| **Administrative Sites** | 12 | 33% or appx. 4 acres of developed areas |
| **Campgrounds and Camping Areas** | 102 | 39% or appx. 40 acres |
| **Viewpoints and Parking Areas** | 52 | No broadcasting is currently proposed in these areas. |
| **Roads and Landings in Managed Timber Stand** | 51 | 39% or approx. 20 acres |
| **Total Acres** | **2,350** | **35% or approx. 814 acres** |

## Treatment Methods

The Proposed Action employs a variety of invasive plant treatment methods. This section offers a brief description of the different methods proposed for manual/mechanical and herbicide treatments under the Proposed Action. These descriptions are based on Tu, et. al. 2001, edited for local conditions and knowledge.

### *Cultural Methods*

**Grazing with Goats -** Grazing animals are limited to goats in this proposal. Goat grazing would not in itself eradicate invasive plants. However, when grazing treatments are combined with other control techniques, such as herbicides, large infestations would be reduced in size and small infestations could be eliminated. Grazing animals may be particularly useful in areas where herbicides cannot be applied (e.g., near water) or are prohibitively expensive (e.g., large infestations). Goats would be used as part of a restoration program by breaking up the soil and incorporating in seeds of desirable native plants. They prefer broadleaf herbs and have been used to control leafy spurge (*Euphorbia esula)*, Russian knapweed (*Acroptilon repens*), and toadflax (*Linaria spp*.). These animals appear to be able to neutralize the phytochemicals toxic to other animals that are present in these and other forbs (Walker 1994). Goats can control woody species because they can climb and stand on their hind legs, and will browse on vegetation other animals cannot reach (Walker 1994).

**Competitive Seeding –** Competitive seeding is part of the restoration plan addressed in Section 2.5 of the GPNF/CRGNSA DEIS.

### *Manual, Mechanical, Restoration Methods*

Manual techniques in the proposed action include hand pulling, clipping, or digging out invasive plants with non-motorized hand tools. Mechanical methods involve chain saws, mowers, or other mechanized equipment, such as brush cutters, or other machinery with various types of blades to remove plants. Manual methods include the use of hand-operated tools (e.g., axes, brush hooks, hoes, shovels, hand clippers) to dig up and remove noxious species (USDI 2003). See Appendix A of the GPNF and CRGNSA DEIS to see manual and mechanical methods currently proposed within each treatment area based on the November 2004 Invasive plant inventory.

These techniques tend to minimize damage to desirable plants and animals, but they are generally labor and time intensive. Treatments must typically be administered several times a year over several years to prevent the weed from re-establishing. Manual and mechanical techniques are generally favored to treat small infestations and/or in situations where a large pool of volunteer labor is available. They are often used in combination with other techniques.

> **Weed Pulling** - Pulling or uprooting plants can be effective against some shrubs, tree saplings, and herbaceous weeds. Annuals and tap-rooted plants are particularly susceptible to control by hand-pulling. Weed wrenches and other tools are surprisingly powerful and can enable a person to control large saplings and shrubs that are too big to be pulled by hand.
>
> Weed pulling is not as effective against many perennial weeds with deep underground stems and roots that are often left behind to re-sprout.
>
> The advantages of pulling include its small ecological impact, minimal damage to neighboring plants, and low (or no) cost for equipment or supplies. Pulling is extremely

labor intensive, however, and is effective only for relatively small areas, even when abundant volunteer labor is available. Hand pulling is easy to plan and implement, and is often the best way to control small infestations, such as when a weed is first detected in an area. Hand pulling may be a good alternative in sites where herbicides or other methods cannot be used.

The key to effective hand pulling is to remove as much of the root as possible while minimizing soil disturbance. For many species, any root fragments left behind have the potential to re-sprout, and pulling is not effective on plants with deep and/or easily broken roots.

Most weed-pulling tools are designed to grip the weed stem and provide the leverage necessary to pull its roots out. Tools vary in their size, weight, and the size of the weed they can extract. The Root Talon is inexpensive and lightweight, but may not be as durable or effective as the all-steel Weed Wrench, which is available in a variety of sizes. Both tools can be cumbersome and difficult to carry to remote sites. Both work best on firm ground as opposed to soft, sandy, or muddy substrates.

**Clip** – "Clip" means to cut or remove seed heads and/or fruiting bodies to prevent germination. This method is labor intensive but effective for small and spotty infestations.

**Clip and Pull** – "Clip and pull" means cutting a portion of the invasive plant stem and pulling it from its substrate, generally the bole of a tree. This method is labor intensive, but can be effective for larger infestations.

**Mowing, Cutting, Brush Hog, Raking, Trimming, Weed-eating** - Mowing and cutting can reduce seed production and restrict weed growth, especially in annuals cut before they flower and set seed. Some species however, re-sprout vigorously when cut, replacing one or a few stems with many that can quickly flower and set seed. These treatments are used as primary treatments to remove aboveground biomass in combination with herbicide treatments to prevent resprouting, or as follow up treatments to treat target plants missed by initial herbicide use.

**Stabbing** - Some plants can be killed by severing or injuring (stabbing) the carbohydrate storage structure at the base of the plant. Depending on the species, this structure may be a root corm, storage rhizome (tuber), or taproot. These organs are generally located at the base of the stem and under the soil. Cutting off access to these storage structures can help "starve" or greatly weaken some species.

**Girdling** - Girdling is often used to control trees or shrubs that have a single trunk. It involves cutting away a strip of bark several centimeters wide all the way around the trunk. The removed strip must be cut deep enough into the trunk to remove the vascular cambium, or inner bark, the thin layer of living tissue that moves sugars and other carbohydrates between areas of production (leaves), storage (roots), and growing points. This inner cambium layer also produces all new wood and bark.

**Restoration -** Treatment site restoration may include hand or machine mulching (machines limited to areas that are on roads), seeding, and/or planting with hand tools, or may be passive in situations where desirable vegetation can naturally replace target invasive species removed.

***Herbicide Application Methods***

The impacts of three types of herbicide application methods are evaluated in this BA:

**1. Broadcast (includes but not limited to boom spray)** – Broadcast methods distribute herbicide over broad areas covering both target plants and non-target plants. Broadcast treatments would typically be used to treat denser patches of target vegetation (where target vegetation covers approximately 70 percent of the area or more). Broadcast methods include booms; boom-less nozzles, and backpack sprayers if not directed at individual plants. A boom, a long horizontal tube with multiple spray heads, may be mounted or attached to a tractor, ATV or other vehicle. The boom is then carried above the weeds while spraying herbicide, allowing large areas to be treated rapidly with each sweep of the boom.

Offsite movement due to vaporization or drift and possible treatment of non-target plants can be of concern when using this method.

**2. Spot spray** - Herbicide is sprayed directly onto small patches or individual target plants; non-target plants are avoided. These applicators range from motorized rigs with spray hoses to backpack sprayers, to hand-pumped spray or squirt bottles, all of which can target very small plants or parts of plants. Applications are typically hand-directed. Drift is far less of a concern because the applicator ensures that spray is directed immediately toward the target plant given the technical advancement in machinery and equipment.

**3. Hand/Selective** – Hand/selective methods treat individual target plants, reducing the potential for herbicide to impact soil or non-target organisms. Hand/selective methods include wicking and wiping; basal bark treatment; frill, hack and squirt, stem injection, and/or cut-stump methods.

**Wicking, Wiping, and other stem and/or leaf application** - Involves using a sponge, spray bottle, paint brush, cloth and/or a wick on a long handle to wipe or apply herbicide onto individual foliage and/or stems. Use of a wick or other tools mentioned above eliminates the possibility of spray drift and minimizes potential for droplets falling on non-target plants. Small amount of herbicide can drip or dribble from some wicks.

**Basal Bark** - This method applies a 6 to 12 inch band of herbicide around the circumference of the trunk of the target plant, approximately one foot above ground. The width of the sprayed band depends on the size of the plant and the species' susceptibility to the herbicide.

**Frill, Hack and Squirt** - The frill and the "hack and squirt" methods are often used to treat woody species with large, thick trunks. The tree is cut using a sharp knife, saw, or ax, or drilled with a power drill or other device. Herbicide is then immediately applied to the cut with a backpack sprayer, squirt bottle, syringe, or similar equipment. Because the herbicide is placed directly onto the thin layer of growing tissue in the trunk (the cambium), an ester formulation is not required.

**Stem Injection** - Herbicides can be injected into herbaceous stems using a needle and syringe. Herbicide pellets can also be injected into the trunk of a tree using a specialized tool. While higher concentrations of active ingredients are often needed for effective stem injection, e.g. maximum label rate of aquatic labeled glyphosate to effectively kill knotweed by stem injection) (Lucero presentation, May 2005).

**Cut-stump** - This method is often used on woody species that normally re-sprout after being cut. The tree or shrub is cut, and herbicide is immediately sprayed or squirted herbicide on the exposed cambium (living inner bark) of the stump. The herbicide must be applied to the entire inner bark (cambium) within minutes after the trunk is cut. The outer bark and heartwood do not need to be treated since these tissues are not alive, although they support and protect the tree's living tissues. The cut stump treatment allows for a great deal of control over the site of herbicide application, and therefore, has a low probability of affecting non-target species or contaminating the environment. It also requires only a small amount of herbicide to be effective.

The following methods are not included in the Proposed Action and may require further analysis:

- Aerial Herbicide Application
- Herbicides other than the ten analyzed in this document
- Prescribed Burning
- Plowing/Tilling/Disking/Digging With Heavy Equipment
- Grazing Or Other Cultural Treatments
- Flooding/Drowning
- Foaming and Steaming

## Common Control Measures/Existing Target Species

Several target species grow within treatment areas on the GPNF and CRGNSA. The common control measures are the starting point for site-specific prescriptions, which would be refined for specific sites according to Project Design Criteria (discussed later in this section).

Appendix B of the GPNF and CRGNSA DEIS provides additional information about the control measures, including restoration emphasis items and manual disposal considerations. Some control measures listed in **Table 5** below or Appendix B of the GPNF and CRGNSA DEIS may not be available in some locations due to the PDC or because they are outside the scope of those analyzed in this BA (for instance, prescribed burning, broadcast treatment of any herbicide within 100 feet of a live stream, and/or aerial application of herbicide). The Common Control Measures in Appendix B of the GPNF and CRGNSA DEIS would be applied to site-specific conditions as part of the Implementation Planning process.

Many of these species may grow in riparian areas. A few, such as knotweed, reed canarygrass, purple loosestrife, and the thistles tend to be associated with meadows, wetlands, and streams.

Table 5 - Common Control Measures by Target Species

| Target Species – Common and *Scientific Names* and Growth Habit | Estimated Treatment Acres | Documented Effective Herbicides | When/How to treat with Herbicides | Integrated Control Measures |
|---|---|---|---|---|
| **Spotted knapweed (*Centaurea biebersteinii)*** <br><br> **Diffuse knapweed (*Centaurea diffusa*)** <br><br> **Meadow knapweed (*Centaurea debeauxii*)** <br><br> **Brownray knapweed (*Centaurea jacea*)** <br><br> **Biennial or perennial** | 696 (Gifford Pinchot) <br><br> 133 (Columbia River Gorge) | Upland:<br>A - Clopyralid,<br>B - Picloram <br><br> Areas having risk of herbicide delivery to surface waters /High Water Table/Porous Soils: Aquatic labeled Glyphosate | Roadsides: Broadcast spray in dense cover or where dominant plant community is non-native. Otherwise, spot spray on smaller, less dense, patchy roadside infestations. <br><br> Follow PDC: they may require a less impacting treatment choice. <br><br> Non-roadside sites: Spot or hand treat. <br><br> Treat in spring before bud stage. <br><br> Yearly revisits would be necessary; the number of which is dependent on the chemical used and the seed bank. | - Hand pull or dig small populations or when volunteer labor is available. Multiple entries per year are required.<br>- Manual Disposal: Remove entire root system from the site, as re-growth can occur.<br>-Mowing is possible, but timing is critical.<br>- Manual treatments may take up to ten years due to long term seed viability.<br>- Revegetate with desirable species in accordance with the Restoration Plan. |

| **Target Species – Common and *Scientific Names* and Growth Habit** | **Estimated Treatment Acres** | **Documented Effective Herbicides** | **When/How to treat with Herbicides** | **Integrated Control Measures** |
|---|---|---|---|---|
| **Yellow star thistle (*Centaurea solstitialis*)**<br><br>**Annual** | 286 (Columbia River Gorge) | Upland:<br>A - Clopyralid,<br>B - Picloram<br><br>Areas having risk of herbicide delivery to surface waters /High Water Table/Porous Soils: Aquatic labeled Glyphosate | Roadsides: Broadcast spray in dense or continuous target vegetation or where dominant plant community is non-native.<br><br>Otherwise, spot spray on smaller, less dense, patchy roadside infestations.<br><br>Follow PDC: they may require a less impacting treatment choice.<br><br>Non-roadside sites: Spot or hand treat.<br><br>Treat in spring before bud stage.<br><br>Yearly revisits would be necessary; the number of which is dependent on the chemical used and the seedbank. | - Manual removal is most effective with small patches or where plants are sporadically located. Best time for manual removal is after the plants have bolted and before they produce viable seed. It is important to detach all above ground stem material. Leaving even a two inch piece of stem can result in re-growth if leaves and buds are still attached at the base of the plant.<br>- For large populations, remove plants at the outward edge, working in towards the interior.<br>- Manual Disposal: Remove all flower heads (at any stage of maturity) from site.<br>- Mowing is possible, but timing is critical. Plants must be developed to where the stem branches are above the mowing height, otherwise flowers might still develop.<br>-Manual treatments may take up to ten years due to long term seed viability.<br>- Revegetate with desirable species in accordance with the Restoration Plan. |
| **Japanese knotweed (*Polygonum cuspidatum*)**<br><br>**Perennial** | 12 (Gifford Pinchot)<br><br>2 (Columbia River Gorge) | Upland:<br>A - Glyphosate,<br>B - Triclopyr<br><br>Areas having risk of herbicide delivery to surface waters:<br>A - Aquatic labeled Glyphosate,<br>B - Aquatic labeled Triclopyr,<br>C- Aquatic labeled Imazapyr | Stems > 3/4": Stem injection; Stems< 3/4": Stem injection or Foliar spray<br><br>Treat June through September<br><br>Stem injection may require one or more revisits, and foliar spray may require at least one, depending on the seed bank. | - Herbicide treatment most effective. Use stem injection or foliar spray. Dead canes can be left.<br>- Some manual removal possible for small infestation (1-5 plants).<br>- Manual Disposal: Remove all plant parts from site, as stems and rhizomes can bud into new individuals.<br>- Revegetate with desirable species if surrounding cover is primarily non-native, in accordance with the Restoration Plan. |

| **Target Species – Common and *Scientific Names* and Growth Habit** | **Estimated Treatment Acres** | **Documented Effective Herbicides** | **When/How to treat with Herbicides** | **Integrated Control Measures** |
|---|---|---|---|---|
| **Hawkweed (*Hieracium pratense*)**<br><br>**Perennial** | 38 (Gifford Pinchot) | Upland:<br>A - Clopyralid,<br>B - Picloram<br><br>Areas having risk of herbicide delivery to surface waters/High Water Table/Porous Soils: Aquatic labeled Glyphosate | Spot spray whenever possible.<br><br>Broadcast spray in areas of dense cover or where dominant plant community is non-native.<br><br>Follow PDC: they may require a less impacting treatment choice.<br><br>Treat in spring after most basal leaves emerge but before buds form. Fall treatment may also be effective, but research is limited.<br><br>Yearly revisits would be necessary; the number of which is dependent on the chemical used and the seedbank. | - Herbicide treatment is most effective.<br>- Some manual removal possible for small infestations.<br>- Manual Disposal: All plant parts should be removed, as new plants can bud from root, stolon, and rhizome fragments.<br>-Covering with a plastic tarp may also work for small infestations.<br>- Nitrogen fertilization after treatment would encourage native plant growth if done in the spring.<br>- Revegetate with desirable species in accordance with the Restoration Plan (see Section 2.5.4). |
| **Butter 'n' eggs (*Linaria vulgaris*)**<br><br>**Toadflax *(Linaria sp.*)**<br><br>**Perennial** | 4 (Gifford Pinchot) | Upland Forested: Metsulfuron methyl<br><br>In native grasses: Imazapic (in fall only)<br><br>Areas having risk of herbicide delivery to surface waters/High Water Table/Porous Soils: Aquatic labeled Glyphosate | Broadcast spray would generally not be necessary: this species tends to be scattered.<br><br>Apply during active growth in spring before bloom or in late summer or fall during re-growth.<br><br>Revisits would be necessary; the number of which is dependent on the chemical used and the seedbank. This control could vary by site. Even after three years of consecutive treatments, control may range widely. | - Hand pull or dig small populations or volunteer labor is available.<br>-Manual Disposal: Plants can be left on site, but may reduce germination of desirable species due to mulching effect. If plants have flower heads with seeds (immature as well), bag and remove them from site.<br>-Cutting stems in spring or early summer would eliminate plant reproduction, but not the infestation.<br>- These treatments may take up to ten years due to long term seed viability.<br>- Revegetate with desirable species in accordance with the Restoration Plan. Plant communities in good condition may recover without replanting. |

| **Target Species – Common and *Scientific Names* and Growth Habit** | **Estimated Treatment Acres** | **Documented Effective Herbicides** | **When/How to treat with Herbicides** | **Integrated Control Measures** |
|---|---|---|---|---|
| **Houndstongue (*Cynoglossum officinale*)**<br><br>**Perennial** | 45 (Gifford Pinchot) | Forested:<br>Metsulfuron methyl<br>In native grasses:<br>Imazapic<br><br>Areas having risk of herbicide delivery to surface waters/High Water Table/Porous Soils: Aquatic labeled Glyphosate | Roadsides: Broadcast spray in dense cover or where dominant plant community is non-native.<br>Otherwise, spot spray on smaller, less dense, patchy roadside infestations.<br><br>Large non-sensitive sites: ATV Broadcast spray<br><br>Follow PDC: they may require a less impacting treatment choice.<br><br>Apply during active growth, preferably basal rosette stage.<br><br>Revisits would be necessary; the number of which is dependent on the chemical used and the seedbank. | - Hand pull or dig small populations.<br>- Manual Disposal: Entire root system must be removed. Plants could be left on site if no seed pods are present (seed can remain viable for more than one year).<br>- Manual treatments may take up to five years.<br>- Revegetate with desirable species in accordance with the Restoration Plan. |
| **Scotch broom (*Cytisus scoparius*)**<br><br>**False Indigo (Amorpha fruticosa)**<br><br>**Perennial** | 780 (Gifford Pinchot)<br><br>58 (Columbia River Gorge) | Upland:<br>A - Triclopyr<br>B - Clopyralid<br>C - Picloram<br><br>Areas having risk of herbicide delivery to surface waters/High Water Table/Porous Soils: Aquatic labeled Glyphosate | Larger plants: Cut and paint.<br><br>Smaller plants: Spot spray where hand-pulling or weed wrenching is not feasible.<br><br>Apply during active growth preferably in the spring to young plants.<br><br>Yearly revisits would be necessary; the number of which is dependent on the chemical used and the seedbank. | - Hand pulling, cutting, weed wrenching or digging of small populations or when volunteer labor is available. Hand-pulling or weed wrenching is most effective in moist soils. Cutting would require multiple visits in one year.<br>-Manual Disposal: Plants can be left on site if no seed pods are present (seed can remain viable for several years).<br>- Manual treatments may take up to ten years due to long term seed viability.<br>- Revegetate with desirable species in accordance with the Restoration Plan. |

| **Target Species – Common and *Scientific Names* and Growth Habit** | **Estimated Treatment Acres** | **Documented Effective Herbicides** | **When/How to treat with Herbicides** | **Integrated Control Measures** |
|---|---|---|---|---|
| **Puncturevine *(Tribulus terrestris*)**<br><br>**Annual** | 1<br>(Columbia River Gorge) | Upland:<br>A – Metsulfuron methyl<br>B – Imazapic (if native grasses are present)<br>C – Chlorsulfuron<br><br>Areas having risk of herbicide delivery to surface waters/High Water Table/Porous Soils:<br>Aquatic labeled Glyphosate | Spot spray whenever possible.<br><br>Broadcast spray in areas of dense cover or where dominant plant community is non-native.)<br><br>Follow PDC: they may require a less impacting treatment choice.<br><br>Apply herbicide in early spring during active growth.<br><br>Yearly revisits would be necessary; the number of which is dependent on the chemical used and the seedbank. | - Handpulling is as effective as chemical control.<br>- Manual Disposal: If flowering, remove plants from site.<br>- Manual treatments may take up to ten years due to long term seed viability.<br>- Mowing is ineffective due to the prostrate growth habit.<br>- Revegetate with desirable species in accordance with the Restoration Plan. |
| **Mat Sandbur (*Cenchrus longispinus)***<br><br>**Annual** | 1<br>(Columbia River Gorge) | Upland:<br>A - Glyphosate<br><br>Areas having risk of herbicide delivery to surface waters/High Water Table/Porous Soils:<br>Aquatic labeled Glyphosate | Spot spray whenever possible.<br><br>Broadcast spray in areas of dense cover or where dominant plant community is non-native.<br><br>Follow PDC: they may require a less impacting treatment choice.<br><br>Apply herbicide in early spring during active growth.<br><br>Yearly revisits would be necessary; the number of which is dependent on the chemical used and the seedbank. | - Digging or pulling before flowering is effective, and may take up to ten years due to long term seed viability.<br>- Manual Disposal: If flowering, remove plants from site.<br>- Mowing is ineffective as plant (grass) would re-grow and produce seed.<br>-If chemical treatment is not an option, repeated mowing (every three weeks) is necessary and may still not be effective. Bag and remove cut material.<br>- Revegetate with desirable species in accordance with the Restoration Plan. |

| **Target Species – Common and *Scientific Names* and Growth Habit** | **Estimated Treatment Acres** | **Documented Effective Herbicides** | **When/How to treat with Herbicides** | **Integrated Control Measures** |
|---|---|---|---|---|
| **Reed canarygrass (*Phalaris arundinaceae*)**<br><br>**Perennial** | 10 (Gifford Pinchot)<br><br>3 (Columbia River Gorge) | Upland:<br>Sulfometuron methyl (highly unlikely the site would be upland)<br><br>Areas having risk of herbicide delivery to surface waters/High Water Table/Porous Soils: Aquatic labeled Glyphosate | Hand wipe or spot spray whenever possible.<br><br>Broadcast spray in dense cover or where dominant plant community is non-native.<br><br>Follow PDC: they may require a less impacting treatment choice.<br><br>Apply in early spring when just sprouting before other wetland species have emerged.<br><br>Yearly revisits would be necessary; the number of which is dependent on the chemical used and the seedbank. | - Use a combination of herbicides and manual, mechanical, or cultural treatments. Manual treatments or mowing are only practical for small stands when multiple entries per year can be made. The entire population must be removed 2 to 3 times per year for at least five years.<br>-Manual Disposal: As reed canary grass can regenerate from short pieces of rhizome, remove all plant parts from site.<br>- Covering populations with black plastic may be effective if shoots are not allowed to grow beyond tarps. This technique could take over two years to be effective. |
| **Canada thistle (*Cirsium arvense*)**<br><br>**Perennial sowthistle (*Sonchus arvensis*)**<br><br>**Perennial** | 426 (Gifford Pinchot)<br><br>135 (Columbia River Gorge) | Upland:<br>A - Clopyralid<br>B – Picloram<br>C – Chlorsulfuron<br><br>Areas having risk of herbicide delivery to surface waters/High Water Table/Porous Soils: Aquatic labeled Glyphosate (best in fall) | Broadcast spray in dense cover or where dominant plant community is non-native.<br><br>Spot spray whenever possible.<br><br>Follow PDC: they may require a less impacting treatment choice.<br><br>Apply in spring to rosettes and prior to flowering. Or apply in fall to rosettes; season is dependent upon herbicide used.<br><br>Yearly revisits would be necessary; the number of which is dependent on the chemical used and the seedbank. | - Herbicide treatment is most effective.<br>- The only manual technique would be hand cutting of flower heads, which only suppresses seed production.<br>-Manual Disposal: bag and remove flower heads form site.<br>-Mowing may be effective in rare cases if done monthly (this intensity would damage native species).<br>-Covering with a plastic tarp may also work for small infestations.<br>- Revegetate with desirable species in accordance with the Restoration Plan. |
| **Herb robert (*Geranium robertianum)***<br><br>**Annual, Biennial or Perennial** | 31 (Gifford Pinchot) | Glyphosate | On large, dense infestations: broadcast spray; on small, scattered infestations: spot spray. Herbicide application most effective in the early spring.<br><br>Yearly revisits would be necessary; the number of which is dependent on the chemical used and the seedbank. | - Hand-pulling is most effective if the entire plant is pulled.<br>-Manual Disposal: Plant can be left on site, if not in flower. If in flower, bag and remove.<br>- Care must be taken not to pull desirable vegetation which is usually intermingled. |

| **Target Species – Common and *Scientific Names* and Growth Habit** | **Estimated Treatment Acres** | **Documented Effective Herbicides** | **When/How to treat with Herbicides** | **Integrated Control Measures** |
|---|---|---|---|---|
| **Purple loosestrife (*Lythrum salicaria*)**<br><br>**Perennial** | 2 (Gifford Pinchot) | Aquatic labeled Glyphosate | Larger stems: Cut and paint high up stem under inflorescence.<br><br>A glove technique for hand wiping could be used. Wick up the top 1/3 of plant after flower heads are removed.<br><br>Yearly revisits would be necessary; the number of which is dependent on the chemical used and the seedbank. | - Herbicide treatment is most effective.<br>- Hand removal of small populations or isolated stems is possible, but only if entire rootstock is removed.<br>-Manual Disposal: All plant parts must be removed from site, as broken off pieces can re-root.<br>- The only other technique would be hand cutting of flower heads, which only suppresses seed production.<br>- Revegetate with desirable species in accordance with the Restoration Plan. |
| **Himalayan blackberry (*Rubus discolor*)**<br><br>**Perennial (canes die off annually)** | 35 (Gifford Pinchot)<br><br>162 (Columbia River Gorge) | Uplands:<br>Triclopyr<br><br>Areas having risk of herbicide delivery to surface waters/High Water Table/Porous Soils:<br>Aquatic labeled Glyphosate | Cut and paint larger canes.<br><br>Broadcast spray is possible after canes are cut if non-targets are not an issue.<br><br>Spot spray whenever possible.<br><br>Yearly revisits would be necessary; the number of which is dependent on the chemical used and the seedbank. | - Use a combination of herbicides and manual and/or mechanical treatments. Usually mechanical removal of large biomass in the summer (using a mower, or brush hog), followed by manual removal of resprouting canes and roots, then herbicide treatment of new growth in the fall/winter is most effective. The massive root crown must be fully dug out at some point if using only manual/mechanical techniques. The cultural technique of grazing with goats is also a technique proving successful if goats can be confined to the blackberry area.<br>- Revegetate with desirable species in accordance with the Restoration Plan. |
| **Butterfly bush (*Buddleja* sp.)**<br><br>**Perennial** | 2 (Gifford Pinchot) | Uplands:<br>Glyphosate<br><br>Areas having risk of herbicide delivery to surface waters/High Water Table/Porous Soils:<br>Aquatic labeled Glyphosate | Cut and paint stumps.<br><br>Use foliar spray on smaller stems that can't be handpulled.<br><br>Yearly revisits would be necessary; the number of which is dependent on the chemical used and the seedbank. | -Use manual and manual treatments combined with herbicides. Smaller plants can be hand pulled or dug.<br>- Manual Disposal: All portions of the plant should be removed.<br>- For large plants, cutting and painting with herbicide is most effective.<br>- Revegetate with desirable species in accordance with the Restoration Plan. |

| **Target Species – Common and *Scientific Names* and Growth Habit** | **Estimated Treatment Acres** | **Documented Effective Herbicides** | **When/How to treat with Herbicides** | **Integrated Control Measures** |
|---|---|---|---|---|
| **Bull thistle (*Cirsium vulgare*)**<br><br>**Spiny plumeless thistle (*Carduus acanthoides*)**<br><br>**Biennial** | 233 (Gifford Pinchot) | Upland:<br>A - Clopyralid,<br>B - Picloram<br><br>Areas having risk of herbicide delivery to surface waters/High Water Table/Porous Soils: Aquatic labeled Glyphosate | Spot spray whenever possible.<br><br>Apply to rosettes in either the spring or fall.<br><br>Yearly revisits would be necessary; the number of which is dependent on the chemical used and the seedbank. | - Use manual, mechanical or chemical control or a combination.<br>- Any manual method that severs the root below the soil surface would kill these plants. Effective control requires cutting at the onset of blooming. Treatment before plants are fully bolted results in re-growth. Repeated visits at weekly intervals over the 4 to 7 week blooming period provide most effective control.<br>-Manual Disposal: Bag and remove from site if plant has a flower head.<br>- Timing of mowing is critical (within 2 days of full flowering for musk thistle).<br>- Biological controls may be helpful to suppress populations in combination with other methods.<br>- Revegetate with desirable species in accordance with the Restoration Plan. |
| **Lesser burdock (*Arctium minus*)**<br><br>**Biennial** | 17 (Gifford Pinchot) | Upland:<br>A- Metsulfuron methyl<br>B – Triclopyr + Clopyralid<br><br>Areas having risk of herbicide delivery to surface waters/High Water Table/Porous Soils: Aquatic labeled Glyphosate (not found as effective in the literature) | Spot spray whenever possible.<br><br>Treat as a biennial. Treat in spring after rosettes are formed when non-targets are dormant or treat fall rosettes.<br><br>* Very little was found on this species.* | - Use a combination of manual and herbicide.<br>- Hand pull or dig small populations or when volunteer labor is available.<br>- If chemicals are used, manual treatments could be used for follow-up. Relative amounts of herbicide to manual treatments would decline over time.<br>- Revegetate with desirable species in accordance with the Restoration Plan. |
| **Yellow nutsedge *(Cyperus esculentus)***<br><br>**Perennial** | 9 (Gifford Pinchot) | Aquatic labeled Glyphosate | Spot spray whenever possible.<br><br>Apply during active growth in midseason but before tubers begin to form.<br><br>Yearly revisits would be necessary; the number of which is dependent on the chemical used and the seedbank.<br><br>Most information from the turf grass industry. | - Hand digging is effective if done before root tubers form.<br>-Manual Disposal: All parts of the root system should be removed.<br>- Out-competing through revegetation is the most effective means. |

| Target Species – Common and *Scientific Names* and Growth Habit | Estimated Treatment Acres | Documented Effective Herbicides | When/How to treat with Herbicides | Integrated Control Measures |
|---|---|---|---|---|
| **Everlasting Peavine *(Lathyrus latifolius*)**<br><br>**Birdfoot Deervetch (*Lotus corniculatus)***<br><br>**Aaron's Rod (*Thermopsis villosa*)**<br><br>**Perennial** | 6 (Gifford Pinchot) | Upland:<br>A-Clopyralid or Picloram (sites without grass cover) ,<br>B-Triclopyr or Imazapyr (sites without grass cover)<br><br>Areas having risk of herbicide delivery to surface waters/High Water Table/Porous Soils: Aquatic labeled Glyphosate | Roadsides: Broadcast spray in dense cover or where dominant plant community is non-native.<br>Otherwise, spot spray on patchy, diffuse roadside infestations.<br><br>Follow PDC: they may require a less impacting treatment choice.<br><br>Apply in the spring or early summer before bud stage or in the fall before the leaves start drying.<br><br>Yearly revisits would be necessary; the number of which is dependent on the chemical used and the seedbank. | -Herbicide treatment most effective.<br>-Hand control possible with repeated effort or combined herbicide/hand treatment.<br>- Hand removal must be repeated for several years.<br>-Manual Disposal: Entire root system must be removed.<br>- Revegetate with desirable species Revegetate with desirable species in accordance with the Restoration Plan. |
| Approximate total acreage to be treated (Gifford Pinchot) = 2,350<br>Approximate total acreage to be treated (Columbia River Gorge) = 360<br>Acres are estimated from field inventories documented in the 2004 Inventory Data Base. Acreages have been adjusted to account for spread since 2004, anecdotal information, and extrapolation into uninventoried areas. Columbia Gorge acres by targets species may overlap and therefore add up to more than 360 total acres. | | | | |

The Common Control Measures are the starting point for site-specific invasive plant treatment and restoration prescriptions. Herbicide selection, application method, and other components of the prescription would be limited according to Project Design Criteria (PDC – see Table 9) during the Implementation Planning Process (see Section 2.5.7 of the GPNF/CRGNSA DEIS).

Additional invasive species are noted in the 2004 Inventory Data Base, notably tens of thousands of acres of oxeye daisy and tansy ragwort. All invasive species listed in the 2004 Inventory Data Base are shown in Appendix A of the GPNF and CRGNSA DEIS, along with the treatment area in which the species is located.

Widespread, low priority species such as tansy ragwort are not the focus of this BA. Treatment of these established populations using manual, mechanical, cultural or herbicide treatment would be cost-prohibitive. However, there would be no *prohibition* on treating these species, and such treatment is possible in conjunction with higher priority treatments in the same area, in high priority areas (e.g. Wilderness, Botanical Area) or where it is currently not well known (ie., tansy ragwort moving into Klickitat County, where it is a new invader).

## Surfactants

Several types surfactants or additives have been reviewed in risk assessments or reviews and thus meet the GPNF Land and Resource Management Plan (LRMP), as amended by the R6 2005 ROD. These additives are used to help herbicides adhere to target plants and reduce drift (Bakke

2003). For the proposed action, only those additives that are approved by the Washington State Department of Agriculture (WSDOA) and Department of Ecology and comply with the amended GPNF LRMP will be permitted for use within riparian areas where there is a highly likelihood of herbicide delivery to surface water, **Table 6**.

Table 6 - Products approved by Washington State Dept of Agriculture (WSDOA) that meet GPNF LRMP.

| Product Name | Registrant | Principal Functioning Agent | Document supporting Std 18 |
|---|---|---|---|
| Agri-Dex | Helena Chemical Company | Petroleum Oil, polyoxyethylene sorbitant fatty acid ester, sorbitant fatty acid ester | SERA 1997, Bakke 2003 |
| Competitor | Wilbur-Ellis Company | Modified vegetable (seed) oil, polyethylene glycol fatty acid ester, polyoxyethylene sorbitant fatty acid ester | SERA 1997, Bakke 2003 |
| InterLock | Agriliance | Modified vegetable (seed) oil, polyoxyethylene sorbitant fatty acid ester, vegetable (seed) oil | SERA 1997, Bakke 2003 |
| LI 700 | Loveland Industries/Loveland Products | Phosphatidylcholine, propanoic (propionic) acid, alkylphenol ethoxylate | SERA 1997, Bakke 2003 |
| Liberate | Loveland Industries/Loveland Products | Phosphatidylcholine, alcohol ethoxylate, modified vegetable (seed) oil | SERA 1997, Bakke 2003 |
| Dyne-Amic | Helena Chemical Company | Modified vegetable (seed) oil, alkylphenol ethoxylate, Polysiloxane polyether copolymer | Bakke 2003 |
| Cygnet Plus | Brewer International | Modified vegetable (seed) oil, alcohol ethoxylate, Limonene | USDA FS 1992 |

The effects of using additive ingredients, along with other inerts and metabolites, have been disclosed in the R6 2005 FEIS. Below are examples of surfactants listed by “type” of surfactant that comply with the amended GPNF LRMP. There are additional surfactants and adjuvants that fall under different “types” or categories that are not listed below. Use of other types of adjuvants/surfactants/inerts/dyes would need to comply with the amended GPNF LRMP, which limits use to only those reviewed in risk assessment documents. When a new adjuvant is registered for aquatic use in the State of Washington, that adjuvant will need to be reviewed in order to ensure that the surfactant “type” meets the amended ONF LRMP. New information about additives would be incorporated into future implementation planning.

**Ethoxylated fatty amines (Cationic)**

*Examples:* Entry™ II (Monsanto Company)

POEA - Roundup® has 15% POEA

**Alkylphenol ethoxylate-based surfactants (non-ionic)**

*Examples:* R-11® Spreader Activator (Wilbur-Ellis Company)

Activator 90 (Loveland Industries)

X-77® (Loveland Industries)

Latron AG-98™ (N) (Dow AgroSciences LLC)

Cide-kick®, Cide-kick® II™ (Brewer International)

These surfactants usually include an alcohol as a solvent (isopropanol (X-77®, AG-98™), butanol (R-11®, AG-98™ (N)), glycol (AG-98™ (N), Activator 90)), a silicone defoamer (polydimethylsiloxane), and water.

**Alcohol ethoxylate-based surfactants (non-ionic)**

*Example:* Activator N.F. (Loveland Industries)

**Silicone-Based Surfactants**

Also known as organosilicones, these are increasing in popularity because of their superior spreading ability. This class contains a polysiloxane chain. Some of these are a blend of non-ionic surfactants (NIS) and silicone while others are entirely silicone. The combination of NIS and a silicone surfactant can increase absorption into a plant so that the time between application and rainfall can be shortened.

*Examples:* Sylgard® 309 (Wilbur-Ellis Company) –silicones

Freeway® (Loveland Industries) –silicone blend

Dyne-Amic® (Helena Chemical Company) - silicone blend

Silwet L-77® (Loveland and Helena) - silicones

Blends normally include an alcohol ethoxylate, a defoamer, and propylene glycol.

**Oils**

Surfactants that are primarily oil-based have been gaining in popularity especially for the control of grassy weeds. Oil additives function to increase herbicide absorption through plant tissues and increase spray retention. They are especially useful in applications of herbicides to woody brush or tree stems to allow for penetration through the bark. Oil adjuvants are made up of either petroleum, vegetable, or methylated vegetable or seed oils plus an emulsifier for dispersion in water.

**Vegetable Oils** – The methylated seed oils are formed from common seed oils, such as canola, soybean, or cotton. They act to increase penetration of the herbicide. These are comparable in performance to crop oil concentrates. In addition, silicone-seed oil blends are also available that take advantage of the spreading ability of the silicones and the penetrating characteristics of the seed oils.

The U.S. Food and Drug Administration (FDA) considers methyl and ethyl esters of fatty acids produced from edible fats and oils to be food grade additives (CFR 172.225). Because of the lack of exact ingredient statements on these surfactants, it is not always clear whether the oils that are used in them meet the U.S. FDA standard.

*Examples*: MSO® Concentrate Methylated Seed Oil (Loveland Industries)

Hasten® (Wilbur-Ellis Company)

The surfactant in Pathfinder™ II (a triclopyr formulation)

Improved JLB Oil Plus (Brewer International)

Cide-Kick and Cide-Kick II (Brewer International)

**Blends of vegetable oils and silicone-based surfactants:**

*Examples:* Syl-tac™ (Wilbur-Ellis Company)

Phase™ (Loveland Industries)

**Crop Oils and Crop Oil Concentrates** - These are normally derivatives of paraffin-based petroleum oil. Crop oils are generally 95-98% oil with 1-2% surfactant/emulsifier. Crop oils also promote the penetration of a pesticide spray. Traditional crop oils are more commonly used in insect and disease control than with herbicides. Crop oil concentrates are a blend of crop oils (80-85%) and a nonionic surfactant (15-20%). The purpose of the nonionic surfactant in this mixture is to emulsify the oil in the spray solution and lower the surface tension of the overall spray solution.

Because kerosene or diesel fuel is found in the Garlon 4 formulation of triclopyr BEE, no broadcasting of Garlon 4 is permitted nor use within 150 feet of surface water bodies or wetlands. In addition, the Naptha Solvent found in sethoxydim (Poast formulation) is not permitted for use within 150 ft of surface waters under the proposed action.

## Herbicides

Herbicide selection would be limited to the ten listed in the amended GPNF LRMP. Broadcast treatments and spot treatments adjacent to waterbodies would not exceed typical label rates as described in the risk assessments and the table below. The highest application rate is the highest rate that was analyzed, which sometimes exceeds approved label rates (e.g. triclopyr). In no case would actual applications exceed rates listed on herbicide labels. **Table 7** lists the typical and highest application rates for the herbicides proposed for use.

Table 7 – Herbicides Application Rates

| Herbicide | Typical Application Rate lb ai/ac* | Highest Application Rate lb ai/ac |
|---|---|---|
| Chlorsulfuron | **0.056** | **0.25** |
| Clopyralid | **0.35** | **0.5** |
| Glyphosate | **2** | **7** |
| Imazapic | **0.13** | **0.19** |
| Imazapyr | **0.45** | **1.25** |
| Metsulfuron Methyl | **0.03** | **0.15** |
| Picloram | **0.35** | **1.0** |
| Sethoxydim | **0.3** | **0.38** |
| Sulfometuron Methyl | **0.045** | **0.38** |
| Triclopyr | **1.0** | **10** |
| NPE | **1.67** | **6.68** |
| Hexachlorobenzene# | **0.000004** | **0.000012** |

* pounds of active ingredient per acre
#These application rates reflect the incidental rates of application of the impurity hexachlorobenzene, found primarily in picloram, and to a lesser extent in clopyralid.
Source: USDA Forest Service 2003, SERA 1998, 2001, 2003

Treatment of invasive plants that are emergent, NOT submerged, would strictly adhere to label requirements and PDCs. The R6 2005 FEIS allows treatment of all invasive plants, with the exception of those that are submerged. Therefore, treatment of "emergent" invasive plants are permitted under the R6 2005 FEIS. For purposes of this BA, the term "emergent" is used to better describe ground conditions relative to where invasive plants are growing alongside a stream or other waterbody. Emergent vegetation is defined as plants that grow from below the water line to above the water line.

## Treatment Site Restoration

Passive restoration is expected to be successful on about 35 percent of the treatment sites, with the majority (65 percent) expected to require mulching, seeding, and/or infrequent planting. This proportion is based on the range of situations evident surrounding the inventoried invasive plant populations known across the GPNF and CRGNSA. Meadows and forested areas are most likely to respond favorably to passive restoration, while roadsides and other highly disturbed areas may require active assistance through mulching and/or seeding/planting desirable vegetation (with hand tools). The intent is to re-establish competitive local, native vegetation post-treatment in areas of bare ground. The tools and methods used for restoration activities are the same as those used for manual and mechanical treatments.

In some cases, preferred non-natives may be utilized as temporary ground cover for erosion control and as noxious weed competitors, until native species can become established at the site.

Preferred non-natives would not aggressively compete with natives, persist long-term, or exchange genetic material with local native plant species.

Evaluation for site restoration may occur before, during and after herbicide, manual and mechanical treatments. Passive site restoration would be favored in areas having a stable, diverse, native plant community and sufficient organics in the soil to sustain natural revegetation. If the soils lack sufficient organics, mulch and/or mycorrhizae would be added.

Deep-rooted shrubs may also be seeded or planted to more fully utilize resources from the lower soil profile, especially late in the growing season. Shrubs allow for easier establishment of understory species by increasing water availability and reducing understory temperatures and evapo-transpiration. Planting of native shrubs may also occur in cases where rapid revegetation is desired; for example, native shrubs may be planted to replace dense scotch broom stands in order to prevent new invasives from colonizing the area.

Appendix F of the GPNF and CRGNSA DEIS is excerpted from the *2003 Guidelines for Revegetation of Invasive Weed Sites and Other Disturbed Areas on National Forests and Grasslands in the Pacific Northwest.* This document provides further information on methods and guidelines for revegetation of invasive weed sites and disturbed areas. Steps are outlined for assessing existing and potential site conditions, and for developing long-term revegetation strategies that are effective, affordable, and consistent with the ecological context and land management objectives of the site and surrounding landscape. This document promotes the use of local native plant materials to establish competitive plant cover and meet the long-term objective to restore ecosystem functioning.

## Early Detection Rapid Response

The Early Detection/Rapid Response process under the Proposed Actions allows for treatment "within the scope of the EIS" to occur on new, unknown, and unpredicted infestations found over the next five to fifteen years. The analysis for the Proposed Action considered treatment of 2,710 acres estimated as the current inventory. However, invasive plants are likely to spread to additional acreage beyond the current inventory within and outside mapped treatment areas.

Under the Early Detection/Rapid Response approach, new or previously undiscovered infestations would be treated using the range of methods described in this EIS, according to the Project design criteria listed later in this section. This approach is needed because 1) the precise location of individual target plants, including those mapped in the current inventory, is subject to rapid and/or unpredictable change, and 2) the typical NEPA process would not allow for rapid response; infestations may grow and spread into new areas during the time it usually takes to prepare NEPA documentation. The intent of the Early Detection/Rapid Response approach is to treat new infestations when they are small so that the likelihood of adverse treatment effects is minimized. The approach is based on the premise that the impacts of similar treatments are predictable, even though the precise location or timing of the treatment may be unpredictable.

The Early Detection/Rapid Response approach included in the proposed action allows the Forest Service to treat new infestations anywhere on the Forest that the need exists, applying the PDCs and appropriate buffers. The Implementation Planning process detailed in the following section is intended to ensure that effects are within the scope of those disclosed in this EIS; new situations that may have different effects would be subject to further NEPA analysis. In addition, further NEPA would be required for the following types of treatments:

- Aerial Herbicide Application

- Herbicides other than the ten analyzed in this document
- Prescribed Burning
- Plowing/Tilling/Disking/Digging With Heavy Equipment
- Flooding/Drowning
- Foaming and Steaming

The procedure used to develop this approach is as follows:

1. The November 2004 invasive plant inventory and database was developed to provide site-specific basis for the Proposed Action. Infested sites were aggregated into treatment areas. See Appendix A of the GPNF and CRGNSA DEIS for data tables that correspond to maps depicting each treatment area.

2. The interdisciplinary team considered the range of site conditions encountered throughout the treatment areas and analyzed the effects of applying a range of treatment prescriptions to these situations.

3. The interdisciplinary team developed Project design criteria intended to minimize potential for significant adverse effects to such a degree that even though precise treatment locations may be uncertain, the character of the impacts can be predicted, and pose low risk to people and/or the environment.

4. The Implementation Planning process detailed in the following section would ensure that treatments of currently undetected invasive plants would have effects within the scope of those disclosed in this EIS because the Project design criteria were developed considering a wide range of conditions that occur throughout the Forest. The Project design criteria serve to eliminate or minimize the likelihood of adverse effects. Uncertainty is addressed through monitoring and adaptive management.

5. If new invaders are found outside existing mapped treatment areas (see Appendix A of the GPNF and CRGNSA DEIS for treatment area maps and details), control methods and site conditions would be evaluated to make sure no site conditions exist that could result in dissimilar effects. The Implementation Planning Process is designed to identify situations that would require further NEPA disclosure as per FSH 1909.15, Chapter 18, which provides guidance of review of ongoing projects to determine if the environmental analysis and documentation should be corrected, supplemented, or revised.

## Implementation Planning Process

This section outlines the process that would be used for treating known or future invasive plants. The methodology follows Integrated Weed Management (IWM) principles (R6 2005 FEIS, 3-3) and satisfies pesticide use planning requirements at FSH 2109.14. It applies to currently known infestations and new sites found within or outside currently mapped treatment areas during ongoing inventory. Appropriate Forest Service specialists will review and apply appropriate PDCs for the final site-specific prescription. For example, a fish biologist will review the annual program of work to ensure that appropriate buffer widths are included where fish species of local interest are present.

## I. Characterize invasive plant infestations to be treated

- Map and describe target species, density, extent, treatment strategy and priority.
- Add or refine target species information to database.
- Validate affected environment at the treatment site and ensure no extraordinary site conditions exist that were not considered in EIS. New treatment areas found during future inventories need to be evaluated for extraordinary site conditions that may trigger additional NEPA requirements. For example, new information may reveals that an action may affect listed species in a way not previously considered; or methods needed to be effective would not follow PDCs and/or buffers. Considering specific site conditions, such as soil type and depth to groundwater, is included in steps for developing site-specific prescriptions.

## II. Develop site-specific prescriptions

- Use Integrated Weed Management principles to identify possible effective treatment methods. Considerations include the biology of the target species and surrounding environment (these items are also evaluated when invasive plant infestations are characterized). Determine whether effective methods are within the scope of those analyzed in the EIS. If preferred methods have effects that are outside the scope of those analyzed in the EIS, additional NEPA would be required. Prescribe herbicides as needed based on the biology of the target species and size of the infestations.
- Broadcast application of herbicide would be considered for situations warranted by the density (approximately 70-80 percent cover) and/or the distribution (e.g. continuous target populations along a road) of invasive plants, unless limited by PDCs. Broadcast would not occur on any road systems identified as having high potential to deliver herbicide to streams. Under the Proposed Action, broadcast applications along stream channels, lakes, and wetlands would be restricted by PDCs and required buffers.
- Apply appropriate standards from the GPNF LRMP as amended, and specific PDCs and buffers based on:
    - The size of the infestation, its treatment history and response to past treatment,
    - Proximity to species of local interest or their habitats
    - Proximity to streams, lakes, wetlands
    - Whether the treatment site is along a road associated with high risk of herbicide delivery to surface water
    - Soil conditions
    - Municipal watersheds and/or domestic water intakes
    - Places people gather (recreation areas, special forest product and special use areas).
    - Effective herbicide (or mixture) and method of application needed. [4]

[4] A tank mixtures analysis, as described in Appendix B, must be conducted and Standard 16 criteria met if tank mixtures are prescribed.

    - Additional considerations, such as weather conditions, can be found in the PDC section. Specialists will review and apply appropriate PDCs for the final site-specific prescription. For example, a fish biologist will review the annual program of work to ensure that appropriate buffer widths are included where fish species of local interest are present.

- Review compliance criteria for Forest Plan and other environmental standards that apply to a given treatment site.
- If treatments would not be effective once PDCs are applied, further NEPA would be required to authorize an alternative treatment.
- Review manual Scotch broom treatments to ensure no effect on heritage resources.
- Complete Form FS-2100-2 (reproduced in Appendix E of the ONF DEIS), Pesticide Use Proposal. This form lists treatment objectives, specific herbicide(s) that would be used, the rate and method of application, and PDFs that apply. Apply for an herbicide application permit from the Washington State Department of Agriculture (WSDA) for treatments of freshwater emergent invasive plants. No permit is required from WSDA for treatment of terrestrial invasive plants.
- Confirm that surfactants proposed meet requirement of GPNF LRMP.
- Confirm restoration plan and ensure acceptable plant or mulch materials are available.
- Determine need for pre-project surveys for species of local interest and/or their habitats.
- Coordinate with adjacent landowners, water users, agencies, and partners.
- Document the public notification plan.

**III. Accomplishment and Compliance Monitoring**

- Develop a project work plan for herbicide use as per FSH 2109.14.3. This work plan presents organizational and operational details including the precise treatment objectives, the equipment, materials, and supplies needed, the herbicide application method and rate; field crew organization and lines of responsibility and a description of interagency coordination.
- Ensure contracts and agreements include appropriate prescriptions and that herbicide ingredients and application rates meet label requirements, R6 2005 ROD, and site-specific PDCs. Contracts and agreements will include the appropriate PDCs, buffers, including herbicide and additive limitations.
- Document and report herbicide use and certified applicator information in the National pesticide use database, via the Forest Service Activity Tracking System (FACTS). A pesticide use report extracts data from FACTS. See Appendix E of the GPNF and CRGNSA DEIS for reporting forms.
- Washington State Department of Agriculture (WSDOA) is the responsible agency for pesticide management. WSDOA also holds the Non-Point Discharge permit for use of herbicides to control aquatic and/or emergent noxious weeds in Washington State. Permits would be sought for herbicide treatments within 100 feet of live streams and other water bodies.

- Implement the public notification plan and document accomplishments.
- For future unknown infestations (EDRR), a project consistency evaluation form (PCEF) will be completed for each treatment where there are federally listed fish or designated critical habitat. The PCEF is currently being developed by the Level 1 team and will be included in the final BO from NOAA Fisheries and USFWS. This form will also serve as the site-specific information required for EDRR projects that screen out as LAA.
- Non-herbicide treatments should be included and reported in the FACTS database.

## IV. Post-treatment Monitoring, Recurring Treatments, and Adaptive Management

- Implementation monitoring would occur during implementation to ensure Project design criteria are implemented as planned. Post-treatment reviews would occur on a sample basis to determine whether treatments were effective and whether or not passive/active restoration has occurred as expected. Non-target vegetation (e.g., botanical species of local interest) would be evaluated before and immediately after treatment, and two to three months later.
- Contract administration and other existing mechanisms would be used to correct deficiencies. Herbicide use would be reported as required by the FSH 2109.14 and FACTS (see Appendix E of the GPNF and CRGNSA DEIS).
- Post-treatment monitoring would also be used to detect whether PDCs were appropriately applied, and whether non-target vegetation impacts are within tolerable levels.
    - Re-treatment and active restoration prescriptions would be developed based on post-treatment results. Changes in herbicide or non-herbicide methods, all within the scope of the DEIS, would occur based on results. For instance, an invasive plant population treated with a broadcast herbicide may be retreated with a spot spray, or later manually pulled, once the size of the infestation is sufficiently reduced following the initial treatment.
    - Treatment buffers would be expanded if damage were found outside buffers as indicated by a decrease in the size of any non-target plant population, leaf discoloration or chlorophyll change, or mortality to individual species of local interest or non-target vegetation. The findings would be applied to buffers for waterbodies. Buffers may be adjusted for certain herbicides/application methods and not others, depending on results.
- Additional monitoring may be included as part of the GPNF and CRGNSA Monitoring Plans or other ongoing programs such as state water quality monitoring. The R6 2005 ROD adopted a monitoring framework to ensure listed species are protected. Treatments within riparian areas may be selected for monitoring as part of this regional, interagency effort. If the Regional Monitoring Framework is not developed or near completion by 2007, then the Forest will develop their own monitoring framework for high risk sites by December 2008.
- Reporting forms and summaries will be submitted to NMFS and USFWS annually, at the beginning of each calendar year, and a meeting to assess adherence will be conducted following receipt.

## Project Design Criteria and Buffers

The following Project Design Criteria (PDC) and buffers minimize or eliminate the potential impacts of invasive plant treatment as per R6 2005 ROD Standards 19 and 20 (and other Forest Plan management direction), and provide sideboards for treatment of existing inventories and future detections. Implementation of the PDC and buffers are mandatory to ensure that treatments would have effects within the scope of those disclosed in Chapter 3 of the GPNF and CRGNSA DEIS. The analysis assumes buffers approximate horizontal (map) distances.

The PDC were developed to address a range of site-specific resource conditions within treatment areas, including (but not limited to): the presence of species of local interest and their habitats, potential for herbicide delivery to water, and the social environment.

The R6 2005 FEIS disclosed that some of the treatments that could be approved under the new standards could adversely affect fish and the aquatic environment, however, implementation of the PDC would substantially reduce the potential for adverse affects, ensuring that future treatments under EDRR would have effects within the scope of those disclosed in this BA. The PDC add layers of caution

The PDC add layers of caution to label requirements and Forest Plan standards by limiting the rate and method of application, by buffering streams from broadcast and spot methods and restricting certain higher-risk herbicides near streams. This conservative approach in the proposed action was taken to limit the potential amount of herbicides coming in contact with water at concentrations of concern, while allowing for a range of effective treatments for known and predicted situations.

Project Design Criteria that minimize or eliminate concerns for impacts on fish are shown in Table 9 below. Under the Proposed Action, buffers along streams, lakes, ponds, and wetlands shown in Tables 10, 11, and 12 would be required. These are excerpts relevant to minimizing or eliminating the effects on listed aquatic organisms. The PDC add a significant degree of caution to the risks inherent in treating invasive plants growing near habitat for listed aquatic species.

Herbicide use would become more restrictive the closer to water a target species grows. PDC and herbicide use buffers within the Aquatic Influence Zone were developed based on label advisories, SERA risk assessments, and Berg's 2004 study of broadcast drift and run off to streams.

Table 8 - Project Design Criteria for the GPNF and CRGNSA, Washington side, Invasive Plant Program.

| PDC Reference | Design Criteria | Purpose of PDC | Source of PDC |
|---|---|---|---|
| ***A*** | ***Pre-Project Planning*** | | |
| A1 | Prior to treatment, confirm species/habitats of local interest, watershed and aquatic resources of concern (e.g. hydric soils, streams, lakes, roadside treatment areas with higher potential to deliver herbicide, municipal watersheds, domestic water sources), places where people gather, and range allotment conditions. | Ensure project is implemented appropriately. | This approach follows several previous NEPA documents. Pre-project planning also discussed in the previous section. |
| ***B*** | ***Coordination with Other Landowners/Agencies*** | | |
| B1 | Work with owners and managers of neighboring lands to respond to invasive plants that straddle multiple ownerships. Coordinate treatments within 150 feet of Forest boundaries, including lands over which the Forest has right-of-way easements, with adjacent landowners. | To ensure that neighbors are fully informed about nearby herbicide use and to increase the effectiveness of treatments on multiple ownerships. | The distance of 150 feet was selected because it approximates the Aquatic Influence Zone for fish bearing streams. |
| B2 | Coordinate herbicide use within 1000 feet (slope distance) of known water intakes with the water user or manager. | To ensure that neighbors are fully informed about nearby herbicide use. | The distance of 1000 feet was selected to respond to public concern. Herbicide use as proposed for this project would not contaminate drinking water supplies. |
| B3 | Coordinate herbicide use with Municipal Water boards. Herbicide use or application method may be excluded or limited in some areas. | To ensure that neighbors are fully informed about nearby herbicide use and standards for municipal watersheds are met. | 1990 Gifford Pinchot National Forest and existing municipal agreements. |
| ***C*** | ***To Prevent the Spread of Invasive Plants During Treatment Activities*** | | |
| C1 | Ensure vehicles and equipment (including personal protective clothing) do not transport invasive plant materials. | To prevent the spread of invasive plants during treatment activities | Common measure. |
| ***D*** | ***Wilderness Areas*** [5] | | |
| D1 | No cultural, mechanical or motorized treatments would occur in Wilderness areas. | To maintain Wilderness character and meet environmental standards. | Wilderness Act, 1990 Gifford Pinchot National Forest Plan |
| D2 | Choose minimum impact treatment methods. | To maintain Wilderness values (e.g. solitude, unimpeded natural processes) and comply with environmental laws and policies. | Wilderness Act, 1990 Gifford Pinchot National Forest Plan |
| ***E*** | ***There are no Design Features under "E".*** | | |
| ***F*** | ***Herbicide Applications*** | | |

[5] Invasive plant eradication within Wilderness areas meets the "no impact" intent of the Wilderness Act and associated land use policies.

| PDC Reference | Design Criteria | Purpose of PDC | Source of PDC |
|---|---|---|---|
| F1 | Herbicides would be used in accordance with label instructions, except where more restrictive measures are required as described below. Herbicide applications would only treat the minimum area necessary to meet site objectives. Herbicide formulations would be limited to those containing one or more of the following 10 active ingredients: chlorsulfuron, clopyralid, glyphosate, imazapic, imazapyr, metsulfuron methyl, picloram, sethoxydim, sulfometuron methyl, and triclopyr. Herbicide application methods include wicking, wiping, injection, spot, and broadcast, as permitted by the product label and these Project Design Criteria. The use of triclopyr is limited to spot and hand/selective methods. Herbicide carriers (solvents) are limited to water and/or specifically labeled vegetable oil. | To limit potential adverse effects on people and the environment. | Standard 16, 2005 R6 ROD; Pesticide Use Handbook 2109.14 |
| F2 | Herbicide use would comply with standards in the Pacific Northwest Regional Invasive Plant Program – Preventing and Managing Invasive Plants FEIS (2005), including standards on herbicide selection, restrictions on broadcast use of some herbicides, tank mixing, licensed applicators, and use of adjuvants, surfactants and other additives.<br><br>See Appendix B for tank mixture analysis. | To limit potential adverse effects on people and the environment. | 2005 R6 ROD Treatment Standards (see Chapter 1). |
| F3 | POEA surfactants, urea ammonium nitrate or ammonium sulfate would not be used in applications within 150 feet of surface water, wetlands or on roadside treatment areas having high potential to deliver herbicide. | To protect aquatic organisms. | The distance of 150 feet was selected because it is wider than the largest buffer and approximates the Aquatic Influence Zone for fish bearing streams. |
| F4 | Lowest effective label rates would be used for each given situation. In no case would broadcast applications of herbicide or surfactant exceed typical label rates. NPE would never be broadcast at a rate exceeding 0.5 active ingrediant per acre, and other classes of surfactants besides NPE would be favored wherever they are expected to be effective. In no case would imazapyr exceed 0.70 lbs. | To eliminate possible herbicide or surfactant exposures of concern to human health, wildlife, and/or fish. | SERA Risks Assessments, Appendix Q of the R6 2005 FEIS |
| F5 | Herbicide applications would occur when wind velocity is between two and eight miles per hour. During application, weather conditions would be monitored periodically by trained personnel. | To ensure proper application of herbicide and reduce drift. | These restrictions are typical so that herbicide use is avoided during inversions or windy conditions. |
| F6 | To minimize herbicide application drift during broadcast operations, use low nozzle pressure; apply as a coarse spray, and use nozzles designed for herbicide application that do not produce a fine droplet spray, e.g., nozzle diameter to produce a median droplet diameter of 500-800 microns. | To ensure proper application of herbicide and reduce drift. | These are typical measures to reduce drift. The minimum droplet size of 500 microns was selected because this size is modeled to eliminate adverse effects to non-target vegetation 100 feet or further from broadcast sites (see Chapter 3.2 of GPNF/CRGNSA DEIS for details). |

| PDC Reference | Design Criteria | Purpose of PDC | Source of PDC |
|---|---|---|---|
| ***G Herbicide Transportation and Handling Safety/Spill Prevention and Containment***<br><br>An *Herbicide Transportation and Handling Safety/Spill Response Plan* would be the responsibility of the herbicide applicator. At a minimum the plan would:<br>✓ Address spill prevention and containment.<br>✓ Estimate and limit the daily quantity of herbicides to be transported to treatment sites.<br>✓ Require that impervious material be placed beneath mixing areas in such a manner as to contain small spills associated with mixing/refilling.<br>✓ Require a spill cleanup kit be readily available for herbicide transportation, storage and application (minimum FOSS Spill Tote Universal or equivalent).<br>✓ Outline reporting procedures, including reporting spills to the appropriate regulatory agency.<br>✓ Ensure applicators are trained in safe handling and transportation procedures and spill cleanup.<br>✓ Require that equipment used in herbicide storage, transportation and handling are maintained in a leak proof condition.<br>✓ Address transportation routes so that traffic, domestic water sources, and blind curves are avoided to the extent possible.<br>✓ Specify conditions under which guide vehicles would be required.<br>✓ Specify mixing and loading locations away from water bodies so that accidental spills do not contaminate surface waters.<br>✓ Require that spray tanks be mixed or washed further than 150 feet of surface water.<br>✓ Ensure safe disposal of herbicide containers.<br>✓ Identify sites that may only be reached by water travel and limit the amount of herbicide that may be transported by watercraft. | | To reduce likelihood of spills and contain any spills. | FSH 2109.14,<br>Bonneville Power Administration Biological Assessment,<br>Buckhead Knotweed Project, Willamette NF Biological Assessment |
| ***H*** | ***Soils, Water and Aquatic Ecosystems*** | | |
| H1 | Herbicide use buffers have been established for perennial and wet intermittent steams; dry streams; and lakes and wetlands. These buffers are depicted in the tables below. Buffers vary by herbicide ingredient and application method.<br><br>Tank mixtures would apply the largest buffer as indicated for any of the herbicides in the mixture. | To reduce likelihood that herbicides would enter surface waters in concentrations of concern.<br><br>Comply with R6 2005 ROD Standards 19 and 20. | Buffers are based on label advisories, and SERA risk assessments. Buffer distances are based on the Berg's 2004 study of broadcast drift and run off to streams, along with Washington State Dept. of Agriculture's DOA's 2003-2005 monitoring results. |

| PDC Reference | Design Criteria | Purpose of PDC | Source of PDC |
|---|---|---|---|
| H2 | The following treatment methods are shown in order of preference (if effective and practical), within roadside treatment areas having high risk of herbicide delivery and aquatic influence areas, especially adjacent to fish bearing streams:<br>(1) Manual methods (e.g, hand pulling).<br>(2) Application of clopyralid, imazapic, and metsulfuron methyl, aquatic glyphosate, aquatic triclopyr, aquatic imazapyr.<br>(3) Application of chlorsulfuron, imazapyr, sulfometuron methyl.<br>(4) Application of glyphosate, triclopyr, picloram, and sethoxydim<br>(see H3, picloram on non-aquatic triclopyr would not be used on roadside treatment areas that have a high risk of herbicide delivery). | To protect aquatic organisms by favoring lower risk methods where effective. | Herbicides were classed into low, moderate and higher risk to aquatic organisms based on SERA Risk Assessments. Lower risk herbicides are preferred where effective. Non-herbicide, manual methods have the least potential for impact, therefore they would be preferred. |
| H3 | No use of picloram or triclopyr BEE and no broadcast of any herbicide on roadside treatment areas that have a high risk of herbicide delivery to surface waters (see Appendix A for map and list of these roads). | To ensure herbicide is not delivered to streams in concentrations that exceed levels of concern. | SERA Risk Assessments, R6 2005 FEIS Fisheries Biological Assessment<br>Extra caution is warranted on the Gifford Pinchot National Forest and Columbia River Gorge National Scenic Area (Washington side) because of the many aquatic Species of Local Interest in Forest streams. |
| H4 | Aquatic labeled herbicides or herbicides associated with lower risk to aquatic organisms would be applied using spot or hand/selective methods within 15 feet of the edge of a wet roadside ditch. For treatments of target vegetation emerging out of the wet roadside ditch only aquatic labeled herbicides would be used. | To ensure herbicide is not delivered to streams in concentrations that exceed levels of concern. | SERA Risk Assessments<br>R6 2005 FEIS and Fisheries Biological Assessment<br>BPA Columbia River Biological Opinion<br>Extra caution is warranted on the Gifford Pinchot National Forest and Columbia River Gorge National Scenic Area (Washington side) because of the many aquatic species of local interest in Forest streams. |
| H5 | Vehicles (including all terrain vehicles) used to access or implement invasive plant projects, would remain on roadways, trails, parking areas or other previously disturbed areas to prevent damage to riparian vegetation and soil, and potential degradation of water quality and aquatic habitat. | To protect riparian and aquatic habitats. | BPA Columbia River Biological Opinion |
| H6 | Avoid use of clopyralid on high-porosity soils (coarser than loamy sand). | To avoid leaching/ground water contamination. | Label advisory. |
| H7 | Avoid use of chlorsulfuron on soils with high clay content (finer than loam). | To avoid excessive herbicide runoff. | Label advisory. |

| PDC Reference | Design Criteria | Purpose of PDC | Source of PDC |
|---|---|---|---|
| H8 | Avoid use of picloram on shallow or coarse soils (coarser than loam.)<br>No more than one application of picloram would be made within a two-year period, except to treat areas missed during initial application. | To reduce the potential for picloram to enter surface and/or ground water and/or accumulate in the soil. Picloram has the highest potential to impact organisms in soil and water, and tends to be more persistent than the other herbicides. | SERA Risk Assessment. Based on quantitative estimate of risk from worst-case scenario and uncertainty |
| H9 | Avoid use of sulfometuron methyl on shallow or coarse soils (coarser than loam.)<br><br>No more than one application of sulfometuron methyl would be made within a one-year period, except to treat areas missed during initial application. | To reduce the potential for sulfometuron methyl accumulation in the soil. Sulfometuron methyl has some potential to impact soil and water organisms and is second most persistent. | SERA Risk Asessments. Based on quantitative estimate of risk from worst-case scenario and uncertainty. |
| H10 | Lakes and Ponds – No more than half the perimeter or 50 percent of the vegetative cover or 10 contiguous acres around a lake or pond would be treated with herbicides in any 30-day period. | To reduce exposure to herbicides by providing some untreated areas for some organisms to use. | SERA Risk Asessments. Based on quantitative estimate of risk from worst-case scenario and uncertainty regarding effects to reptiles and amphibians. |
| H11 | Wetland vegetation would be treated when soils are driest. If herbicide treatment is necessary for emergent target plants when soils are wet, use aquatic labeled herbicides. Favor hand/selective treatment methods where effective and practical. | To reduce exposure to herbicides by providing some untreated areas for some organisms to use. | SERA Risk Assessments. Reduces exposure to herbicides by providing untreated areas for organisms to use. Abates risks associated with worst-case models for treatment of emergent vegetation. |
| H12 | Broadcast spraying would not occur within 50 feet of wells. Follow label guidance relative to water contamination. | Safe drinking water. | Label advisories and state drinking water regulations. |
| H13 | With the exception of hand/select methods, herbicides would be applied at typical (or lower) rates within Aquatic Influence Zones. | To ensure herbicide exposures are below thresholds of concern for aquatic ecosystems. | SERA Risk Assessments, Biological Assessment |
| H14 | Treatments above bankfull, within the aquatic influence zone, would not exceed 10 acres along any 1.5 mile of stream reach within a 6th field subwatershed in any given year.<br><br>In addition, treatments below bankfull would not exceed 7 acres total within a 6th field sub-watershed in any given year. | Limits the extent of treatment within the Aquatic Influence Zone so that adverse effects are within the scope of analysis. | Based on SERA risk assessment worksheets and emergent vegetation analysis. |
| H16 | Plan and schedule project activities to avoid disturbance of spawning fish or damage to redds. | Minimize adverse impacts within waterbodies. | Memorandum of Understanding between WDFW and USDA Forest Service, January 2005 |
| H17 | Limit the numbers of people on any one site at any one time while treating areas within 150 feet of creeks. | To minimize trampling and protect riparian and aquatic habitats. | The distance of 150 feet was selected because it approximates the Aquatic Influence Zone for fish bearing streams. |
| H18 | Fueling of gas-powered equipment with gas tanks larger than 5 gallons would not occur within 150 feet of surface waters.<br><br>Fueling of gas-powered equipment with gas tanks smaller than 5 gallons would not occur within 25 feet of any surface waters. | To protect riparian and aquatic habitats. | The distance of 150 feet was selected because it approximates the Aquatic Influence Zone for fish bearing streams. Filling of smaller tanks has inherently less risk. |

| PDC Reference | Design Criteria | Purpose of PDC | Source of PDC |
|---|---|---|---|
| ***I*** | ***Vascular and Non-Vascular Plant and Fungi Species of Local Interest*** | | |
| I1 | The buffer distances recommended in I2-I4 may be refined as needed in order to adequately protect perennial fungi, vascular and non-vascular plant Species of Local Interest (SOLI) and other non-target plants | To prevent any repeated effects to SOLI populations, thereby mitigating any long-term effects. | Broadcast buffer sizes are based on Marrs, R.H., 1989, based on tests on vascular plants.<br><br>Spot and hand/selective buffer distances are based on reports from experienced applicators.<br><br>Uncertainty about effects on non-vascular plants would be addressed through monitoring (see Implementation Planning Section above). |
| I2 | Perennial fungi, vascular and non-vascular plant SOLI within 100 feet of planned broadcast would be covered by protective barrier, or broadcast application would be avoided in these areas (spot or hand herbicide treatment, or non-herbicide methods may be used). | To ensure SOLI are protected and surveys are conducted when appropriate. | Forest Service Manual 2670<br><br>Survey and Manage Species Direction. |
| I3 | Perennial fungi, vascular and non-vascular plant SOLI within 10 feet of planned spot applications would be covered by protective barrier, or spot application would be avoided in these areas (hand herbicide treatment, or non-herbicide methods may be used).<br>Under saturated or wet soil conditions present at the time of treatment, only hand application of herbicide is permitted within 10 feet of SOLI. | To ensure SOLI are protected and surveys are conducted when appropriate. | Forest Service Manual 2670<br><br>Survey and Manage Species Direction<br>. |
| I4 | Prior to treatment, botanical surveys would occur to identify vascular and non-vascular plant and perennial fungi SOLI if unsurveyed suitable habitat is within 100 feet of planned broadcast treatments, 10 feet of planned spot treatments, and/or 5 feet of planned hand herbicide treatments (increased to 10 feet in saturated/wet soils). | To ensure SOLI are protected and surveys are conducted when appropriate. | Forest Service Manual 2670<br><br>Survey and Manage Species Direction |
| I5 | Use special care when applying sulfonourea herbicides due to their potency and potential to harm non-target vegetation. Do no use chlorsulfuron, metsulfuron methyl or sulfometuron methyl on dry, ashy, or light, sandy soils. | To protect non-target vegetation. | Label advisories. |
| ***J*** | ***Wildlife Species of Local Interest*** | | |
| **J1** | **Bald Eagle** | | |
| J1a | Treatment of areas within 0.25 mile, or 0.50 mile line-of-sight, of bald eagle nests would be timed to occur outside the nesting season of January 1 to August 31, unless treatment activity is within ambient levels of noise and human presence (as determined by a local specialist). Occupancy of nest sites (i.e. whether it is active or not) would be determined each year prior to treatments. | To minimize disturbance to nesting bald eagles and protect eggs and nestlings | Bald Eagle Management Guidelines for OR-WA (Anonymous); U.S. Fish and Wildlife Service 2003, p. 9 |

| PDC Reference | Design Criteria | Purpose of PDC | Source of PDC |
|---|---|---|---|
| J1b | Noise-producing activity above ambient levels would not occur between October 31 and March 31 near known winter roosts and concentrated foraging areas. Disturbance to daytime winter foraging areas would be avoided. | To minimize disturbance and reduce energy demands during stressful winter season | Bald Eagle Management Guidelines for OR-WA (Anonymous); Gifford Pinchot National Forest Programmatic BA (USDA Forest Service 2001, ) |
| **J2** | **Spotted Owl** | | |
| | Chainsaw use within 65 yards, and mower or heavy equipment use within 35 yards, of any nest site, activity center, or un-surveyed suitable habitat will be timed to occur outside the early nesting season of March 1 to June 30, unless treatment activity is within ambient levels of noise and human presence (as determined by a local specialist). There is no seasonal restriction on the use of roadside broadcast sprayers. | To minimize disturbance to nesting spotted owls and protect eggs and nestlings | Gifford Pinchot National Forest Programmatic BA (USDA Forest Service 2001) |
| **J3** | **Marbled Murrelet** | | |
| J3a | Chainsaw or motorized tool use within 45 yards, and mower or heavy equipment use within 35 yards of any known occupied site or un-surveyed suitable habitat will be timed to occur outside April 1 to August 5, unless treatment activity is within ambient levels of noise and human presence (as determined by a local specialist). There is no seasonal restriction on the use of roadside broadcast sprayers. | To minimize disturbance to nesting marbled murrelets and protect eggs and nestlings | Gifford Pinchot National Forest Programmatic BA (USDA Forest Service 2001) |
| J3b | After August 5 and before April 1, activities generating noise above 92 dB may occur within the disturbance distances listed above, but must still be conducted between 2 hours after sunrise and 2 hours before sunset. | To minimize disturbance to marbled murrelets returning to nest tree during the late breeding season. | Gifford Pinchot National Forest Programmatic BA (USDA Forest Service 2001) |
| **J4** | **Great Gray Owl** | | |
| J4 | Do not broadcast spray NPE surfactant in mapped opening habitat (i.e. within suitable portions of treatment areas 33-04, 33-05, 33-05a, 33-05m3, 33-05r3, 33-12a). | To minimize exposure of owls to NPE surfactant from ingesting contaminated prey. | Tables 5 & 6 in Appendix P of R6 2005 FEIS |
| **J5** | **Peregrine Falcon** | | |
| J5a | Seasonal, spatial and temporal restrictions would apply to all known peregrine falcon nest sites for the periods listed below based on the following elevations:<br><br>Low elevation sites (1000-2000 ft 01 Jan - 01 July<br>Medium elevation sites (2001 - 4000 ft) 15 Jan - 31 July<br>Upper elevation sites (4001+ ft) 01 Feb - 15 Aug | To reduce disturbance to nesting falcons and protect eggs and nestlings. Agitated parents can damage the eggs with thin shells resulting in failed reproduction for that nest. | Pagel, J. (2006)<br>Peregrine falcon nest site data, 1983-2006. |

| PDC Reference | Design Criteria | Purpose of PDC | Source of PDC |
|---|---|---|---|
| J5b | Seasonal restrictions would be waived if the site is unoccupied or if nesting efforts fail and monitoring indicates no further nesting behavior. Seasonal restrictions would be extended if monitoring indicates late season nesting, asynchronous hatching leading to late fledging, or recycle behavior which indicates that late nesting and fledging would occur. The nest zones associated with those nest sites are described below:<br><br>(1) Primary: average of 0.5-mile radius from the nest site. Site-specific primary nest zones would be determined and mapped by a local Biologist for each known nest site.<br>(2) Secondary: average of 1.5- mile radius from the nest site. Site-specific secondary nest zones would be determined and mapped for each known nest site.<br>(3) Tertiary: a three-mile radius from the nest site including all zones. The tertiary nest zones are not mapped; they apply to a circular area based on the three-mile radius. | To reduce disturbance to nesting falcons and protect eggs and nestlings. Agitated parents can damage the eggs with thin shells resulting in failed reproduction for that nest. | Pagel, J. (2006)<br>Peregrine falcon nest site data, 1983-2006. |
| J5c | Protection of nest sites would be provided until at least two weeks after all young have fledged. | To reduce disturbance to nesting falcons and protect eggs and nestlings. Agitated parents can damage the eggs with thin shells resulting in failed reproduction for that nest. | Pagel, J. (2006)<br>Peregrine falcon nest site data, 1983-2006. |
| J5d | Invasive plant activities within the secondary nest zone requiring the use of machinery would be seasonally restricted. This may include activities such as mulching, chainsaws, vehicles (with or without boom spray equipment) or other mechanically based invasive plant treatment. | To reduce disturbance to nesting falcons and protect eggs and nestlings. Agitated parents can damage the eggs with thin shells resulting in failed reproduction for that nest. | Pagel, J. (2006)<br>Peregrine falcon nest site data, 1983-2006. |
| J5e | Non-mechanized or low disturbance invasive plant activities (such as spot spray, hand pull, etc.) within the secondary nest zone would be coordinated with the wildlife biologist on a case-by-case basis to determine potential disturbance to nesting falcons and identify mitigating measures, if necessary. Non-mechanized invasive plant activities such as back pack spray, burning, hand-pulling, lopping, and/or re-vegetation planting may be allowed within the secondary nest zone during the seasonal restriction period. | To reduce disturbance to nesting falcons and protect eggs and nestlings. Agitated parents can damage the eggs with thin shells resulting in failed reproduction for that nest. | Pagel, J. (2006)<br>Peregrine falcon nest site data, 1983-2006. |

| PDC Reference | Design Criteria | Purpose of PDC | Source of PDC |
|---|---|---|---|
| J5f | All foot and vehicle entries into Primary nest zones would be seasonally prohibited except for the following reasons:<br>(1) Biologists performing monitoring in association with the eyrie and coordinated with the District Biologist.<br>(2) Law enforcement specialists performing associated duties with notice to the District Ranger.<br>(3) Access for fire, search/rescue, and medical emergencies under appropriate authority (Forest Service line officer or designee).<br>(4) Trail access, when determined by a biologist to be non-disturbing.<br>(5) Other exceptions on a case-by-case basis as determined by the Deciding Official. | To reduce disturbance to nesting falcons and protect eggs and nestlings. Agitated parents can damage the eggs with thin shells resulting in failed reproduction for that nest. | Pagel, J. (2006)<br>Peregrine falcon nest site data, 1983-2006. |
| J5g | Picloram and clopyralid would not be used within 1.5 miles of peregrine nest more than once per year. | To reduce exposure to hexachlorobenze, which has been found in peregrine falcon eggs. | Pagel, J. (2006)<br>Peregrine falcon nest site data, 1983-2006. |
| **J6** | **Oregon Spotted Frog** | | |
| J6a | Avoid broadcast spraying of herbicides, and avoid spot spraying of glyphosate with POEA surfactant, sulfometuron methyl, and NPE-based surfactants, in or adjacent to spotted frog habitat. Coordinate treatment methods, timing, and location with local Biologist. | To minimize exposure of frogs to herbicides or surfactants that pose risk to frogs. | Appendix P of the R6 2005 FEIS; SERA 2003, 2004; Bakke 2003 |
| **J7** | **Larch Mountain, Van Dyke's, Cope's Giant, and Cascade Torrent Salamanders** | | |
| J7a | Avoid broadcast spraying of herbicide in talus or rocky outcrops, springs, seeps or stream margins. Utilize aquatic design criteria for suitable habitat in riparian areas, streams, and rivers. (see PDC– H1, H1a, H6-11) | To reduce likelihood of exposure to contaminated soil and water. | Herbicide characteristics and risk to amphibians in SERA risk assessments, and professional opinion of local biologists |
| **J8** | **Northwestern Pond Turtle** | | |
| J8a | As part of the annual coordination meeting agreed to in the 2005 MOU, the Forest Service would review treatment locations, timing, and methods with Washington Department of Fish and Wildlife to minimize adverse impacts to pond turtles.<br><br>To minimize impacts to pond turtles, conduct treatments prior to April 1 or between August 1 and September 30, when effective for invasive plant control. Treat only portions of pond turtle habitat in any one season if treatment poses a risk of adverse impacts to pond turtles. | To minimize disturbance, trampling, and herbicide exposure to pond turtles. | 2005 MOU between Washington Dept. of Fish and Wildlife and USDA Forest Service; David Anderson, WA Dept. of Fish and Wildlife, personal communication, 2005. |
| **J9** | **Mardon Skipper** | | |
| J9a | Use only selective herbicide application methods and avoid use of ester formulations of herbicide and NPE-based surfactants in known mardon skipper habitat. Use herbicides on only a portion of a mardon skipper site in any one year. Coordinate treatment method, timing, and locations annually with local Biologist. | To minimize exposure to herbicides, surfactants, and trampling while effectively protecting and improving habitat | Herbicide characteristics and risk to insects in SERA risk assessments; Sucoff et al. 2001; Bramble et al. 1997; Bramble et al. 1999; and professional opinion of local biologists |

| PDC Reference | Design Criteria | Purpose of PDC | Source of PDC |
|---|---|---|---|
| **J10** | **Sensitive Mollusk Habitat** (**Warty and Malone jumping slug, blue-gray taildropper** | | |
| J10a | In known sites or high potential suitable habitat outside of roadside treatment locations, avoid manual, mechanical, or herbicide treatments when soil moisture is high (generally late fall to late spring). | To reduce risk of trampling and herbicide exposure | Herbicide characteristics in SERA risk assessments, and professional opinion of local taxa expert. |
| **J11** | **Puget Oregonian (*Cryptomastix devia*)** | | |
| J11a | Conduct manual or selective herbicide treatments within 50 feet of big-leaf maple trees that are larger than 20 inches dbh when soil moisture is low. Avoid broadcast spraying of herbicides within suitable habitat. Coordinate treatment method, timing, and locations annually with local Biologist. | To reduce risk of trampling and herbicide exposure | Herbicide characteristics in SERA risk assessments, and professional opinion of local taxa expert. |
| ***K*** | ***Public Notification*** | | |
| K1 | High use areas, including administrative sites, developed campgrounds, visitor centers, and trailheads would be posted in advance of herbicide application or closed.<br>Areas of potential conflict would be prominently marked on the ground or otherwise posted.<br>Postings would indicate the date of treatments, the herbicide used, and when the areas are expected to be clear of herbicide residue. | To ensure that no inadvertent public contact with herbicide occurs. | These are common measures to reduce conflicts. |
| K2 | The public would be notified about upcoming herbicide treatments via the local newspaper or individual notification, fliers, and posting signs. Forest Service and other websites may also be used for public notification. | To ensure that no inadvertent public contact with herbicide occurs. | R6 2005 ROD Standard 23 (see table 1). |
| ***L*** | ***Special Forest Products*** | | |
| L1 | Triclopyr would not be applied to foliage in areas of known special forest products or other wild foods collection. | To eliminate any scenario where people might be exposed to harmful doses of triclopyr. | Appendix Q of the R6 2005 FEIS |
| L2 | Special forest product gathering areas may be closed for a period of time to ensure that no inadvertent public contact with herbicide occurs. | To eliminate any scenario where people might be exposed to herbicide. | R6 2005 ROD Standard 23 |
| L3 | Popular berry and mushroom picking areas would be posted prominently marked on the ground or otherwise posted. | To eliminate any scenario where people might be exposed to herbicide. | R6 2005 ROD Standard 23 |
| L4 | Special forest product gatherers would be notified about herbicide treatment areas when applying for their permits. Flyers indicating treatment areas may be included with the permits, in multi-lingual formats if necessary. | To ensure that no inadvertent public contact with herbicide occurs. | R6 2005 ROD Standard 23 |
| ***M*** | ***American Indian Tribal and Treaty Rights*** | | |

| PDC Reference | Design Criteria | Purpose of PDC | Source of PDC |
|---|---|---|---|
| M1 | American Indian tribes would be notified annually as treatments are scheduled so that tribal members may provide input and/or be notified prior to gathering cultural plants. Individual cultural plants identified by tribes would be buffered as above for botanical species of local interest. | To ensure that no inadvertent public contact with herbicide occurs and that cultural plants are fully protected. | Government to government agreements between American Indian tribes and the Gifford Pinchot National Forest and Columbia River Gorge National Scenic Area. |
| M2 | The Forest Archaeologist will annually assess proposed treatment areas where minor ground disturbing actions such as weed wrenching and grubbing with a shovel in areas that are outside landslides, flood deposits, previously surveyed areas, skid trails, landings, road shoulders, cuts and fills, are proposed.<br><br>The Forest Archaeologist will have an opportunity to review project locations to determine if any cultural resources could be affected. Weed wrenching and grubbing techniques will not be used in known archaeological sites. Alternative treatment methods will be selected from those that would have no potential to affect cultural resources. | To avoid conflicts impacts to cultural resources. | Common practice. |
| M3 | Coordination of treatment timing at Fisher Hill (Treatment Area 2216) with the Yakama Nation. | To avoid conflicts with invasive treatments and tribal use of Fisher Hill fishery. | Government to government coordination between the Yakama Nation and Columbia River Gorge National Scenic Area. |

## ***Buffers***

The development of buffers considered results from the worst-case scenarios analyzed in the SERA risk assessments, risk level associated to aquatic organisms as identified in the R6 2005 FEIS Fish BA, differences in application methods, whether water is present at the treatment site or not, buffers from previous Section 7 ESA consultations on herbicide treatments, Forest Service monitoring results from Neil Berg (2004), Washington State Department of Agriculture 2003-2005 monitoring results and inherent herbicide properties.

Buffer distances shown in Tables 9, 10, and 11 are in feet for perennial and wet intermittent streams, streams that are dry at the time of treatment, and wetlands, high water table areas, lakes and ponds. Buffers are measured as **horizontal** distance from bankfull or the ordinary high water mark.

Table 9 – Perennial and wet intermittent stream buffers

| Herbicide | Perennial and Wet Intermittent Stream Buffers | | |
|---|---|---|---|
| | **Broadcast (feet)** | **Spot (feet)** | **Hand/ Select (feet)** |
| Chlorsulfuron | 100 | 50 | Bankfull |
| Clopyralid | 100 | 15 | Bankfull |
| Glyphosate | 100 | 50 | 50 |
| ***Glyphosate (Aquatic Formula)*** | ***50*** | *No buffer*** | *No buffer* |
| Imazapic | 100 | 15 | Bankfull |
| Imazapyr | 100 | 50 | Bankfull |
| ***Imazapyr (Aquatic Formula)*** | ***50*** | *No buffer* | *No buffer* |
| Metsulfuron Methyl | 100 | 15 | Bankfull |
| Picloram | 100 | 50 | 50 |
| Sethoxydim | 100 | 50 | 50 |
| Sulfometuron Methyl | 100 | 50 | *Bankfull* |
| Triclopyr-BEE | None Allowed | 150 | 150 |
| Triclopyr-TEA (Aquatic Formula) | None Allowed | 15 | *No buffer* |

**No buffer means that treatment may occur anywhere across the stream channel where target vegetation exists including backwater channels, braided streams, floodplains, etc even when water is present.

Table 10 – Buffers for streams that are dry at the time of treatment

| **Herbicide** | **Buffers For Streams That Are Dry At The Time Of Treatment** | | |
|---|---|---|---|
| | **Broadcast (feet)** | **Spot (feet)** | **Hand/ Select (feet)** |
| Chlorsulfuron | ***50*** | 15 | Bankfull |
| Clopyralid | ***50*** | Bankfull | *No buffer* |
| Glyphosate | 100 | 50 | 50 |
| Glyphosate (Aquatic Formulation) | ***50*** | *No buffer*** | *No buffer* |
| Imazapic | ***50*** | Bankfull | *No buffer* |
| Imazapyr | ***50*** | 15 | Bankfull |
| Imazapyr (Aquatic Formulation) | ***50*** | *No buffer* | *No buffer* |
| Metsulfuron Methyl | ***50*** | Bankfull | *No buffer* |
| Picloram | 100 | 50 | 50 |
| Sethoxydim | 100 | 50 | 50 |
| Sulfometuron Methyl | ***50*** | 15 | Bankfull |
| Triclopyr-BEE | None Allowed | 150 | 150 |
| Triclopyr-TEA (Aquatic Formula) | None Allowed | 15 | *No buffer* |

**No buffer means that treatment may occur anywhere across the stream channel where target vegetation exists including backwater channels, braided streams, floodplains, etc even when water is present.

Table 11 – Buffers for wetlands, high water table areas, lakes and ponds

| Herbicide | Wetlands, High Water Table Areas, Lakes and Ponds | | |
|---|---|---|---|
| | **Broadcast (feet)** | **Spot (feet)** | **Hand/ Select (feet)** |
| Chlorsulfuron | 100 | 50 | Water's Edge |
| Clopyralid | 100 | 15 | Water's Edge |
| Glyphosate | 100 | 50 | 50 |
| Glyphosate (Aquatic Formula) | ***50*** ** | *No buffer*** | *No buffer* |
| Imazapic | 100 | 15 | Water's Edge |
| Imazapyr (Aquatic Formula) | ***50*** ** | *No buffer* | *No buffer* |
| Imazapyr | 100 | 50 | Water's Edge |
| Metsulfuron Methyl | 100 | 15 | Water's Edge |
| Picloram | 100 | 50 | 50 |
| Sethoxydim | 100 | 50 | 50 |
| Sulfometuron Methyl | 100 | 50 | Water's Edge |
| Triclopyr-BEE | None Allowed | 150 | 150 |
| Triclopyr-TEA (Aquatic Formula) | None Allowed | 15 | *No buffer* |

** If wetland, pond or lake is dry, there is no buffer. No buffer means that treatment may occur anywhere across the stream channel where target vegetation exists including backwater channels, braided streams, and floodplains.

Figure 1 below is used to illustrate how the Aquatic Influence Zone restricts application methods and herbicides to only those approved for use in aquatic areas. "Aquatic Influence Zone" is not equal to the "buffer widths" listed in the tables above. For purposes of analysis in this BA, the Aquatic Influence Zone is defined by the innermost half of the Riparian Reserve, as defined by the Northwest Forest Plan. For instance, a 300 foot Riparian Reserve would have an Aquatic Influence Zone of 150 feet. Establishing buffer widths reduces the potential for herbicides to come in contact with water via drift, leaching, and runoff at or near concentrations of concern.

Figure 1. Illustration of how herbicide selection and application methods in the established buffer widths are more limited in Aquatic Influence Zones.

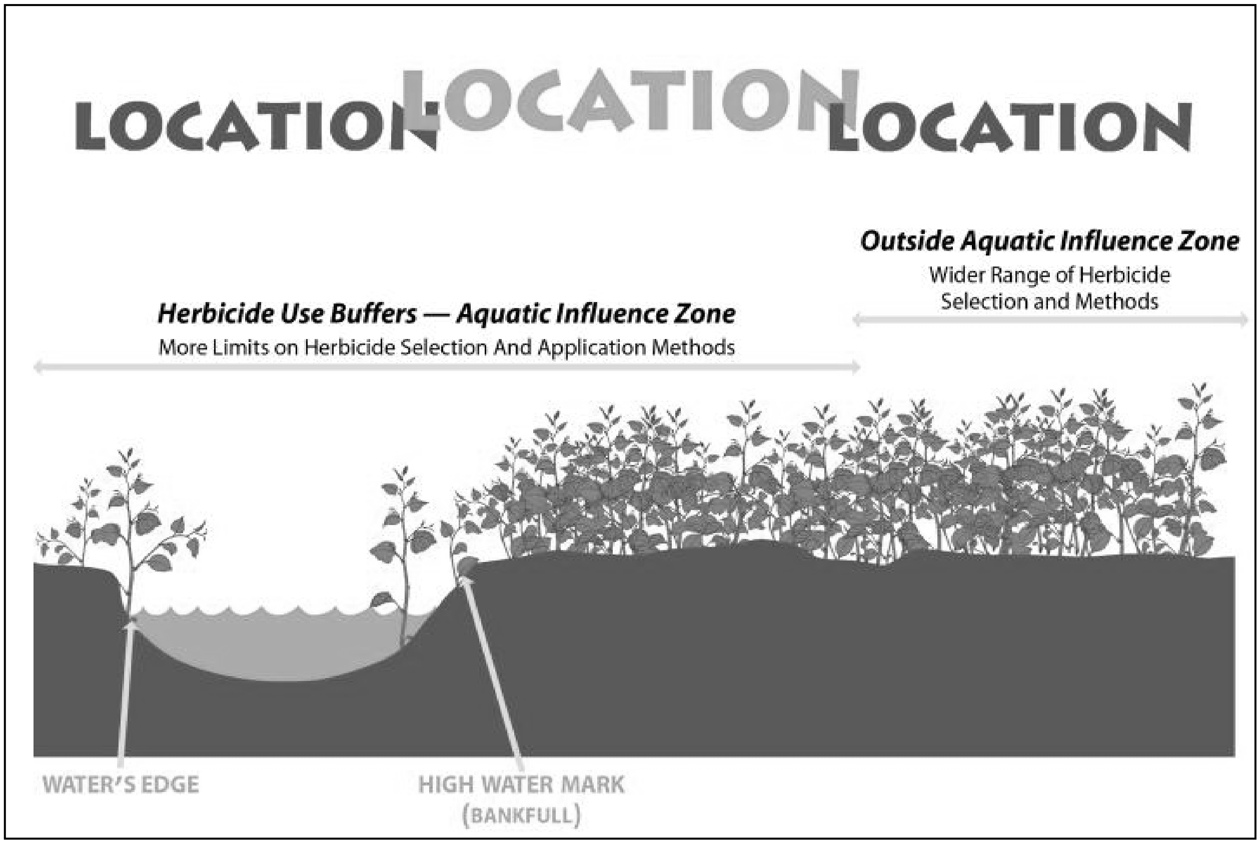


Figure 1 - Herbicide Selection and Application Methods Limited in Aquatic Influence Zones

***Roadside Ditches***

The illustration above in Figure 1 exemplifies a cross-section of either a stream or a roadside ditch that has a high potential for herbicide delivery. Roadside ditches can also act as extensions of the stream network when there is enough flow and depth in a ditch to deliver sediment. The analysis in this BA uses sediment delivery as a surrogate for potential herbicide delivery in roadside ditches.

To reduce the potential for herbicides to come in contact with water via runoff at or near concentrations of concern, the following restrictions would apply to roadside treatments:

- No broadcasting of any herbicide on roads identified as a high potential for herbicide delivery (PDF H3)
- No use of picloram or Triclopyr BEE on roads identified as a high potential for herbicide delivery (PDF H3)
- Where there is standing water in a roadside ditch located outside the established buffers of a stream, apply a 15 foot buffer around the standing water and use only low risk herbicides within 15 feet of the edge of a wet roadside ditch. For treatments of target vegetation emerging out of the wet roadside ditch only aquatic labeled herbicides would be used (PDF H4).
- Apply appropriate buffer widths to road sections that cross streams (refer to buffer tables)

Table 12 below displays the protection buffers specific to botanical species of local interest. These buffers are in addition to herbicide use buffers within Aquatic Influence Zones. Hence, if a botanical species of local interest is found at or near the edge of a stream buffer, then the stream buffer size may be enlarged to incorporate protection buffers established for botanical species of local interest.

Table 12 - Protection Buffers for Botanical Species of Local Interest

| | **Distance from Botanical Species of Interest** | | |
|---|---|---|---|
| | **Further than 100 ft.** | **100 ft to 10 ft.** | **Closer than 10 ft.** |
| **Application Method Allowed** | All methods according to PDCs. | Botanical SOLI would be shielded with a protective barrier during broadcast herbicide application.<br><br>No additional limitations for spot and hand/selective treatments | 1. Broadcast application is not permitted.<br><br>2. If soils are saturated or wet at time of application, spot application is not permitted. Elsewhere, botanical SOLI would be shielded with a protective barrier during spot treatments. Hand/selective application of herbicide and/or non-herbicide treatment permitted without protective shielding. |

## Gifford Pinchot National Forest Plan Amendment

The Proposed Action would amend one standard and eliminate another standard from the Gifford Pinchot National Forest Plan:

1. Current Standard: Herbicides and other pesticides will not be applied in Riparian Reserves.

Amendment: Herbicides and other pesticides will not be applied in Riparian Reserves, except to treat invasive plants according to standards listed in the Pacific Northwest Region 2005 Record of Decision for Managing and Preventing Invasive Plants.

The existing wording would be retained for native vegetation management.

2. Current Standard: Vegetation adjacent to the designated travel route or recreation site (in visual emphasis area V) should be controlled in a visually inconspicuous manner, primarily by hand or machine methods. Any use of chemicals should be timed to avoid vegetative brownout (e.g., a dormant spray used in the fall).

Amendment: This standard would be deleted in its entirety.

Both of these changes are intended to allow for effective treatment in accordance with the R6 2005 ROD. The reason the brown out standard is proposed for deletion in its entirety is that the temporary effects of brown out are not important to scenery management. Scenery analysts and managers emphasize that restoration of native plant communities and natural landscapes is a more suitable and productive approach to meeting visual objectives. The existing brown out standard could conflict with effective restoration and the potential, temporary impacts of brown out are far outweighed by the need for restorative action.

## Monitoring

The GPNF and CRGNSA invasive plants coordinator is maintaining an up-to-date invasive plant inventory using NRIS/Terra (a Forest Service accepted protocol at the national level). The inventory will be used as the main vehicle for tracking treatment effectiveness at site-specific, Forest wide and Regional scales.

The GPNF and CRGNSA Plan includes a Monitoring Plan. Annually, monitoring results are reported by the Forest. In addition, the R6 2005 ROD established a framework for project and program monitoring (see Appendix 1 of the R6 2005 ROD).

The monitoring categories described the R6 2005 ROD framework (implementation/compliance, and effectiveness (of treatments in meeting project objectives, and effectiveness of protection measures) can be used to implement a long-term adaptive management strategy. By implementing an adaptive management approach, managers on GPNF and CRGNSA will identify and respond to changing conditions and new information on an ongoing basis, and assess the need to make changes to treatment and restoration strategies within the scope of the EIS. If there is a need to make changes to treatment and restoration strategies outside the scope of this analysis, then the Forest will need to do additional NEPA.

### Implementation/Compliance Monitoring

Implementation/compliance monitoring answers the question, “Did we do what we said we would do?” This question needs to be answered on a Regional scale, because adaptive management strategies require determination that actions are taking place as described in the R6 2005 FEIS.

The GPNF and CRGNSA will contribute to compliance monitoring under the R6 2005 ROD as a part of Forest Plan Implementation monitoring. Regional Office staff will periodically aggregate this information as a part of program oversight.

An implementation/compliance monitoring database would track invasive plant treatment projects that are the subject of Section 7 consultations under the Endangered Species Act (ESA), generate annual reporting of compliance for use by the Services (NOAA Fisheries, U.S. Fish and Wildlife) and Forest Service (FS), and allow for common reporting of data on individual projects. At a minimum, on each project requiring consultation, reporting will be required on compliance with Standards 16, 18, 19, and 20 in the R6 2005 ROD. Additional standards could be included, as appropriate. For example, Northwest Forest Plan (NWFP) riparian standards relevant to herbicide use.

### Effectiveness Monitoring

The Effectiveness Monitoring component in the R6 2005 FEIS is intended to answer the following questions:

- Have the number of new invasive plant infestations increased or decreased in the Region or at the project level?

- What changes in distribution, amount and proportion of invasive plant infestations have resulted due to treatment activities in the region or at the project level?
- Has the infestation size for a targeted invasive plant species been reduced regionally or at the project level?
- Which treatment methods, separate or in combination, are most successful for specific invasive species?
- Which treatment methods have not been successful for specific invasive species?

The nation-wide NRIS/Terra database, and the FACTS database, provide common reporting formats to input information and provide a mechanism for addressing the above questions. In addition, current long-term ecological monitoring networks will assist the FS in determining trends of invasive plant infestations at the Regional level.

Monitoring that addresses the effectiveness of various measures designed to reduce potential adverse effects to listed species, from the project, including standards in the R6 2005 FEIS, "project design criteria", and "protection measures" would only be required for a representative sample of invasive plant treatment projects that pose a "high risk" to federally listed species. "High risk" projects are defined as projects with the potential to affect listed species, in the following situations:

- Any project involving aerial application of herbicide.
- Projects involving the use of heavy equipment or broadcast application of herbicide (e.g. boom spray or backpack spraying that is not limited to spot sprays) that occur in 1) riparian areas (as defined in NWFP, Pacfish, or Infish, as applicable), ditches or water corridors connected to habitat for listed fish; or, 2) proximity to federally listed plants or butterfly habitat.

No broadcast treatments would occur within 50 feet of any wet or dry stream, lake, or within any wetland with water present. Broadcast treatments would also not occur along roads that pose a high risk of herbicide delivery to surface waters, regardless of whether the road ditches are connected to habitat for listed fish or not.

However, broadcast of aquatic glyphosate and/or aquatic imazapyr may occur within a riparian area as defined in the NWFP. These treatments, along with herbicide treatment of wetland or stream emergent vegetation using spot or hand/selective methods, would be submitted as candidates for monitoring via the R6 2005 Monitoring framework to ensure the design criteria for such treatments are effective.

## D. Layers of Caution Integrated Into Herbicide Use

Figure 2 displays the added layers of caution that are integrated into herbicide use in the Pacific Northwest Region (Region Six). Each layer of caution serves to reduce risk to humans and the environment from proposed herbicide use. First, label requirements, federal and state laws, and the EPA approval process provide an initial level of caution and manage risk regarding chemical use. Second, the SERA Risk Assessments disclosed hazards associated with worst-case herbicide conditions for the types of uses proposed by the Forest Service.

Third, the R6 2005 FEIS included an additional margin of safety to the results of the SERA Risk Assessments by further reducing acceptable thresholds of herbicide exposure to account for increased protection needed for federally listed species (EPA 2004). Fourth, the GPNF LRMP adopted standards from the R6 2005 ROD that minimize or eliminate risks to people and the environment. The GPNF and CRGNSA Site-Specific Invasive Plant Treatment Project is designed to comply with the R6 2005 ROD standards. Risk is further reduced by identifying treatment methods appropriate to the GPNF and CRGNSA and project design criteria that minimize or eliminate the potential for adverse affects at the project scale.


Figure 2. Layers of Caution Integrated Into Herbicide Use

Figure 2 also depicts how the site-specific situation on the GPNF and CRGNSA allows for additional layers of caution to be integrated into herbicide use locally:

1. Treatment methods have been limited to those necessary to eradicate, control or contain invasive plants on the GPNF and CRGNSA; higher risk projects such as aerial application and/or broadcast application within 50 feet of streams, within wetlands with water present, or on roads associated with high risk of herbicide delivery are not necessary or proposed.

2. Project design criteria (Criteria) limit the rate, type and method of herbicide application sufficiently to eliminate exposure scenarios that would cause concern, based on the site conditions at the time of treatment.

3. The implementation planning and monitoring and adaptive management processes described in Chapter 2 of the GPNF and CRGNSA DEIS would ensure that effective treatments are completed according to PDCs, and undesired effects are indeed minimized. Further analysis

would be required if a new infestation would not be treated effectively according to the PDCs (for instance, the herbicides available for use near streams were not effective for a new infestation).

4. Each state may also have its own separate registration process for herbicides, which may be more stringent than the EPA's registration process. Washington State's registration procedure follows EPA registration. It requires that the applicant submit a copy of the market label and a copy of the confidential statement of formula. Washington State Department of Agriculture (WSDOA) reviews these submittals for compliance with state and federal requirements. The three aquatic labeled herbicides allowed in the Proposed Action are registered for use in the Washington state for treatment of emergent vegetation.

5. Research on previous ESA consultations related to buffer widths was conducted in order to fully develop the proposed action for purposes of meeting relevant standards in the GPNF LRMP, as amended. Where there was not enough information, such is the case for dry intermittent streams, a conservative approach was taken by the interdisciplinary team in developing buffers using knowledge of herbicide properties and level of risk to aquatic organisms.

Buffer zones where broadcast applications are prohibited (no-broadcast-buffers) were adopted from previous ESA consultations, modified by results of previous monitoring. Two sources, Neil Berg's 2004 Best Management Practices effectiveness monitoring report for herbicides used in Forested settings across the U.S. and Washington State Department of Transportation monitoring results also factored into the development of no broadcast buffers that provide a substantial degree of caution and minimize risks. WSDOA results indicate that very little, if any, glyphosate remains in the water near treatment sites (WSDOA 2003) under spot and hand/selecove applications. Monitoring results since 2003 continue to be below a level of concern.

Detections of herbicide in water from WSDOA's monitoring efforts found that the amount of herbicide is being used was the most relevant factor in determining concentrations in water (Greg Haubrich, personal communication). Ironically, WSDOA's monitoring of glyphosate stem injections are resulting in more detections than foliar applications but remain below toxicity thresholds. Perhaps this is because of the amount of solution used (ibid).

# II. HERBICIDE RISK ASSESSMENTS

Because herbicides have the potential to adversely affect the environment, the U.S. Environmental Protection Agency (EPA) must register all herbicides prior to their sale, distribution, or use in the United States. In order to register herbicides for outdoor use, the EPA requires the manufacturers to conduct a safety evaluation on wildlife including toxicity testing on representative species of birds, mammals, freshwater fish, aquatic invertebrates, and terrestrial and aquatic plants. An ecological risk assessment uses the data collected to evaluate the likelihood that adverse ecological effects may occur as a result of herbicide use.

The Forest Service conducts its own risk assessments, focusing specifically on the type of herbicide uses in forestry applications. The FS contracts with Syracuse Environmental Research Associates, Inc. (SERA) to conduct human health and ecological risk assessments for herbicides that may be proposed for use on National Forest System lands. The herbicide formulations included in the SERA risk assessments are listed in Appendix C of this BA. The information contained in this BA, and in the EIS, relies on these risk assessments. All toxicity data, exposure scenarios, and assessments of risk are based upon information in the FS/SERA risk assessments unless otherwise noted. FS/SERA risk assessments use peer-reviewed articles from the open scientific literature and current EPA documents, including Confidential Business Information. Specific methods used in preparing the FS/SERA risk assessments are described in SERA, 2001-Preparation. The risk assessments and associated documentation are available in total in the administrative record for the EIS. Estimates of risk are not absolute; rather, they are relative and based on assumptions contained in generic "worst case" scenarios. Risk assessments have inherent limitations; these are discussed later in this chapter.

The risk assessments considered worst-case scenarios including accidental exposures and application at maximum reported rates. The R6 2005 FEIS added a margin of safety to the SERA Risk Assessments by lowering acceptable thresholds of herbicide exposure to account for increased protection needed for federally listed species (EPA 2004). Although the risk assessments have limitations (see R6 2005 FEIS pages 3-95 through 3-97), they represent the best science available.

The table below displays the risk assessments that may be accessed via the Pacific Northwest Region website at http://www.fs.fed.us/r6/invasiveplant-eis/Risk-Assessments/Herbicides-Analyzed-InvPlant-EIS.htm. Herbicide formulations covered in the SERA risk assessments are listed in Appendix C of this BA.

Table 13 - Risk Assessments for Herbicides Considered in this EIS

| Herbicide | Date Final | Risk Assessment Reference |
|---|---|---|
| **Chlorsulfuron** | November 21, 2004 | SERA TR 04-43-18-01c |
| **Clopyralid** | December 5, 2004 | SERA TR 04 43-17-03c |
| **Glyphosate** | March 1, 2003 | SERA TR 02-43-09-04a |
| **Imazapic** | December 23, 2004 | SERA TR 04-43-17-04b |
| **Imazapyr** | December 18, 2004 | SERA TR 04-43-17-05b |
| **Metsulfuron methyl** | December 9, 2004 | SERA TR 03-43-17-01b |
| **Picloram** | June 30, 2003 | SERA TR 03-43-16-01b |
| **Sethoxydim** | October 31, 2001 | SERA TR 01-43-01-01c |
| **Sulfometuron methyl** | December 14, 2004 | SERA TR 03-43-17-02c |
| **Triclopyr** | March 15, 2003 | SERA TR 02-43-13-03b |
| **NPE** | May 2003 | USDA Forest Service, R-5 (Bakke 2003) |

## A. Herbicide Analysis

The risk assessments prepared by SERA (1998, 2001, 2003) contain the detailed analysis of the potential effects of each herbicide. Portions of the risk assessments pertaining to terrestrial wildlife are summarized in USDA Forest Service (2005b, Appendix B). This summary contains a detailed description of factors influencing exposure and dose, use of surrogate species for toxicity data, field studies, and analysis results for each individual herbicide. Refer to the summary, found in Appendix B of the FWS BA for the R6 2005 FEIS, for more information on analysis methods used to determine the potential effects to listed wildlife species. A summary of potential effects to listed fish can be found in USDA Forest Service 2005c (NMFS BA).

Toxicity data found in the risk assessments, exposure scenarios, and project worksheets were used to derive quantitative estimates of dose for worst-case situations. The worksheets used in the analysis may be found in the project record for the R6 2005 FEIS.

For terrestrial wildlife, when enough data was available for a particular type of animal, an exposure scenario was developed, and a quantitative estimate of dose received by the animal type in the scenario was calculated (SERA, 2001). The quantitative estimates of dose were compared to available toxicity data to determine potential adverse impacts. We used the most sensitive response (i.e. a sub-lethal effect that occurred at the lowest dose) from the most sensitive species to determine the "toxicity indices" (aka acceptable threshold) for each herbicide[6]. Adverse affects to wildlife health such as lethargy, weight loss, nausea, and fluid loss due to diarrhea or vomiting, can affect their ability to compete for food, locate and/or capture food, avoid or fight off predators, or reproduce. The following analysis relies on these types of effects, when sufficient data exists, rather than directly lethal doses, to determine the potential for doses to cause an "adverse effect" to wildlife.

6 For example, the most sensitive response to picloram in mammals is weight loss in rabbits. We used the dose of picloram that did not cause weight loss in rabbits as the toxicity index. This dose was reported in scientific literature or toxicity studies as the no-obeservable-adverse-effect-level (NOAEL).

For fish, toxicity indices (thresholds) were established using either measured chronic NOAEL's, or 1/20th of the acute LC50, whichever was lower. Use of these thresholds, including a chronic NOAEL for acute exposures, was intended to account for uncertainty regarding sublethal effects to fish (USDA Forest Service 2005c – NMFS BA). Worst case scenarios were developed to estimate the herbicide concentration in water and therefore the dose received by fish and aquatic organisms.

The estimated dose (from the scenarios) was divided by the "toxicity index" and the result is known as the Hazard Quotient. When the Hazard Quotient is less than 1.0, the dose is les than the toxicity index. Potential effects from doses calculated to be below the toxicity indices are discountable. When a calculated dose was greater than the toxicity index, we stated that there was a potential for adverse effects. This very protective approach constitutes a "worst-case" analysis for potential effects of herbicides.

Whenever sufficient data were available to determine the dose that resulted in no observable adverse effects (NOAEL), the NOAEL was used as the toxicity index. If data were not sufficient to determine a NOAEL, other endpoints of toxicity were used, such as the lowest-adverse-effect level (LOAEL), or the dose that was lethal to 50 percent of the test population ($LD_{50}$). When a LOAEL or $LD_{50}$ was used as the toxicity index, standard EPA methods for applying an uncertainty factor to the toxicity index to determine a level of concern were used. The standard EPA method for listed terrestrial species is to take 0.1 of the $LD_{50}$ (EPA/OPP 2004) and for listed fish 0.20 of the $LC_{50}$, which is the protocol used in this analysis when a NOAEL is not available.

### *Herbicide Mixtures*

A Standard in the GPNF LRMP limits mixtures to three herbicides or fewer and requires the use of a dose addition analysis at the project scale to determine if a particular mixture may be used. Under specified conditions, dose addition analysis is believed to provide a reasonable estimate of the cumulative toxicity of chemical mixtures. The hazard index (HI) method of assessing dose addition is relatively simple and straightforward. The approach is used or recommended by a number of agencies, including EPA, National Academy of Sciences, National Research Council, and Occupational Health and Safety Administration (ATSDR, 2004).

The individual herbicides in each mixture are analyzed to determine estimated dose, which is then divided by the respective "toxicity index" to produce a hazard quotient (HQ). When the HQ is less than 1.0, then the dose is less than the toxicity index. The HI is calculated by adding all the HQ's for the herbicides in the mixture. This is known as dose addition. If the HI is < 1.0, then an acceptable level of mixture toxicity risk is assumed to be present. A HI would be calculated at the project level to assess potential effects to listed species in a project area. See Appendix B of this BA for Tank Mixture Analysis Method.

Dose addition is considered most appropriate for mixtures with components that affect the same endpoint by the same mode of action, and are believed to behave similarly with respect to uptake, metabolism, distribution, and elimination (Choudhury et al., 2000). The precise toxic mechanism(s) in birds and mammals are not known for all of the 10 herbicides contained in the proposed action. But in terrestrial wildlife, effects to the kidney and liver are typical endpoints. Effects to the fish and fry are typical endpoints.

Dose addition analysis is also a reasonable assumption when analyzing mixtures of chemicals with different or unknown toxicity mechanisms, when expected doses will be below known toxic levels (ATSDR, 2004). This is also supported by data from Feron et al. (1995), as cited in EPA (Choudhury et al., 2000), which showed interaction when mixture chemical components were present in concentrations at or near their respective LOAELs. No interaction was observed between chemical components when present at concentrations 1/10 or 1/3 or their respective LOAELs. Similarly, Relyea (2005) found, in studies of growth and survival of amphibians exposed to combinations of pesticides, that effects from combined pesticides were similar to that predicted by the total concentration of pesticides in the system.

The dose addition analysis described in this document is believed to produce conservative estimates of mixture toxicity for several reasons. First, the assumption of dose addition in itself is conservative; the dose addition protocol assumes an additive response for all chemicals in the mixture, when in fact some chemicals may produce independent, non-additive responses. For example, the EPA description of dose addition analysis in Choudhury et al. (2000) states that separate dose addition analyses should be performed for each affected organ. This protocol utilizes one HI that includes all herbicides, regardless of toxicity site, potentially resulting in a higher HI value than if mixture components were analyzed in smaller groups by affected organ.

Also, by requiring the HI for the mixture to be less than 1.0, the Hazard Quotients of each component in the mixture must be below known toxic levels and will meet the criteria cited in ATSDR (2004) and Choudhury et al. (2000).

The primary sources of uncertainty in utilizing dose addition analysis in the proposed manner are the lack of mixture analysis studies utilizing more than two chemicals. The risk of adverse effects, with respect to the lack of information on mixtures involving more than two chemicals, increases with the number of mixture components. In an effort to minimize these risks, the proposed action states the mixtures will contain no more than three active herbicide ingredients.

## B. Uncertainty and Data Gaps

Generally, active ingredients have been tested on only a limited number of species and mostly under laboratory conditions. While laboratory experiments can be used to determine acute toxicity and effects to reproduction, cancer rates, birth defect rates, and other effects that must be considered, laboratory experiments do not account for fish and wildlife in their natural environments. Environmental stressors can increase the adverse effects of contaminants, but the degree to which these effects may occur for various herbicides is largely unknown. Various fish and wildlife species may also be more or less sensitive to a particular herbicide than laboratory animals. This leads to uncertainty in the risk assessment analysis. Additional discussion of incomplete and unavailable information can be found in the EIS.

<u>The Use of Surrogate Species</u>

Most toxicity testing utilizes surrogate species. Surrogate species serve as a substitute for the species of interest, because all species of interest could not be tested. Surrogate species are typically organisms that are easily tested using standardized methods, are readily available, and inexpensive. The physiological requirements for some organisms prohibit their use in toxicity testing because these requirements cannot be met within the test system. Rare or federally listed species are not used for a variety of reasons, including legal restrictions and having only a limited numbers of individuals available. On the rare occasions when data can be obtained from federally listed species, the limited conditions under which they are taken may bias the results (e.g. see Wiemeyer et al., 1993).

Even when desired species are available (e.g. salmon), researchers may choose a surrogate, like zebrafish *(Danio rerio)*(aka zebra danio), because test results are more easily discerned with the surrogate, and reproductive capacity allows testing of large numbers of individuals, among other reasons (Scholz, unpub. proposal, 2003).

However, caution should to be taken when addressing ecological risk and the use of surrogates when analyzing those ecological risks. Some herbicides demonstrate more variation than others in effects among different species, and very limited numbers of species have been tested.

Because of the variation of responses among species, and the uncertainty with regard to how accurately a surrogate species may represent other wildlife, the FS/SERA risk assessments use the most sensitive endpoint from the most sensitive species tested as the toxicity index for all wildlife. This does not alleviate concerns over interspecies variations in response.

Doses and Responses

The likelihood that an animal will experience adverse effects from an herbicide depends on: (1) the inherent toxicity of the chemical, (2) the amount of chemical to which an animal is exposed, (3) the amount of chemical actually received by the animal (dose), and (4) the inherent sensitivity of the animal to the chemical.

The amount of chemical to which an animal may be exposed is influenced by several factors, such as the presence of fur or feathers, environmental conditions, and foliar interception of spray. When an animal is exposed to a chemical, only a portion of the chemical applied or ingested is actually absorbed or taken in by the animal (the dose). Various absorption rates for wildlife are not available, so direct spray scenarios assume 100 percent absorption for this analysis. For fish, the dose is taken as the concentration in the water to which they are exposed.

In this analysis, only the highest ranges of exposure assumptions are included, although a more complete range of possible values is included in the FS/SERA risk assessments and in all worksheets used to calculate doses. For example, for a given herbicide, residues of the herbicide on vegetation that are reported in the literature will vary between studies and by vegetation type. A range of residue rates is used in the FS/SERA risk assessment worksheets, but only the highest reported rates are used in the data reported here. Only the highest values are used here to reduce length and complexity of this document and also to present a reasonable “worst-case” exposure analysis. It should be noted, however, that reporting only the upper estimates of exposure assumptions could distort the risk (by potentially over stating it) and does not adequately encompass the uncertainties involved (Durkin, pers. com.).

For exposures to fish, the maximum water contamination rates (GLEAMS model output) for the local combinations of soil and rainfall were used.

## C. Effects of Herbicides and Surfactants

Herbicides vary in their environmental activity and physical form. Some may be oil- or water-soluble molecules dissolved in liquids, or attached to granules for dry application to soil surface. Herbicides may move from their location of application through leaching (dissolved in water as it moves through soil), volatilization (moving through air as a dissolved gas), or adsorption (attached by molecular electrical charges to soil particles that are moved by wind or water).

In soil and water, herbicides may persist or decompose by sunlight, microorganisms, or other environmental factors. Soil properties, rainfall patterns, slope, and vegetative cover greatly influence the likelihood that an herbicide will move off-site, once applied.

In combination with other site and biological factors, these characteristics influence both the probability of meeting site-specific goals for invasive plant control, and the potential of impacting non-target components of the environment.

The effects from the use of any herbicide depends on the toxic properties (hazards) of that herbicide, the level of exposure to that herbicide at any given time, and the duration of that exposure. Risk to fish and wildlife can be reduced by choosing herbicides with lower potential for toxic effects when exposure may occur. Exposure of wildlife to herbicides can be greatly reduced or increased depending on site-specific implementation techniques and timing used in herbicide application projects. Exposure can be reduced by such methods as streamside buffer zones, timing applications to avoid sensitive seasons, varying application methods used, and combining herbicide treatments with non-herbicide treatments to reduce overall use. These project design criteria are included in the proposed action, as discussed previously.

The hazards associated with each herbicide active and inert ingredients, impurity or metabolite were determined by a thorough review of available toxicological studies. For a background discussion of all toxicological tests and endpoints considered in Forest Service Risk Assessments, refer to SERA, 2001.

Herbicides are not pure compounds and they contain the active ingredient, impurities, adjuvants, inert ingredients, and may also contain surfactants. The effects of inert ingredients, adjuvants, impurities, and surfactants to wildlife are discussed first, followed by a discussion of the effects of the active ingredients.

### *Inerts, Adjuvants and Impurities*

Inert compounds are those that are intentionally added to a formulation, but have no herbicidal activity and do not affect the herbicidal activity. Inerts are added to the formulation to facilitate its handling, stability, or mixing. Impurities are inadvertent contaminants in the herbicide, usually present as a result of the manufacturing process. Adjuvants are compounds added to the formulation to improve its performance. They can either enhance the activity of an herbicide's active ingredient (activator adjuvant) or offset any problems associated with its application (special purpose or utility modifiers). Surfactants are one type of adjuvant that makes the herbicide more effective by increasing absorption into the plant, for example.

Inerts and adjuvants, including surfactants, are not under the same registration guidelines as are pesticides. The EPA classifies these compounds into four lists based on the available toxicity information. If the compounds are not classified as toxic, then all information on them is considered proprietary and the manufacturer need not disclose their identity. Therefore, inerts and adjuvants generally do not have the same amount of research conducted on their effects, especially to wildlife species, compared to active ingredients.

**Impurities and Metabolites**

All herbicides likely contain impurities as a result of the synthesis or production process. The toxic effects of impurities are addressed in toxicity tests using the technical grade product, which would contain the impurities.

Hexachlorobenzene is an impurity in the technical grade products of clopyralid and picloram. Hexachlorobenzene is a ubiquitous and persistent chemical in the environment, as it is used or present in a wide variety of manufacturing processes. It has been shown to cause tumors in mice, rats and hamsters, and EPA has classified it as a probable human carcinogen (SERA, 2003 Picloram). The amount of hexachlorobenzene released into the environment from Forest Service use of picloram and clopyralid is inconsequential in comparison to existing background levels and the annual release from manufacturing processes (SERA, 2003 Picloram). The use of picloram and clopyralid in remote forest locations could constitute the primary source of localized contamination. The projected amounts of hexachlorobenzene released during invasive plant treatments is calculated to be well below the level that poses a risk to cancer in mammals.

Technical grade glyphosate contains an impurity, N-nitrosoglyphosate, but the amount of this impurity in glyphosate has been classified as toxicologically insignificant by the EPA.

POEA surfactant used in Roundup and Roundup Pro contain 1,4-dioxane as an impurity, which has been classified by EPA as a probable human carcinogen. Based on current toxicity data and an analysis by Borrecco and Neisess (1991), the potential effects of 1,4-dioxane are encompassed by the available toxicity data on the Roundup formulation (SERA, 2003 Glyphosate). Borrecco and Neisess (1991) also demonstrated that the upper limit of risk of cancer from this impurity was less than one in a million.

Triclopyr contains an impurity, 2- butoxyethanol (aka EGBE), that is a major industrial chemical used in a wide variety of industrial and commercial applications. It is known to cause fragile red blood cells in rodents (Borrecco and Neisess, 1991). EPA has classified EGBE as moderately toxic. Borrecco and Neisess (1991) found that potential doses of EGBE to mammals were less than 0.001 of the lowest $LD_{50}$ and did not substantially increase risk over the risk identified for triclopyr, even under worst-case scenarios. Data on toxicity of EGBE to birds was lacking, but the authors conclude that comparative sensitivities between birds and mammals, and the extremely low doses indicated a low risk to birds.

Similar to impurities, the potential health effects of herbicide metabolites are often accounted for in the available toxicity studies, assuming that the toxicological effects of metabolism within the test animal species would be similar to those in other animals. The potential toxic effects of environmental metabolites (those formed as a result of processes outside of the body) may not be accounted for by laboratory toxicity studies.

TCP (3,5,6-trichloro-2-pyridinol) is an environmental metabolite of triclopyr. It is substantially more toxic to fish than either triclopyr acid or triclopyr TEA, and is similar to the toxicity of triclopyr BEE (SERA, 2003 Triclopyr). For fish, the risk characterization for TCP was considered quantitatively, using available toxicity data. SERA (2003, Triclopyr) found that worst-case exposures of fish to TCP did not exceed levels of concern when triclopyr is applied at the typical application rate. However, at higher application rates, the level of concern is substantially exceeded and adverse effects to fish are plausible (using worst-case exposure assumptions) from this metabolite.

In mammals, TCP has about the same toxicity as triclopyr. No quantitative estimate of exposure to mammals or birds was calculated in the SERA risk assessment, due to the lack of appropriate data. However, since TCP is as toxic as triclopyr, the risk characterization for triclopyr could be applied to TCP.

The GPNF and CRGNSA restricts use of triclopyr to specific application methods, such as spot spray or cut stump applications. Since the worst-case exposure estimates were done using either an accidental spill of 200 gallons of triclopyr, or a broadcast spray of triclopyr to a 10-acre area, it does not appear plausible for the resulting estimates of TCP concentration to occur given the restrictions contained in the Proposed Action. Exposure of mammals or birds to TCP would also be minimal.

**Inert Ingredients**

An inert ingredient in an herbicide is any ingredient that does not kill plants. Surfactants are a special type of inert ingredient discussed in a following section.

The EPA has categorized approximately 1,200 inert ingredients into four lists. Lists 1 and 2 contain inert ingredients of known or suspected toxicological concern. List 4 contains non-toxic substances such as corn oil, honey and water. List 3 includes substances for which EPA has insufficient information to classify as either hazardous (List 1 and 2) or non-toxic (List 4).

None of the inert ingredients included on EPA's List 2, 3, or 4 need to be disclosed on the herbicide label, despite evidence that some compounds on these lists may cause adverse effects to laboratory animals and humans. EPA's own website (http://www.epa.gov/opprd001/inerts/) states, "Since neither federal law nor the regulations define the term "inert" on the basis of toxicity, hazard or risk to humans, non-target species, or the environment, it should not be assumed that all inert ingredients are non-toxic." Northwest Coalition for Alternatives to Pesticides (NCAP) obtained the identity of many inert ingredients through a Freedom of Information Act request; the list of inerts they obtained can be found at http://www.pesticide.org/FOIA/

Use of formulations containing inert ingredients on List 3 and 4 is preferred for invasive plant treatment under current Forest Service policy. A standard in the GPNF LRMP and CRGNSA requires review of inert ingredients in a risk assessment prior to formulations being approved for use on FS projects.

Most information about inert ingredients that is submitted to EPA for pesticide registration is classified as "Confidential Business Information" (CBI). CBI is not generally released or available for public review. SERA risk assessors obtained clearance to review the identity and data on inerts in the CBI files, as well as used publicly available data, when preparing herbicide risk assessments. However, even when the inert ingredients can be identified, toxicity data on the ingredient may be lacking. This leads to substantial uncertainty in the assessment of hazard or risk posed by the inert ingredients. This is particularly true for wildlife species, as there is very little data regarding the effects to most wildlife species from inert ingredients contained in the 10 herbicides considered in the Proposed Action.

FS/SERA Risk Assessments analyze the effects of inert ingredients and full formulations by the process described below:

- Compare acute toxicity data between the formulated products (includes inert ingredients) and their active ingredients alone;
- Disclose whether or not the formulated products have undergone chronic toxicity testing; and
- Identify, with the help of EPA and the herbicide registrants, ingredients of known toxicological concern in the formulated products and assess the risks of those ingredients.

Researchers who have studied the relationships between acute and chronic toxicity have found that relationships do exist and acute toxicity data can be used to give an indication of overall toxicity (Zeise, et al., 1984). The court in *NCAP v. Lyng*, 844 F.2d 598 (9th Cir 1988) decided that this method of analysis provided sufficient information for a decision maker to make a reasoned decision. *In SRCC v. Robertson*, Civ.No. S-91-217 (E.D. Cal., June 12, 1992) and again in *CATs v. Dombeck*, Civ. S-00-2016 (E.D. Cal., Aug 31, 2001) the district court upheld the adequacy of the methodology described above for disclosure of inert ingredients and additives.

Available information for the inerts contained in the proposed herbicides are as follows:

Chlorsulfuron – The identity of inerts used in chlorsulfuron are confidential, but SERA reviewed them for preparation of the risk assessment (SERA, 2003 Chlorsulfuron). EPA has not classified any of the inerts as toxic. These inert ingredients do not affect the assessment of risk

Clopyralid – Identified inerts include monoethanolamine and isopropyl alcohol, both approved food additives. These inert ingredients do not impact the assessment of risk

Glyphosate – There are at least 35 glyphosate formulations that are registered for forestry applications (SERA, 2003 Glyphosate) with a variety of inert ingredients. SERA obtained clearance to access confidential business information (i.e. the identity of proprietary ingredients) and used this information in the preparation of the risk assessment. Surfactants (discussed below) were the only additives identified that impact risk (SERA, 2003 Glyphosate).

Imazapic - The identity of inerts used in imazapic formulations are confidential, but SERA reviewed them for preparation of the risk assessment (SERA, 2003 Imazapic). None of the inerts are classified by EPA as toxic.

Imazapyr – The NCAP website (http://www.pesticide.org/FOIA/picloram.html) identifies only glacial acetic acid as an inert ingredient. Isopropanolamine is also present, and it is classified as a List 3 inert.

Metsulfuron methyl - The identity of inerts used in metulfuron methyl formulstions are confidential, but SERA reviewed them for preparation of the risk assessment (SERA, 2003 Metsulfuron methyl). None of the inerts are classified by EPA as toxic.

Picloram formulations, Tordon K and Tordon 22K contain the following inerts: potassium hydroxide, ethoxylated cetyl ether, alkyl phenol glycol ether, and emulsified silicone oil (NCAP website; http://www.pesticide.org/FOIA/picloram.html). Potassium hydroxide is an approved food additive. The other compounds are all on EPA's List 4B, inerts of minimal concern. They may also contain the surfactant polyglycol 26-2, which is on EPA's List 3: Inerts of Unknown Toxicity, discussed in the following section. The toxicity data on the formulations encompasses toxic risk from the inerts. Inerts in picloram formulations do not appear to pose a unique toxic risk to wildlife (SERA, 2003 Picloram).

Sethoxydim - The formulation Poast contains 74 percent petroleum solvent that includes naphthalene. The EPA has placed this naphthalene on List 2 ("agents that are potentially toxic and a high priority for testing"). Petroleum solvents and naphthalene depress the central nervous system and cause other signs of neurotoxicity (SERA, 2001). Poast has also been reported to cause skin and eye irritation. There is no information suggesting that the petroleum solvent has a substantial impact on the toxicity of sethoxydim to experimental animals, with the important and notable exception of aquatic animals (SERA, 2001). Poast is much more toxic to aquatic species than sethoxydim.

Sulfometuron methyl - The identity of inerts used in Oust are confidential, but SERA reviewed them for preparation of the risk assessment (SERA, 2003 Imazapic). None of the inerts are classified by EPA as toxic. Based on comparison of the toxicities of the active ingredient and the formulation, there is no reason to suspect that Oust contains other ingredients that substantially affect the potential risk to wildlife.

Triclopyr - Formulations contain ethanol (Garlon 3A) or kerosene (Garlon 4), which are known to be neurotoxic. However, the toxicity of these compounds is less than that of triclopyr, so the amount of ethanol and kerosene in these formulations is not toxicologically significant (SERA, 2003 Triclopyr) for wildlife.

The amount of inert ingredients in the formulations is generally not known, so exposure and dose estimates cannot be calculated. Use of formulations containing toxic inert ingredients may increase the risk of toxic effects to wildlife above that, or in addition to, the risk discussed for the active ingredient.

### Surfactants

Surfactants, or surface-acting agents, facilitate and enhance the absorbing, emulsifying, dispersing, spreading, sticking, wetting, or penetrating properties of herbicides. There is a fair amount of research on the effects of surfactants to terrestrial and aquatic organisms because they are widely used in detergents, cosmetics, shampoos and other products designed for human exposure.

The following information is taken from “Analysis of Issues Surrounding the Use of Spray Adjuvants With Herbicides” (USDA FS, 2003) and “Human and Ecological Risk Assessment of Nonylphenol Polyethoxylate-based (NPE) Surfactants in Forest Service Herbicide Applications” (USDA FS, 2003). Refer to these documents for more complete discussions.

Some glyphosate formulations contain polyethoxylated tallow amine (POEA) surfactant, which is substantially more toxic to aquatic species than glyphosate or other surfactants that may be used with glyphosate (SERA, 2003 Glyphosate). In the SERA risk assessment, **the toxicity of glyphosate is characterized based on the use of a surfactant, either in the formulation or added as an adjuvant in a tank mixture** (SERA, 2003 Glyphosate).

Polyglycol 26-2, used in picloram, will impact mitochondrial function *in vitro*, but information is insufficient to evaluate risks to wildlife *in vivo* from field applications at plausible levels of exposure (SERA, 2003 Picloram).

The primary active ingredient in many of the non-ionic surfactants used by the Forest Service is a component known as Nonylphenol polyethoxylate (NPE). NPE is found in these commercial surfactants at rates varying from 20 to 80 percent. NPE is formed through the combination of ethylene oxide with nonylphenol (NP), and may contain small amounts of un-reacted NP. Nonylphenol is a material recognized as hazardous by the U.S. EPA (currently on U.S. EPA’s inerts List 1). Both NP and NPE exhibit estrogen-like properties, although they are much weaker than the natural estrogen, estradiol.

Data is insufficient or lacking on the toxic effects of NP or NPE to birds and terrestrial invertebrates. NPE and NP are slightly toxic to practically non-toxic to mammals.

NP and NPE are weakly estrogenic in aquatic and terrestrial organisms (1000 to 100,000 times weaker than natural estrogen). NP and NPE are not toxic to soil microbes. NP is highly toxic to many aquatic organisms at low concentrations (currently on U.S. EPA’s Inert List 1).

The use of NPE-based surfactants in any of the 12 herbicides considered in this EIS could result in toxic effects to some mammals at typical and high application rates (USDA FS, 2003). The exposure scenarios and calculated doses used in the analysis represent worst-case scenarios and are not entirely plausible. Wildlife at most risk from adverse effects of NPE surfactants, at the typical application rate, include small mammals that may be directly sprayed, and large mammals consuming contaminated vegetation. At the highest application rate, small mammals that may be directly sprayed, and large or small mammals consuming contaminated vegetation may be at risk of adverse effects. No chronic exposures result in plausible risk to mammals.

NP and NPE have been studied for effects to aquatic organisms. NP is more toxic than NP9E, by one to three orders of magnitude (USDA FS, 2003). The toxicities of the intermediate breakdown products, NPEC and others, are intermediate between NP and NPE. In the aquatic environment, the breakdown products NP1EC and NP2EC are likely to be present also. These two metabolites are known to affect vitellogenin (a precursor for egg yolk) production in male fish, but NP, which is a more potent estrogenic compound, did not cause vitellogenin increases in male *Xenopus laevis*, or leopard frogs (Selcer et al., 2001; cited in USDA FS, 2003).

Mann and Bidwell (2000, 2001) tested several Australian frogs and *Xenopus* for effects to NP8E. They found that *Xenopus* was the most sensitive to toxic effects, with an $LC_{50}$ of 3.9 ppm (3.9

mg/L). Similar to studies with herbicides, the $LC_{50}$ values for the frogs are comparable to those for fish (USDA FS, 2003). NP8E inhibited growth at concentrations as low as 1 ppm (Mann and Bidwell, 2000, 2001). Mild narcosis of tadpoles can occur at $EC_{50}$ values as low as 2.3 ppm, and reduced dissolved oxygen content in the water lowered the $EC_{50}$ values by about half as compared to normal oxygen levels. The tadpoles recovered from the narcosis. Malformations in Xenopus occurred at $EC_{50}$ values between 2.8 and 4.6 mg/L.

NP may cause tail resorption with a 14-day NOEC of 25 ppb for *Xenopus laevis* (Fort and Stover 1997; cited in USDA FS, 2003). NP also increased the percentage of female *Xenopus* developing from tadpoles exposed to 22 ppb for 12 weeks, but did not produce this effect at 2.2 ppb.

During operational use of NPE surfactant, ambient levels of NP9E (including a small percentage of NP, NP1EC, and NP2EC) could average 12.5 ppb (range 3.1 to 31.2 ppb). The duration of these exposures from Forest Service use would generally be much shorter than those used in laboratory experiments, due to transport by flowing streams, dilution, and environmental degradation. These levels are not likely to adversely affect amphibians found in the Pacific Northwest for normal operations. However, overspray or accidental spills could produce concentrations of NP9E that could adversely affect amphibians, particularly in small stagnant ponds.

***<u>Endocrine disruption</u>***

Recent information has highlighted the potential for certain synthetic and natural chemicals to affect endocrine glands, hormones, and hormone receptors (endocrine system). The endocrine system helps control metabolism, body composition, growth and development, reproduction, and many other physiological regulators. An endocrine disrupter is a substance that may exert effects to the body by affecting the availability of a hormone to its target tissue(s) and/or affecting the response of target tissues to the hormone (SERA, 2002). Estrogen is a prominent hormone in animal systems and substances that mimic estrogen or stimulate similar responses in target tissues are referred to as “estrogenic.”

Scientists have expressed concern regarding estrogenic effects of synthetic chemicals since before the 1970’s. The EPA (1997) reports effects of endocrine disruption in animals that “include abnormal thyroid function and development in fish and birds; decreased fertility in shellfish, fish, birds, and mammals; decreased hatching success in fish, birds, and reptiles; demasculinization and feminization of fish, birds, reptiles, and mammals; defeminization and masculinization of gastropods, fish, and birds; decreased offspring survival; and alteration of immune and behavioral function in birds and mammals.”

Some of the more noted endocrine glands include gonads, adrenal, pancreas, thyroid and pituitary. Alteration in endocrine function may affect reproductive output (i.e. feminization, masculization), and therefore, could affect population numbers of affected species.

Many of the known endocrine disrupting contaminants have been banned or are regulated (e.g. DDT/DDE, PCB, TCDD). Some endocrine disrupting compounds are persistent and are still found within the living tissue of wildlife; their decomposition half-life is lengthy, and they are bioaccumulatory and present at high background levels. A local example is the high level of DDT/DDE and PCB that are found within peregrine falcons in the Pacific Northwest (Pagel, unpub. data). Research has suggested that embryonic exposure to endocrine disrupters may cause permanent health effects to adult animals. Some of these effects may include altered blood hormone levels, reduced fecundity, reproductive behavioral alterations, reduced immune function, masculization and feminization, undescended testicles, increased cancer rates, altered bone density and structure, and malformed fallopian female reproductive tract (Kubiak et al., 1989; Colborn and Clement, 1992; White et al., 1994; Fry, 1995; LeBlanc, 1995). Examples of wildlife species that have been adversely affected by endocrine disrupters include wood ducks in Arkansas, wasting and embryonic deformities of Great Lakes piscivorous birds, reproductive abnormalities of snapping turtles, gulls, trout and salmonids, alligators, mink, and Florida panther (Bishop et al., 1991; Colborn, 1991; Facemire et al., 1995; Fox et al., 1978, 1981, 1991 (a, b), Fry and Toone, 1981; Fry et al. 1987; Giesyet et al. 1994; Gilbertson et al., 1991; Guillette et al., 1994, 1995; Kubiak et al., 1989; Mac and Edsall, 1991, 1993; Leatherland, 1993; Peakall and Fox, 1987; White and Hoffman, 1995; and Wren, 1991).

Of the chemicals analyzed in this EIS, and NPE surfactants have been identified as potentially having estrogenic effects (USGS, 1998; Bakke, 2003). Triclopyr and glyphosate have been evaluated for endocrine disrupting effects, and while some data exists to the contrary (i.e. Yousef et al., 1995, testing glyphosate), the weight of evidence indicates that these herbicides cause no specific toxic effects on endocrine function (SERA, 2002).

***Synergistic Effects***

Certain chemicals may cause synergistic effects in the presence of other chemicals: that is, the total effect of two chemicals may be greater than that suggested by the sum of the effects from the individual components (USEPA, 2000). However, information regarding the existence or potential for synergistic effects from the herbicides discussed in this document is very limited.

Some of the herbicides analyzed for the EIS (e.g. picloram) have been investigated for possible synergistic effects but the study designs were insufficient for the assessment of toxicologic interactions (SERA, Picloram, p.3-35). Some studies of some chemicals (not necessarily herbicides) have noted statistically significant interactions (both synergistic and antagonistic) (Durkin, pers. com.). Even with excellent data, the complexity of the experimental designs necessary to properly assess interactions, and the uncertainties regarding the dose-response relationship for interactions, make the quantitative use of interaction data in risk assessments infeasible (ATSDR 2004, USEPA 2000).

USEPA (2000) did state that for exposures at low doses, with low risk for each component in the chemical mixture, that the likelihood of significant interaction (e.g. synergistic effects) is usually considered to be low. Likewise, a report by ATSDR (2004) cited several studies using rats that found no synergistic effects for mixtures of four, eight and nine chemicals at low (sub-toxic) doses. However, some studies have found different results for some chemicals, the study of synergist effects is extremely complicated, and there can be substantial uncertainty in the risk characterization for chemical mixtures (ATSDR, 2004; USEPA, 2000).

## D. Risk Assessment Assumptions for Waterbodies

Streams and other waterbodies can be contaminated from runoff, as a result of leaching from contaminated soil or from a direct spill. Two estimates for the concentration of herbicides in ambient water were completed for the R6 FEIS risk assessments; acute/accidental exposure from an accidental spill and longer-term exposure to herbicides in ambient water that could be associated with the application of the herbicide to a 10 acre block that is adjacent to and drains into a small stream or pond. Water contamination estimates were based on the GLEAMS (Groundwater Loading Effects of Agricultural Management Systems).

GLEAMS is a root zone model that can be used to examine the fate of chemicals in various types of soils under different meteorological and hydrogeological conditions. As with many environmental fate and transport models, the input and output files for GLEAMS can be complex. The general application of GLEAMS model and the use of the output from this model to estimate concentrations in ambient water are detailed in SERA (2003).

Using the GLEAMS models, the default assumptions used to calculate plausible (mathematically possible) herbicide exposures for the R6 2005 FEIS were:

- 0.25 acre pond, 1 meters deep, with a 0.01 sediment fraction. 10 acre square field (660' by 660') with a root zone of 60 inches and four soil layers.

- Stream with base flow rate of 4,420,000 L/day with a flow velocity of 0.08 m/second (1.8 cfs) or 6912 meters/day. Stream width of 2 meters (about 6.6 feet') and depth of about 1 foot. 10 acre square field (660' by 660') adjacent to stream, with a root zone of 60 inches and four soil layers.

- Broadcast spray application on sparse grass vegetation cover on 10% slope, which assumes that there is no herbicide taken up by vegetation.

- Worst combination of soil and rainfall (different for each herbicide), with rainfall timing of once every 10 days, with rain event beginning immediately after treatment.

- Assumes entire herbicide used reaches water at one point.

- The most sensitive no observable effect concentration value for the most sensitive species were used to derive the toxicity thresholds.

- For estimates of exposures, we used the upper exposure limits from the SERA risk assessment worksheets instead of the central and lower limits, and assessed impacts at the high application rates.

- Steady delivery of herbicide into a stream over 90 days for fish and 21 days for invertebrates, algae, and aquatic plants.

- The aggregate risks of exposure to TCP (a major metabolite; 3,5,6-trichloro-2-pyridinol) from the breakdown of both triclopyr and chlorpyrifos (an insecticide) are considered in SERA risk assessment for triclopyr due to toxicity to mammals and other species. The most conservative estimate of exposure to TCP is reflected in the applications of triclopyr and chlorpyrifos, which are spaced in such a way as to result in the maximum possible concentrations of TCP in water (SERA 2003).

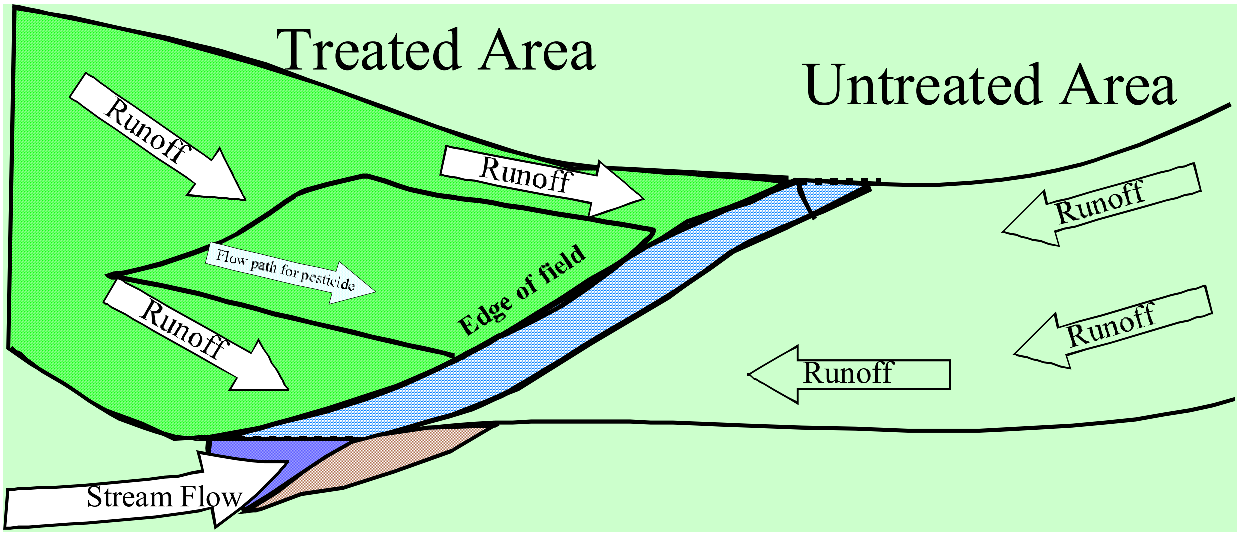


Figure 3 - GLEAMS Worst-Case Stream Scenario Modeled in the SERA Risk Assessments.

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# III. TERRESTRIAL WILDLIFE

This chapter discusses the general effects of invasive plant treatments to wildlife, and then discusses the status, environmental baseline, and effects of the Proposed Action to federally listed species found within the action area. Much of the information presented here in terms of herbicide properties can also be applied to aquatic organisms, and in some cases is reiterated in the Aquatic Section in the next chapter.

## A. General Effects of Invasive Plant Treatments

The following section is a general overview of the potential impacts to federally listed wildlife from all control methods included in the proposed action. For all methods, project design criteria will be used to mitigate the majority of these impacts.

The effects of other methods of invasive plant treatment to listed wildlife were evaluated by consulting peer-reviewed literature, previous Biological Opinions, and species experts, as well as using professional judgment and common sense..

### *Effects of Non-herbicide Treatment*

Wildlife species may be adversely affected by invasive plant treatment methods. All treatment methods have the potential to disturb, temporarily displace, or directly harm various wildlife species. Successful control of invasive plant infestations provides long-term benefits by restoring native habitat. Treatment of larger infestations may create more disturbances for longer periods than small infestations, but the specific amount and duration is largely dependant upon specific treatment method. Several techniques can create bare ground, which may reduce cover and expose certain species to increased predation. Large tracts of bare ground can alter migration and dispersal of some species (Semlitsch, 2000). The likelihood of these effects depends on the size and distribution of bare ground created.

The effects of the invasive plant treatment are also relative to the size and locations of existing and future invasive plant infestations. Treatments of infestations along disturbed roadsides are not likely to substantially affect terrestrial wildlife populations, since this vegetation type does not provide essential habitat for native wildlife species, and it consists of long, narrow areas spread over large distances. Adverse effects to individuals using the roadside vegetation at the time of treatment could occur.

Treatments of moderate infestations may pose the greatest risk to native wildlife. In moderately infested areas, enough native habitats may remain to support some native wildlife, and the infestation may be large enough to require more intensive and extensive treatment techniques. Very large infestations and monocultures of invasive plants do not support native wildlife populations and the presence of native wildlife in these areas is greatly reduced in comparison to native habitat.

### *Manual*

Manual treatments can result in trampling of non-target plants and animals and create bare ground. The degree of threat and effect from manual treatments depends on the number of workers present and the size of the area being treated. Because manual techniques are slower than mechanical or chemical methods, the duration of disturbance, caused by the presence of people, may be longer in the treatment area. The slower pace of work allows animals in the area to leave and reduces the risk of direct harm from trampling. Bare ground is likely to be patchy in distribution with this method and less likely to interfere with animal movement or dispersal.

### *Mechanical*

Some mechanical treatments may crush small mammals, reptiles, amphibians, or eggs of ground-nesting birds. Hand-held mechanical equipment, like chainsaws and string trimmers, can be used very selectively on target plants and may be less likely than larger equipment to directly harm wildlife. Use of vehicle-mounted mechanical equipment (mowers, tractors with disks or hammer flails, bull dozers with brush rakes, etc.) is much less selective and more likely to directly harm small wildlife species. Vehicle-mounted equipment is most often applied to monocultures of invasive plants on gentle slopes or road verges, and even though those areas do not provide preferred or suitable habitat for most native wildlife, adverse effects from disturbance or crushing are still possible. Mechanical treatments may produce more bare ground, reducing cover, exposing more soil to erosion, potentially disrupting dispersal or foraging patterns of small animals, and possibly exposing some to increased predation as a result of decreased cover. Mechanical methods generate more noise than other treatments, except for aerial applications and have a higher likelihood of disturbing species that are secretive or sensitive to noise.

### *Cultural*

Livestock grazing, in this case goats, conducted to reduce invasive plant populations while increasing native plant populations, would provide long-term beneficial effects to wildlife. Grazing would also cause short-term disturbance similar to mechanical methods, resulting in more bare ground and decreased cover for wildlife. Fertilization may increase competitive advantages of native plants and improve forage quality and quantity, contributing to improved wildlife habitat. However, in naturally nutrient-poor soils, fertilization may give the competitive advantage to invasive species, which would further degrade wildlife habitat. Off-site movement of fertilizer can have substantial adverse effects to aquatic wildlife habitat and may have toxic effects to some species as well.

### *Site Restoration/Revegetation*

Reseeding or revegetation to increase competition with invasive plants can cause short-term disturbance to wildlife similar to manual or mechanical treatments, depending on specific methods used. If native or non-native, non-invasive forage species are used in restoration or competitive plantings, increased food and native habitat could benefit wildlife. Restoration activities have the potential to restore important wildlife habitat faster than natural or passive revegetation.

#### *Effects of Active Ingredients in Herbicides to Birds*

The most sensitive effect from the most sensitive species tested was used to determine the toxicity indices for each herbicide. Throughout this document, “toxicity indices” and “acceptable thresholds” are used interchangeably. Quantitative estimates of dose from each exposure scenario were compared to the corresponding toxicity index to determine the potential for adverse effect. Doses below the toxicity indices resulted in discountable effects. That is, the dose did not cross the threshold for concern. Table 14 lists the doses used as toxicity indices for birds. Indices represent the most sensitive endpoint from the most sensitive species for which adequate data are available.

Table 14 - Toxicity Indices for Birds

| Herbicide | Duration | Endpoint | Dose | Species | Effects Noted at LOAEL |
|---|---|---|---|---|---|
| Chlorsulfuron | Acute | NOAEL | 1686 mg/kg | Quail | No significant effects at highest dose |
| | Chronic | NOAEL | 140 mg/kg/day | Quail | No significant effects at highest dose |
| Clopyralid | Acute | NOAEL | 670 mg/kg | Mallard & Quail | No signs of toxicity reported, LOAEL not determined |
| | Chronic[1] | NOAEL | 15 mg/kg/day | Rat | Thickening of gastric epithelium at 150 mg/kg/day |
| Glyphosate | Acute | NOAEL | 562 mg/kg | Mallard & Quail | No effects at highest dose |
| | Chronic | NOAEL | 100 mg/kg | Mallard & Quail | No effects on reproduction at highest dose |
| Imazapic | Acute | NOAEL | 1100 mg/kg | Quail | No effects at highest dose |
| | Chronic | NOAEL | 113 mg/kg/day | Quail | Decreased weight gain in chicks at 170 mg/kg/day |
| Imazapyr | Acute | NOAEL | 674 mg/kg | Quail | No effects at highest dose |
| | Chronic | NOAEL | 200 mg/kg/day | Mallard & Quail | No effects at highest dose |
| Metsulfuron methyl | Acute | NOAEL | 1043 mg/kg | Quail | No significant effects at highest dose |
| | Chronic | NOAEL | 120 mg/kg/day | Mallard & Quail | No significant effects at highest dose |
| Picloram | Acute | NOAEL | 1500 mg/kg | Chicken & pheasant | No effect to reproduction. LOAEL not reported |
| | Chronic[3] | NOAEL | 7 mg/kg/day | Dog | Increased liver weight at 35 mg/kg/day |
| Sethoxydim | Acute | NOAEL | >500 mg/kg | Mallard & Quail | No or low mortality at highest doses tested. LOAEL not available. |
| | Chronic | LOAEL[4] | 10 mg/kg/day | Mallard | Decreased number of normal hatchlings at 10 mg/kg/day |
| Sulfometuron methyl | Acute | NOAEL | 312 mg/kg | Mallard | Decreased weight gain at 625 mg/kg/day |
| | Chronic[5] | NOAEL | 2 mg/kg/day | Rat | Effects on blood and bile ducts at 20 mg/kg/day |
| Triclopyr BEE[6] | Acute | $LD_{50}$ | 388 mg/kg | Quail | 50% mortality at 388 mg/kg |
| | Chronic | NOAEL | 10 mg/kg/day | Mallard & quail | Decreased survival of offspring, reduced eggshell thickness at 20 mg/kg/day |
| Triclopyr TEA | Acute | $LD_{50}$ | 535 mg/kg | Quail | 50% mortality at 535 mg/kg |
| | Chronic | NOAEL | 10 mg/kg/day | Mallard & Quail | Decreased survival of offspring, reduced eggshell thickness at 20 mg/kg/day |

| Herbicide | Duration | Endpoint | Dose | Species | Effects Noted at LOAEL |
|---|---|---|---|---|---|
| NPE Surfactants[8] | Acute | NOAEL | 10 mg/kg | Rat | Slight reduction of polysaccharides in liver at 50 mg/kg/day |
| | Chronic | NOAEL | 10 mg/kg/day | Rat | Increased weights of liver, kidneys, ovaries, and decreased live pups at 50 mg/kg/day |

1 Chronic toxicity studies in birds are not available, so the value from mammal studies is used.
2 Acute values are based on chronic values; if the dose does not cause an effect over a period of 21 weeks, it is reasonable to assume that it will not cause effects after one day of exposure (SERA 2004 Dicamba).
3 Chronic toxicity studies in birds are not available, so the value from mammal studies is used.
4 Based on one study in which a NOAEL was not determined, so the LOAEL is used.
5 Birds may be somewhat less sensitive than mammals, but data are limited, so the lower value from mammal studies is used.
6 Unlike in mammals, the toxicities of triclopyr BEE and triclopyr TEA are different for birds, so the indices of the two forms of triclopyr are presented separately
7 Weed Science Society of America 2002.
8 Data on birds is not available in published literature so data from mammals is used.
Source: SERA 1998, 2001, 2003, 2004; USDA FS 2003; and Weed Science Society of America 2002.

Results of the exposure scenarios as applied to threatened species on the GPNF and CRGNSA are displayed in the table below. A symbol in the tables represents at least one exposure scenario that exceeds the toxicity index. The exposure scenarios do not account for factors such as timing of application, animal behavior and feeding strategies, animal presence within a treatment area, or other relevant factors. Results of triclopyr exposures take into account the strict limitations on use identified in the forest plan standards, which makes the exposure scenarios implausible.

The table below displays the results of exposure if all "worst-case" conditions reflected in the scenario occur.

Table 15 - Summary of exposure scenario results for listed species.

Symbol meanings are as follows:
-- Exposure scenarios result in a dose below the toxicity index at both the typical and highest application rates.
★ Exposure scenarios result in a dose that exceeds the toxicity index at the typical and highest application rates.
♦ Exposure scenarios result in a dose that exceeds the toxicity index at the highest application rate only.

| SPECIES | Chlorsulfuron | Clopyralid | Glyphosate | Imazapic | Imazapyr | Metsulfuron methyl | Picloram | Sethoxydim | Sulfometuron methyl | Triclopyr | NPE Surfactant |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Bald Eagle | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Northern Spotted Owl | -- | -- | -- | -- | -- | -- | -- | ♦[1] | -- | -- | ♦[1] |
| Marbled Murrelet | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Grizzly Bear | -- | -- | ♦ | -- | -- | -- | -- | -- | -- | -- | ★ |
| Gray Wolf | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | ♦ |

1 These scenarios exceed the toxicity index only for assumed chronic exposures, risks are actually unknown. However, the chronic exposure scenarios are not plausible, as discussed in the effects sections for each species.

Source: SERA 1998, 2001, 2003, 2004 and USDA FS 2003.

## B. Federally Listed Terrestrial Wildlife Species and Effects of the Proposed Action

### *Bald Eagle*

***Status of the Species***

#### Background

A detailed account of the taxonomy, ecology, and reproductive characteristics of the bald eagle is found in the Pacific States Bald Eagle Recovery Plan (U.S. Fish and Wildlife Service, 1986), the final rule to reclassify the bald eagle from endangered to threatened in all of the lower 48 states (U.S. Fish and Wildlife Service, 1995), the proposed rule to remove the bald eagle from the Endangered Species List in the lower 48 states (U.S. Fish and Wildlife Service, 1999), Stalmaster (1987), and the Region Six Invasive Plant Program BA and BO (USDA Forest Service 2005, U.S. Fish and Wildlife Service 2005, respectively). Information from the 2005 BA and BO are incorporated by reference. A brief summary of life history information relevant to invasive plant treatments is included below.

#### Listing History

The bald eagle was reclassified in 1995 from endangered to threatened as a result of the significant increase in numbers of nesting pairs, increased productivity and expanded distribution.

On July 6, 1999, the FWS published a proposal to remove bald eagle from the list of threatened and endangered species (U.S. Fish and Wildlife Service, 1999). This proposal is based on goals having been met or exceeded in all five recovery areas (Northern, Chesapeake Bay, Southeast, Southwest, and Pacific). Further, threats to the species had been eliminated or substantially reduced. At the time of writing this biological assessment, a final decision has not been made on the delisting proposal.

**Distribution**

The bald eagle ranges throughout much of North America, nesting on both coasts and north into Alaska, wintering as far south as Baja California. The largest breeding populations in the contiguous United States occur in the Pacific Northwest states, the Great Lake states, Chesapeake Bay and Florida. Oregon and Washington are important for wintering bald eagles in the conterminous United States.

**Life History and Habitat Desciption**

Bald eagles are most common along coasts, major rivers, lakes and reservoirs (U.S. Fish and Wildlife Service, 1986), and require accessible prey and trees for suitable nesting and roosting habitat (Stalmaster, 1987). Food availability, such as aggregations of waterfowl or salmon runs, is a primary factor attracting bald eagles to wintering areas and influences the distribution of nests and territories (Stalmaster 1987). Bald eagles feed primarily on fish during the breeding season, and eat waterfowl, seabirds and carrion during the winter (U.S. Fish and Wildlife Service, 1995).

Bald eagles usually nest in trees near water, but are known to nest on cliffs and (rarely) on the ground. Nest sites are usually in large trees along shorelines in relatively remote areas that are free of disturbance. The trees must be sturdy and open to support a nest that is often 5 feet wide and 3 feet deep. Adults tend to use the same breeding areas year after year, and often the same nest, though a breeding area may include one or more alternative nests (U.S. Fish and Wildlife Service, 1999).

**Population Dynamics**

The FWS' 1999 delisting proposal estimated that the current nesting population in the lower 48 States constitutes more than a tenfold increase from the known population level in 1963. There were over 5,700 occupied breeding areas in 1998. The bald eagle population has essentially doubled every 7 to 8 years during the past 30 years. Where they are federally listed, bald eagles nest primarily in the Pacific Northwest states, the Great Lake states, Florida, and Chesapeake Bay (U.S. Fish and Wildlife Service, 1986). The Pacific Northwest contains a significant concentration of reproducing bald eagles and the bald eagle population in the Pacific Recovery Area experienced a 50% increase between 1985 and 1989 (Rees and Lee, 1990).

**Threats**

Bald eagles declined before 1940 due to widespread shooting, reduced prey base, secondary poisoning from bait set out to kill livestock predators, and loss of nesting habitat from forest harvest. After the passage of the Bald Eagle Protection Act in 1940, eagles suffered continued declines due to reproductive failure from DDT and mercury contamination. After DDT was prohibited in the US, eggshell thickness improved and reproductive success increased.

Contamination from other persistent organochlorines, including PCB, continues to be a concern in some areas (Mierzykowski and Carr 2002, U.S. Fish and Wildlife Service, 1999).

Currently, mortality to bald eagles occurs from habitat loss, disturbance by humans, pesticide and mercury contamination, decreasing food supply, electrocution, impacts with wind turbines, and illegal shooting (U.S. Fish and Wildlife Service 1999, Welch, 1994). Human disturbance can flush eagles from a nest. Nesting can fail if disturbance is frequent (U.S. Fish and Wildlife Service, 1999).

A recent threat to bald eagles is mortality caused by a new disease, avian vacuolar myelinopathy (AVM) (U.S. Fish and Wildlife Service, 1999). AVM, first reported in 1994, has been the cause of death for at least 100 bald eagles (and 1,000's of American coots) at 11 sites from Texas to North Carolina. A recent hypothesis implicates a type of cyanobacteria that grows on the invasive aquatic plant, *Hydrilla verticillata* (Wilde, 2004). The cyanobacteria are thought to produce a neurotoxin that is fatal to herbivorous birds and their avian predators. Mortalities caused by AVM can have localized impact on bald eagles but there is currently no evidence that the overall recovery of the population is affected (U.S. Fish and Wildlife Service, 1999).

## Ongoing Conservation

This species is afforded uncommonly comprehensive statutory and regulatory protection under Federal and State law. The Endangered Species Act (16 U.S.C. 1531 et seq.), the Bald Eagle Protection Act (16 U.S.C 668), the Migratory Bird Treaty Act (16 U.S.C. 703) and the Lacey Act (16 U.S.C. 3372 and 18 U.S.C. 42-44) all include prohibitions that protect bald eagles and/or their habitat.

Disturbance of nests during breeding season can result in reproductive failure due to nest abandonment by adults, egg and hatchling mortality due to exposure and predation, premature fledgling or nest evacuation, depressed feeding rates of adults and offspring, reduced or slower growth of nestlings, and avoidance of otherwise suitable habitat.

Management guidelines published by the U.S. Fish and Wildlife Service (1981) recommend establishing primary and secondary zones around all known eagle nests and restricting activities that occur within those zones. The primary zone is, at a minimum, 330 feet around the nest site and should be managed to protect or maintain the nest site by prohibiting timber harvest, mining, road or residential development, drilling or other disturbances that might alter the habitat. The secondary zone includes the area 660 feet around the nest and is designed to protect or maintain the habitat within the primary zone and to reduce disturbance of eagles during the breeding season.

## Conservation Needs

Human related impacts will continue into the future, and may increase locally with the continued growth of the eagle population and subsequent conflicts with expanding human activities. However, through existing statutes, knowledge gained and partnerships developed in the recovery process, many of these conflicts can be avoided or minimized. Conservation measures and goals for the five regions and the attainment of those goals are described in the federal register notice proposal to delist the bald eagle (U.S. Fish and Wildlife Service, 1999).

**Critical Habitat**

There is no critical habitat designated or proposed for the bald eagle in the Pacific Recovery Area.

***Action Area – Bald Eagle***

Currently, there are no invasive plants on the GPNF adversely affecting bald eagles. If left untreated, Japanese knotweed and Himalayan blackberry have the potential to adversely affect fish habitat on the GPNF, and could affect the quality of some foraging areas for bald eagles. There is no evidence to suggest this is happening at present.

Nesting eagles are sensitive to disturbance (U.S. Fish and Wildlife Service, 1986). The critical period in Washington when human activities could disturb occupied nest sites extends from January 1 until August 31 (Anthony and Isaacs, 1989, U.S. Fish and Wildlife Service, 1981). Nest initiation, including courtship and nest building, occurs in January through March. Incubation occurs from March until late May, and young are in nests from early April through mid-August. Young usually remain in the nest area throughout August.

Wintering eagles on the Forest can be sensitive to disturbance from October 31 to March 31 (U.S. Fish and Wildlife Service 2003, p. 9). The Forest and Scenic Area utilize a winter limited operating periods near bald eagles from October 31 to March 15 (U.S. Fish and Wildlife Service, letter of concurrence dated Sept. 28, 2001). Table 17 lists the disturbance distances for nesting and wintering eagles. If disturbance-causing activities occur farther away from nesting or roosting eagles than the distances specified in Table 17, then no adverse effect will occur.

A Programmatic Wildlife Letter of Concurrence (Programmatic LOC) for the GPNF and CRGNSA (U.S. Fish and Wildlife Service 2001) identifies nesting and winter limited operating periods near bald eagles. The table below lists the disturbance distances for nesting and wintering eagles. If disturbance-causing activities occur farther away from nesting or roosting eagles than the distances specified in Table 16, then no adverse effect will occur.

**Table 16**- Disturbance Distances for Nesting and Wintering Eagles

| Activity | Distance |
|---|---|
| Use of chainsaw and other motorized tools | 0.25-mile no-line-of sight, or 0.50-mile line-of-sight |
| Use of heavy equipment | 0.25-mile no-line-of sight, or 0.50-mile line-of-sight |
| Burning | 1-mile |

Two nests are known to occur on the GP; one at Swift Reservoir and one at Goose Lake (Wainwright, personal communication, 2005). There is one active nest outside of, but near, National Forest land on the Cowlitz Valley Ranger District. None of the nests or roosts on the GP are within 0.25 miles of any treatment sites. Five bald eagle locations are on the Washington side of the CRG. No known nest sites are within 0.25 mile of any treatment area. Additional treatments could occur within 0.25 mile of eagle sites under the early detection / rapid response procedures.

Bald eagles are common winter residents along the main Cowlitz and Cispus Rivers, the Lewis River within two miles of the upper end of Swift Reservoir downstream to the Columbia River, and larger tributaries like Skate Creek, lower Lake Creek, and others on Cowlitz Valley Ranger District (Kogut, Wainwright, personal communication, 2005). Surveys conducted along the Lewis River during the winters of 1984-1985 and 1985-1986 by personnel from Pacific Power and Light and Washington Department of Fish and Wildlife documented a suspected winter roost site on the GP just west of Miller Creek (about 2 miles east of the upper end of Swift Reservoir). Within the CRG, bald eagle winter surveys of the lower 13 miles of the Klickitat River noted from 1 to 52 birds from 2003-2005.

***Effects of the Proposed Action to Bald Eagle***

### Direct and Indirect Effects

Methods used to treat invasive plants or restore habitat may affect the bald eagle. The general effects of each non-herbicidal method to wildlife are discussed previously in this chapter. The potential effects from herbicides are summarized previously in this chapter, and discussed in detail in Appendix B of USDA Forest Service 2005 (FWS BA).

#### *Manual and Mechanical Methods*

Potential effects of invasive plant treatment methods on bald eagles are associated with disturbance that may occur during the nesting season. Direct effects from invasive plant treatment include disturbance caused by noise, people and vehicles. Human and vehicle presence can disturb bald eagles during the breeding season, causing the birds to leave nests, or stay away from the nest long enough to have detrimental effects to eggs or young (U.S. Fish and Wildlife Service, 1986). Effects from mechanical methods (e.g. tractors, bulldozers, chainsaws, or string trimmers) may be more likely to occur, and occur at greater distances from the project site, because machinery creates louder noise.

The critical period in Oregon and Washington when human activities could disturb occupied nests extends from January 1 to August 31 (Anthony and Isaacs, 1989, U.S. Fish and Wildlife Service, 1981). Bald eagles are sensitive to human disturbance during this time, particularly within sight distance of nest sites. Disturbance near winter roost sites is not likely to occur because invasive plant treatments do not occur during the winter. Invasive plant treatments will avoid conducting projects that create noise or disturbance above ambient levels in proximity to an occupied nest or winter roosts during the time-frames required by PDC J1-a and J1-b.

Invasive plant treatments will not result in the removal of bald eagle nest or roost trees, or suitable habitat, because invasive plants do not provide habitat. Projects could occur within suitable habitat, however.

#### *Herbicides*

Exposure scenarios used to analyze potential effects from herbicides are discussed in USDA Forest Service 2005b, Appendix B, p. 461). None of the herbicides proposed for use in this EIS nor NPE surfactants, applied at typical application rates, pose a risk to bald eagles.

Bald eagles are not likely to be directly sprayed, or encounter vegetation that has been directly sprayed, because no aerial application is proposed. No ground applications of herbicide would reach the upper canopies of mature trees where bald eagles nest.

The potential for the herbicides to adversely affect bald eagles was determined using quantitative estimates of exposure from worst-case scenarios. The dose estimates for fish-eating birds were calculated using herbicide or NPE concentrations in fish that have been contaminated by an accidental spill of 200 gallons into a small pond. Assumptions used include no dissipation of herbicide, bioconcentration is equilibrium with water, contaminant level in whole fish is used, and upper estimate assumes 15 percent of body weight eaten/day. For chronic exposures, we used a scenario where the bird consumes fish from water contaminated by an accidental spill over a lifetime. All estimated doses used in effects analysis were the upper levels reported in the Forest Service/SERA risk assessments.

The following interpretations of the exposure scenario results are made with the reservation that toxicity data was generated from laboratory animals which may not accurately represent potential effects to free-ranging wildlife.

The results of these exposure scenarios indicate that no herbicide or NPE surfactant poses any plausible risk to birds from eating contaminated fish. All expected doses to fish-eating birds for all herbicides and NPE are well below any known NOAEL (see Appendix B).

The weight of evidence suggests that adverse effects to bald eagles from NPE or the herbicides included in the proposed action are not plausible.

**Summary of Effects to Bald Eagle**

There are 11 bald eagle locations within 0.25 mile of proposed treatment areas. Additional eagle locations could occur in future years as eagles move, disperse, increase in population, or as additional survey data is obtained. Additional treatments near eagles sites could occur under EDRR treatments. Disturbance by humans and vehicles during project implementation is the primary adverse effect that is plausible for bald eagles. The project design criteria required for bald eagles (PDC's J1-a and J1-b), which imposes a seasonal restriction on activities near or within line-of-sight of nesting or roosting eagles, will minimize adverse effects from disturbance to current known eagle sites as well as future eagle sites. If new sites found under the Early Detection/Rapid Response approach could not be adequately treated with the project design criteria, it would be considered outside the scope of the EIS and this consultation. New NEPA analysis and consultation would be conducted.

Conducting invasive plant treatments may affect, but is not likely to adversely affect the bald eagle. This conclusion is based on:

- ❖ The project design criteria required for areas near or within line-of-sight of bald eagle sites will minimize adverse effects from disturbance.

Adverse effects to bald eagles from herbicide exposure are not plausible because:

- ❖ Even if they fed, for a lifetime, upon fresh-water fish that had been contaminated by an accidental spill of herbicide, they would not receive a dose that exceeds any known NOAEL.

**Cumulative Effects to Bald Eagle**

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur within the action area of the Federal action subject to consultations

(50 CFR 402.02). The "reasonably certain to occur" clause is a key factor in assessing and applying cumulative effects and indicates, for example, actions that are permitted, imminent, have an obligation of venture, or have initiated contracts (U.S. Fish and Wildlife Service and National Marine Fisheries Service, 1998). Past and present impacts of non-Federal actions are part of the environmental baseline.

Local County Noxious Weed Boards continue to focus on priority weeds that pose a risk to high valued areas, such as riparian corridors and recreational lakes. Knotweed is a common priority species among all Counties. Knotweed control is usually done with a group of two or three people that walk to and into the infestation and treat it with herbicide (glyphosate or imazapyr).

Bald eagles could be disturbed by invasive plant control acitivities on State, Tribal, or private land, depending upon the equipment used to control invasive plants and the time of year the project is conducted. Bald eagles along the Columbia River Gorge in close proximity to the National Forest are also exposed to vehicle and boat traffic, people recreating, construction, timber harvest activities on non-federal land, and other sources of disturbance and habitat loss. Oregon Forest Practices Rules and Washington's Bald Eagle Protection Rule protect bald eagle territories from timber harvest and disturbance during the breeding season.

It is unlikely that there would be negative cumulative effects to bald eagle from the proposed action when added to actions from Tribes, local Counties, State, or private activities because the proposed action creates only discountable or no effects from disturbance or herbicide exposure and does not affect bald eagle habitat. The probability of an effect from the proposed action is so low that it could not be added to those from State, Tribal, or private activities in a meaningful way. Therefore, the proposed action will not create any cumulative effects to bald eagles.

### *Northern Spotted Owl*

#### ***Status of the Species***

#### **Background**

Detailed accounts of the taxonomy, ecology, and reproductive characteristics of the spotted owl are found in the 1987 and 1990 FWS Status Reviews (U.S. Fish and Wildlife Service, 1987; U.S. Fish and Wildlife Service, 1990b), the 1989 Status Review Supplement (U.S. Fish and Wildlife Service, 1989), the Interagency Scientific Committee (ISC) Report (Thomas et al., 1990), the Forest Ecosystem Management Assessment Team (FEMAT) Report (Thomas and Raphael, 1993), the final rule designating the spotted owl as a threatened species (U.S. Fish and Wildlife Service, 1990a), the final rule designating critical habitat (U.S. Fish and Wildlife Service, 1992a), the Northern Spotted Owl Five Year Review (Courtney et al. 2004), and the draft recovery plan (U.S. Fish and Wildlife Service, 1992b). The spotted owl is one of three subspecies of spotted owls currently recognized by the American Ornithologists' Union and is typically associated with old-growth forested habitats throughout the Pacific Northwest. The taxonomic separation of these three subspecies is supported by genetic (Barrowclough and Gutierrez, 1990), morphological (Gutierrez et al., 1995), and biogeographic information (Barrowclough and Gutierrez, 1990). More extensive discussion of the northern spotted owl's life history, conservation, and susceptibility to effects from invasive plant treatments is included in the Region Six Invasive Plant Program BA and BO (USDA Forest Service 2005, U.S. Fish and Wildlife Service 2005, respectively). This information is incorporated by reference. A brief summary of life history information relevant to invasive plant management is included below.

## Listing History

The spotted owl was listed as threatened on June 26, 1990 (U.S. Fish and Wildlife Service, 1990a). It was listed due to widespread habitat loss across the entirety of its range and the inadequacy of existing regulatory mechanisms to provide for its conservation. Critical habitat for the spotted owl was designated on January 15, 1992 (U.S. Fish and Wildlife Service, 1992a).

On November 18, 2004, the FWS announced the completion of the 5-year review of the northern spotted owl. As a result of the review, the FWS has concluded that the species continues to warrant the protection of the Endangered Species Act as a threatened species.

## Distribution

The current range and distribution of the spotted owls extends from southern British Columbia through western Washington, Oregon, and California, as far south as Marin County (U.S. Fish and Wildlife Service, 1990b). Although the current range of the spotted owl is similar to its historical range where forested habitat still exists (the distribution is relatively contiguous, but influenced by the natural insularity of habitat patches within geographic province, and by natural and man-caused fragmentation of vegetation), the owl is extirpated or uncommon in certain areas (*e.g.*, southwestern Washington).

## Life History

*Reproductive Biology.* The spotted owl is a relatively long-lived bird (average life span approximating 8 years) with a naturally low reproductive rate. Females lay an average of 2 eggs per clutch (range 1-4 eggs). Nest sites are usually located within stands of old-growth and late-successional forest dominated by Douglas-fir, and consist of existing structures such as cavities, broken tree tops, or mistletoe (*Arceuthobium* spp.) brooms (Forsman et al. 1984, Blakesley et al., 1992, LaHaye and Gutierrez, 1999). In general, courtship and nesting behavior begins in February to March with nesting occurring from March to June: however timing of nesting and fledging varies with latitude and elevation (Forsman et al., 1984). After the young fledge from the nest, they are still dependent on their parents until they are able to fly and hunt on their own. Parental care continues post-fledging into September (U.S. Fish and Wildlife Service, 1990b), and sometimes into October (Forsman et al., 1984). During this time the adults may not roost with the young during the day, but they will respond to begging vocalizations by bringing food to the young (Forsman et al., 1984).

*Food Habits.* Composition of prey in the spotted owl's diet varies geographically and by forest type. Generally, flying squirrels (*Glaucomys sabrinus)* and red tree voles (*Arborimus longicaudus*) are more prominent prey items for spotted owls in Douglas-fir and western hemlock forests (Forsman et al., 1984), whereas dusky-footed woodrats (*Neotoma fuscipes*) dominate the diet in the Oregon and California Klamath provinces (Forsman et al., 1984; Ward et al., 1998). Depending on location, other prey species (i.e., mice, birds, and insects) also comprise a small portion of the spotted owl diet (Forsman et al., 1984).

## Habitat Description

Spotted owls rely on older forested habitats because they contain the structures and characteristics required for nesting, roosting, foraging, and dispersal. These characteristics include the following: a multilayered, multi-species canopy dominated by large overstory trees; moderate to high canopy closure; a high incidence of trees with large cavities and other types of deformities; numerous large snags; an abundance of large, dead wood on the ground; and open space within and below the upper canopy for owls to fly (Thomas et al., 1990; U.S. Fish and

Wildlife Service, 1990a). Forested stands with high canopy closure also provide thermal cover as well as protection from predation. In some ecotypes, recent landscape-level analyses suggest that a mosaic of late-successional habitat interspersed with other vegetation types may benefit spotted owls more than large, homogeneous expanses of older forests (Franklin et al., 2000, Meyer et al., 1998).

### Reasons For Listing

The northern spotted owl was listed as threatened throughout its range "due to loss and adverse modification of suitable habitat as a result of timber harvesting and exacerbated by catastrophic events such as fire, volcanic eruption, and wind storms" (U.S. Fish and Wildlife Service, 1990b). At the time of listing, significant threats to the spotted owl included: low populations; declining populations; limited habitat; declining habitat; distribution of habitat or populations; isolation of provinces; predation and competition; lack of coordinated conservation measures; and vulnerability to natural disturbance (U.S. Fish and Wildlife Service, 1992b).

### Threats

The draft recovery plan for the northern spotted owl (U.S. Fish and Wildlife Service, 1992b) identified significant threats to the owl by physiographic province. These threats are summarized as follows: low populations, overall population decline, limited habitat, declining habitat, distribution of habitat or populations, isolation of provinces, predation and competition, lack of coordinated conservation measures, and vulnerability to natural disturbance.

### New Threats

Since listing of the northern spotted owl, new information suggests that additional threats include competition with the barred owl and wildfire are greater threats than previously anticipated (Courtney et al., 2004). In addition, new diseases have surfaced that threaten spotted owls (i.e. West Nile Viruse) or their habitat (i.e. Sudden Oak Death).

### Habitat Trends

The amount of spotted owl habitat continues to decline on a range-wide basis across all ownerships, although at a rate that is less than in the years prior to the listing of the spotted owl, particularly on Federal lands within the NWFP boundary (Courtney et al., 2004). Approximately 7.4 million acres of suitable habitat were estimated to exist on Federal lands in 1994. Most management-related, consulted-on habitat loss has been concentrated in the Oregon physiographic provinces.

### Population Trends

Recent demographic analysis indicates that northern spotted owl populations are declining in many areas (Anthony et al., 2004). Four study areas in Washington showed the sharpest declines.

### Ongoing Conservation Efforts

The NWFP is the current conservation strategy for the spotted owl on Federal lands. It is designed around the conservation needs of the spotted owl and based upon the designation of a variety of land-use allocations to protect large blocks of habitat for spotted owl population clusters and to maintain connectivity between population clusters. Recently, a northern spotted owl recovery team has been formed and begun work on the recovery plan.

## Conservation Needs

Based on the above assessment of threats, the spotted owl has the following habitat-specific and habitat-independent conservation (i.e., survival and recovery) needs:

### *Habitat-specific needs*

(1) large blocks of suitable habitat maintained to support clusters or local population centers of spotted owls (e.g., 15 to 20 breeding pairs) throughout the owl's range; (2) suitable habitat conditions and spacing maintained between local spotted owl populations throughout its range to facilitate survival and movement; (3) suitable habitat managed across a variety of ecological conditions within the spotted owl's range to reduce risk of local or widespread extirpation; (4)(a) a coordinated, adaptive management effort to reduce the loss of habitat due to catastrophic wildfire throughout the spotted owl's range, (b) a research program to clarify whether these risk reduction methods are effective, and (c)a research program to determine how owls use habitat treated to reduce fuels; and, (5) in areas of significant population decline, spotted owl habitat managed to sustain the full range of survival and recovery options for this species in light of significant uncertainty.

### *Habitat-independent needs*

(1) a coordinated research and adaptive management effort should be made to better understand and manage competitive interactions between spotted and barred owls; and (2) monitoring to better understand the risk that West Nile virus and sudden oak death pose to spotted owls and, for West Nile virus, research into methods that may reduce the likelihood or severity of outbreaks in spotted owl populations.

## Critical Habitat

Critical habitat for the spotted owl was designated on January 15, 1992 (U.S. Fish and Wildlife Service, 1992a). Primary constituent elements for owl critical habitat consist of habitat features that support nesting, roosting, foraging, and dispersal.

The attributes of nesting and roosting habitat include moderate to high canopy closure (60 to 80 percent); a multi-layered, multi-species canopy with large (>30 inches dbh) overstory trees; a high incidence of large trees with various deformities; large snags; large accumulations of fallen trees and other woody debris on the ground; and sufficient open space below the canopy for owls to fly (Thomas et al. 1990).

Foraging habitat varies across the range of the owl and contains attributes similar to nesting and roosting habitat, but may also include more open fragmented habitat. Dispersal habitat consists of stands with adequate tree size and canopy closure to provide protection from avian predators and at least minimal foraging opportunities.

Private land was excluded from critical habitat designation, so the vast majority of critical habitat occurs on National Forests (U.S. Fish and Wildlife Service, 1992a). The FWS designated a total of nearly 6.9 million acres in 190 critical habitat units in Washington, Oregon and California. Almost 5.7 million acres occur on land administered by the Forest Service. Critical habitat areas are aligned very closely with the Late Successional Reserves defined in the Northwest Forest Plan (USDA Forest Service and USDI Bureau of Land Management, 1994).

***Action Area -- Northern Spotted Owl***

There are currently no invasive plant species on the Gifford Pinchot National Forest or Columbia River Gorge National Scenic Area adversely affecting spotted owls or their habitat.

The early nesting season for the northern spotted owl in on the Gifford Pinchot National Forest and Columbia River Gorge National Scenic Area has been identified as the period from March 1 through June 30. The early nesting season is when egg-laying, incubation, hatching, feeding of nestlings, and fledging occurs, and active nest sites could be adversely affected by disturbance.

Spotted owls may be sensitive to disturbance caused by noisy machinery during certain times of the year. If sound-generating activities occur within close proximity to a nest or unsurveyed suitable habitat during the early breeding season (March 1 to June 30), spotted owls may be disturbed by the sound, potentially causing missed feedings or the adults to flush, leaving young susceptible to predation and weather (U.S. Fish and Wildlife Service 2003, p. 129). After June 30, spotted owlets are no longer completely dependent upon the adults and are able to thermoregulate, fly, and forage on their own, reducing their susceptibility to disturbance-related effects.

The Gifford Pinchot National Forest utilizes a Limited Operating Period restriction of no noise-producing activities above ambient levels between March 1 and June 30, for the distances listed below in **Error! Reference source not found.**. If disturbance-causing activities occur farther away from spotted owls than the distances specified in **Table 17** then no adverse effect will occur.

Table 17- Disturbance Distances for Spotted Owls

| Activity | Distance[1] |
|---|---|
| Use of chainsaw and other motorized tools | 65 yards |
| Use of heavy equipment | 35 yards |
| Burning | 0.25-mile |

1 U.S. Fish and Wildlife Service. 2003. Estimates of distances at which incidental take of murrelets and spotted owls due to harassment are anticipated from sound-generating, forest-management activities in Olympic National Forest. Unpublished report prepared by Kent Livezey, Western Washington Fish and Wildlife Office, Lacey, WA. 20 pp.

Spotted owls may detect and become alerted by sounds without any adverse effects occurring. Louder sounds can cause a spotted owl to flush from a nest or miss feeding a chick, which would be considered an “injury” (U.S. Fish and Wildlife Service 2003). Sound-only injury distances for activities that would cause disturbance to the northern spotted owl are those at 92 decibels (dB) and above (U.S. Fish and Wildlife Service 2003). The estimated ambient noise levels for a forest setting are at 40 dB (U.S. Fish and Wildlife Service 2003). Hamer and Nelson (1998) measured mean decibel (dB) levels of some equipment in a forested environment at a distance of 25 m. They reported mean decibel levels of 58 dB for automobiles, 67 dB for trucks, and 72 dB for chainsaws. U.S. Fish and Wildlife Service (2003) reported higher dB levels for chainsaws used in timber harvest. The maximum 1-minute reading for the largest chainsaw (Stihl 38) was 90.8 dB, with a peak reading of 104.2 dB.

Some equipment used to treat invasive plants could create noise above ambient levels, depending upon site-specific conditions. Engines used to pump herbicide and other liquids through nozzles for roadside spraying operations, normally in the back of a pick up truck, may generate noise levels that could disturb spotted owls. Because noise levels of this type of equipment were not known, two diesel pump engines used for roadside spraying and mounted in the back of running pick-up trucks were evaluated for noise level. Two separate readings of different pump engines using different decibel meters produced readings of 72-75 decibels within 10 yards, dropping to 64-67 decibels at 35 yards (observations in the project file). The threshold for a noticeable noise is 70 decibels and the threshold for disturbance causing "injury" is 92 decibels (U.S. Fish and Wildlife Service 2003). No measurements exceeded 92 dB. County Weed Coordinators also reported that the noise of diesel pump engines measured for this analysis was greater than the noise of gasoline-powered pump engines used by some operators (D Sherwin, pers. comm. 2005, D. Durfey, pers. comm. 2005). The gasoline-powered pump engines will be quieter than the diesel pump engines that we measured.

There are 20,112 acres of spotted owl suitable habitat (nesting, roosting, and foraging) and dispersal habitat within 65 yards of proposed weed treatment sites on the Gifford Pinchot National Forest. All suitable habitat that does not have current surveys completed to protocol is considered occupied. Applicable project design criteria are therefore implemented for un-surveyed habitat. On the Columbia River Gorge National Scenic Area, there are about 277 acres of suitable spotted owl habitat within 65 yards of a proposed treatment areas.

Designated critical habitat for the northern spotted owl occurs on the Gifford Pinchot National Forest and a small amount occurs on the Washington side of the CRG. Table 18 lists total designated critical habitat for the northern spotted owl on each unit, and the acres of critical habitat located within proposed treatment areas.

Table 18. Designated critical habitat for the northern spotted owl on GPNF and CRGNSA

| **Administrative Unit** | **Total Critical Habitat (acres)** | **Critical Habitat within Proposed Treatment Areas (acres)** |
|---|---|---|
| Gifford Pinchot NF | 581,025 | 16,655 |
| Columbia River Gorge NSA | 4,211 | 0 |

***<u>Effects of the Proposed Action to Northern Spotted Owl</u>***

### Direct and Indirect Effects

#### *Manual and Mechanical Methods*

Potential effects of invasive plant treatment methods on spotted owls are associated with disturbance that may occur during the nesting season. Direct effects from invasive plant treatment include disturbance caused by noise, people and vehicles. However, the potential for visual disturbance from people to cause harassment of spotted owls is low. Noise-generating activities above ambient could potentially cause enough disturbance to result in harassment of northern spotted owls during the breeding season. Noise or visual stimuli may interrupt or preclude essential nesting and feeding behaviors, cause flushing from the nest or missed feedings of young (U.S. Fish and Wildlife Service, 2003). Projects that generate noise or activity above ambient levels and occur within the disturbance distances specified in **Error! Reference source not found.** from an active spotted owl nest may cause these harassment effects (U.S. Fish and Wildlife Service, 2003). Some equipment used to treat invasive plants could create noise above ambient levels, depending upon site-specific conditions.

Vehicles used to spray roadside vegetation with herbicides do not make noise above 92 dB, based on the measurements taken, so no adverse effect to the northern spotted owl from noise disturbance will occur with this method. Within 10 yards of a nest or un-surveyed suitable habitat, roadside spraying could create a brief noise of notice to spotted owls (e.g. slightly above 70 dB), but not loud enough to create injury or harassment (U.S. Fish and Wildlife Service 2003, project file data).

Mowing and brushing uses machinery that can create louder noise, so treatment areas with these methods was considered a potential disturbance effect for owls and murrelets. Of the owl sites within treatment areas on the Gifford Pinchot National Forest, none propose to use mowing or brushing. No spotted owl sites on are within treatment areas on the Columbia River Gorge National Scenic Area. Treatment areas that may use brushing or mowing include 543 acres of suitable habitat for spotted owls on the Gifford Pinchot and 271 on the north side of the Columbia River Gorge National Scenic Area. The mandatory PDC for spotted owls requires that these methods, or others that generate sufficient noise, to be conducted farther away that 65 yards or outside the breeding season. This will minimize any potential disturbance to spotted owls.

Therefore, mechanical and manual methods to control invasive plant treatments on the Gifford Pinchot National Forest and Columbia River Gorge National Scenic Area are not likely to adversely affect spotted owls.

***Herbicides***

Exposure scenarios used to analyze potential effects from herbicides are discussed in USDA Forest Service 2005b, Appendix B, p. 461. None of the herbicides proposed for use in this EIS nor NPE surfactants, applied at typical application rates, pose a risk to northern spotted owls.

Spotted owls are not likely to be directly sprayed, or encounter vegetation that has been directly sprayed, because no aerial applications are proposed. No ground applications of herbicide would reach the upper canopies of mature trees where the owls nest and forage.

Spotted owls within Douglas-fir/hemlock forests prey on red tree voles and flying squirrels, which are nocturnal and chiefly arboreal. Voles feed on the needles of Douglas-fir trees and the flying squirrels feed primarily on fungi and lichen. It is not likely for the arboreal owls or their prey to be exposed to herbicides used within their activity centers in this forest type. However, a worst-case exposure scenario for the spotted owl was conducted using consumption of prey that had been directly sprayed, and assuming 100 percent absorption of the herbicide.

The following interpretations of the exposure scenario results are made with the reservation that toxicity data was generated from laboratory animals which may not accurately represent potential effects to free-ranging wildlife.

At typical application rates, the estimated doses from the exposure scenarios are all less than the reported NOAELs (no-observable adverse effect level) for all herbicides and NPE. Therefore, there is no basis for asserting or predicting that adverse effects to spotted owls from NPE or the herbicides considered in this EIS are plausible.

### Determination of Effects to Northern Spotted Owl

Disturbance by humans and vehicles during project implementation is the primary adverse effect that is plausible for northern spotted owls. Project design criteria for activities conducted within or adjacent to occupied or un-surveyed suitable habitat will minimize adverse effects from disturbance. There are no invasive plant locations or species that cannot be adequately treated using the project design criteria. All new locations treated under the Early Detection/Rapid Response approach would also be conducted with the project design criteria. If the EDRR site could not be adequately treated with the project design criteria, it would be considered outside the scope of the EIS and this consultation. New NEPA analysis and consultation would be conducted.

Conducting invasive plant treatments "may effect, but are not likely to adversely affect" the northern spotted owl. This determination is based on:

- ❖ The project design criteria required for northern spotted owl sites or potential habitat will eliminate adverse effects from disturbance.

- ❖ Exposure of spotted owls or their prey to herbicides is not plausible because:
  - □ Spotted owls and the majority of their prey are arboreal and not likely to be exposed.
  - □ Even if an owl consumed a prey item that had been directly sprayed, the resulting dose would be below those known to cause any adverse effects in birds.

- ❖ Invasive plant treatment projects conducted according to the project design criteria will not affect critical habitat for the northern spotted owl. This determination is based on:
  - □ No primary constituent elements are affected by invasive plant treatments.

### Cumulative Effects to Northern Spotted Owls

Invasvive plant treatment activities by non-federal parties are the same as described for the bald eagle. Northern spotted owls on non-federal lands are also exposed to disturbance from vehicle traffic, recreationists, timber harvest activities, development, and other potential sources of disturbance and habitat loss.

It is unlikely that there would be negative cumulative effects to northern spotted owls from the proposed action when added to actions from Tribes, local Counties, State, or private activities because the proposed action creates only discountable or no effects from disturbance or herbicide exposure and does not remove or degrade spotted owl habitat. The probability of an effect from the proposed action is so low that it could not be added to those from State, Tribal, or private activities in a meaningful way. Therefore, the proposed action will not create any cumulative effects to northern spotted owls.

### *Marbled Murrelet*

***Status of the Species***

**Background**

An account of the taxonomy, ecology, and reproductive characteristics of the murrelet is found in the 1988 Status Review (Marshall 1988), the final rule designating the species as threatened (Fish and Wildlife Service 1992), the final rule designating critical habitat for the species (U.S. Fish and Wildlife Service 1996), the FWS's biological opinion for Alternative 9 (U.S. Fish and Wildlife Service 1994) of the Final Supplemental Environmental Impact Statement on Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Spotted Owl (U.S. Department of Agriculture and U.S. Department of Interior 1994a), the Recovery Plan for the Threatened Marbled Murrelet (U.S. Fish and Wildlife Service 1997), and the 2004 Evaluation Report prepared by EDAW, Inc. for the murrelet 5-year review (McShane et al. 2004). More extensive discussion of the marbled murrelet's life history, conservation, and susceptibility to effects from invasive plant treatments is included in the Region Six Invasive Plant Program BA and BO (USDA Forest Service 2005, U.S. Fish and Wildlife Service 2005, respectively). This information is incorporated by reference. A brief summary of life history information relevant to invasive plant management is included below.

**Listing History**

On October 1, 1992, the FWS issued a final notice listing the marbled murrelet as threatened (U.S. Fish and Wildlife FWS 1992). Within the area covered by this listing, this species is known to occur in California, Oregon, and Washington. Critical habitat was designated for this species on May 24, 1996 (U.S. Fish and Wildlife FWS, 1996). On August 31, 2004, the FWS announced the completion of the 5-year review of the marbled murrelet. As a result of its review, the FWS has concluded that the population of marbled murrelets in California, Oregon, and Washington does not satisfy the criteria for designation as a Distinct Population Segment (DPS) under the FWS's 1996 DPS policy (Department of Interior and Department of Commerce 1996). The current status of the marbled murrelet will not change unless the FWS completes the formal process to de-list the species.

**Distribution**

The murrelet ranges from the Aleutian Archipelago to central California. The distribution of murrelets becomes more disjunct at the southern extreme of their range. In Washington, Oregon, and California, there are distinct gaps between breeding populations that are thought to relate to availability of onshore nesting habitat. Murrelets are generally found in near-shore ocean waters but come inland to nest.

Murrelet nests are not evenly distributed between the coast and the inland extremes of their range, but are observed most often within about 12 miles of the ocean. However, their inland nesting distribution is not fully known because survey effort has been inconsistently distributed, especially in areas greater than 40 miles from the coast. In marine environments, there are also distinct gaps between breeding populations that are thought to relate to availability of onshore nesting habitat. It is believed that marine productivity is high along most of this coast during the breeding season which suggests foraging habitat is not limiting.

## Life History and Habitat Description

The murrelet is a small robin-sized seabird of the family Alcidae in the order Charadriiformes. These small, fast flying seabirds are unique among North American alcids in their use of coastal coniferous forest, primarily late-successional trees as nesting habitat. Nesting season occurs from late March to September. Their solitary nests are usually concealed within the forest canopy and breeding birds are cryptic and primarily crepuscular at nest sites. Egg laying, incubation, and hatching occur before August 5, and feeding of young occurs from August 6 to September 15 (Hamer and Nelson, 1995). Marbled murrelets have a life history strategy unique among seabirds. Although they feed on fish and invertebrates primarily in nearshore marine waters, they nest as far as 50 miles inland from the marine environment, on large limbs of mature conifers. Marbled murrelets are mostly pelagic during the winter.

### *Nest Tree Characteristics*

Lank et al. (2003) states that murrelets use single platform trees generally within 20 miles, and older forest stands generally within 50 miles, of the coast for nesting. Unlike most auks, murrelets nest solitarily on mossy platforms of large branches in old-forest trees (Lank et al., 2003). Suitable habitat for murrelets may include contiguous forested areas with conditions that contain potential nesting structure. These forests are generally characterized by large trees greater than 18 inches dbh, multistoried canopies with moderate closure, sufficient limb size and substrate (moss, duff, etc.) to support nest cups, flight accessibility, and protective cover from ambient conditions and potential avian predators (Manley, 1999; Burger, 2002; and Nelson and Wilson, 2002). Over 95 percent of measured nest limbs were $\geq$ 15 cm diameter, with limb diameter ranges from 7-74 cm diameter (Burger, 2002).

### *Nest Stand Characteristics*

Nest stands are typically composed of low elevation conifer species. In California, nest sites have been located in stands containing old-growth redwood and Douglas-fir, while nests in Oregon and Washington have been located in stands dominated by Douglas-fir, western hemlock, and Sitka spruce. Murrelets appear to select forest stands greater than 50 ha (Burger, 2002), but are found nesting in stands as small as one acre (Nelson and Wilson, 2002). In surveys of mature or younger second-growth forests in California, murrelets were only found in these forests where there was nearby old-growth stands or where residual older trees remained (U.S. Fish and Wildlife Service, 1992, and Singer et al., 1995).

### *Landscape Characteristics*

Studies to determine the characteristics of murrelet nesting habitat at a landscape scale have been conducted using a variety of methods, including predictive models, radio telemetry, audio-visual surveys, and radar. McShane et al. (2004) report, "At the landscape level, areas with evidence of occupancy tended to have higher proportions of large, old-growth forest, larger stands and greater habitat complexity, but distance to the ocean (up to about 37 miles [60 km]) did not seem important."

Multiple radar studies (e.g., Burger 2001, Cullen, 2002, Raphael et al., 2002, Steventon and Holmes, 2002) in British Columbia and Washington have shown radar counts of murrelets to be positively associated with total watershed area, increasing amounts of late-seral forests, and with increasing age and height class of associated forests. The radar counts of murrelets are also negatively associated with increasing forest edge and areas of logged and immature forests (McShane et al., 2004). There are also several studies concluding murrelets do not pack into higher densities within remaining habitat when nesting habitat is removed (Burger 2001, Manley et al., 2001, Cullen, 2002).

### Population Dynamics

The present population estimate for the murrelet in Oregon is 9,500 (± 3,000) and approximately 23,700 (± 5,200) within the conterminous United States (Huff et al., 2003, Strong 2003a and Strong, 2003b). Spiech and Wahl (1995) concluded murrelet populations in Puget Sound are lower now than they were at the beginning of this century, and total estimates for Washington are still about 9,800 murrelets (Huff et al., 2003). Ralph and Miller (1995) estimated the California population to be approximately 6,500 birds, and this estimate remains at the high end of the statistical confidence interval with roughly 4,000 birds being the low end (Huff et al., 2003, Strong 2003a and 2003b, McShane et al., 2004).

Beissinger (1995) constructed a demographic model of the murrelet and concluded that the population may be declining at rates of 4-6 percent per year, but this estimate is hampered by the possibility that the age-ratio data used in the model are reflective of a relatively temporary decline due to unusual ocean conditions (Ralph et al., 1995). Lank et al. (2003) states, "Regardless of the approaches taken to estimate [(sic) vital rate] parameter values, the output from the Leslie matrix models representing survivorship and fecundity values for all populations in Washington, Oregon and California (Beissinger and Nur, 1997) suggest negative population growth rates." McShane et al. (2004) produced a demographic model of murrelet populations in WA, OR, and CA by each of the six conservation zones. Similar to previous studies, they found that populations in all conservation zones are in decline, with mean annual rates of decline between 2.1 and 6.2 percent.

### Threats

The Marbled Murrelet Recovery Plan (U.S. Fish and Wildlife Service, 1997) identified the primary threats to the species: (1) predation; (2) loss of nesting habitat; (3) by-catch in gill-nets, and; (4) oil pollution both chronic and from major spills. More recently, McShane et al. (2004), has concluded all threats are still present although loss of nesting habitat, particularly on Federal lands, has declined. In 2002, the Biscuit Fire on the Siskiyou NF burned 1,600 acres of habitat for the marbled murrelet, including two known occupied sites (USDA Forest Service, 2004, Appendix E-11; R. Miller, pers. comm.). The new gill-netting regulations in northern California and Washington have reduced the threat from catch in gill-nets. The threat from oil pollution continues to be unpredictable and effects are variable. New information on predation indicates a high threat level due to limiting murrelet nest success (Hebert and Golightly, 2003, Peery *et al.* in prep., Luginbuhl et al., 2001). It is uncertain whether the increased threat of predation represents an actual increase in predation since listing or a better understanding of the magnitude (McShane et al., 2004).

### Critical Habitat

The FWS designated critical habitat for the marbled murrelet in 1996 (U.S. Fish and Wildlife Service, 1996). Coastal forests in Washington, Oregon, and northern California contain designated critical habitat. Critical habitat consists of only suitable nesting habitat and does not include foraging habitat in marine areas. The FWS determined that marine foraging habitats did not need additional management consideration or protection.

The primary constituent elements of murrelet critical habitat include: 1) individual trees with potential nesting platforms, and 2) forested areas within 0.5 miles (0.8 kilometers) of individual trees with potential nesting platforms and with a canopy height of at least one-half the site-potential tree height (U.S. Fish and Wildlife Service, 1996).

Individual nest trees are usually large trees, generally more that 32 inches (81 centimeters) dbh, with large branches or deformities that can serve as nest platforms. Forested areas around nest trees provide more suitable microclimate and protect nest trees from windthrow.

Designated critical habitat included most of the Late Successional Reserves (LSR) described in the Northwest Forest Plan (federal); State lands in southwestern Washington, northwestern Oregon, and California south of Cape Mendocino; as well as private lands. No tribal lands were included in the critical habitat designation. FWS designated a total of about 3.8 million acres in 32 critical habitat units. Twenty-two of the critical habitat units contain some State, county, city, or private lands. Federal land in the three states accounts for just over 3 million acres of critical habitat.

***Action Area - Marbled Murrelet***

Mabled murrelets do not occur on the north side of the Columbia River Gorge National Scenic Area, but they do occur on the Gifford Pinchot National Forest. The marbled murrelet recovery plan (U.S. Fish and Wildlife Service, 1997) identified six recovery zones for the marbled murrelet. The Gifford Pinchot National Forest is included in Zones 1 and 2. There are currently no invasive plant species on the Gifford Pinchot National Forest adversely affecting marbled murrelets or their habitat.

A Programmatic Wildlife Letter of Concurrence (Programmatic LOC) for the GPNF and CRGNSA (U.S. Fish and Wildlife Service 2001) identified limited operating period near marbled murrelet nests between April 1 and August 5 within the distances listed below in Table 19. If disturbance-causing activities occur farther away from nesting marbled murrelets than the distances specified in **Table 19**, then no adverse effect will occur. All activities that generate noise above 92 dB must be scheduled between 2 hours after sunrise and 2 hours before sunset during the murrelet nesting season (April 1 to September 15).

Table 19 - Disturbance Distances for Marbled Murrelets

| Activity | Distance[1] |
|---|---|
| Use of chainsaw or motorized equipment | 45 yards |
| Use of heavy equipment | 35 yards |
| Burning | 0.25 miles |

1 U.S. Fish and Wildlife Service. 2003. Appendix 1: Estimates of distances at which incidental take of murrelets and spotted owls due to harassment are anticipated from sound-generating, forest-management activities in Olympic National Forest. Unpublished report prepared by Kent Livezey, Western Washington Fish and Wildlife Office, Lacey, WA. 20 pp.

Marbled murrelets may detect and become alerted by sounds without any adverse effects occurring. Louder sounds can cause a marbled murrelet to flush from a nest or miss feeding a chick, which would be considered an “injury” (U.S. Fish and Wildlife Service 2003). Sound-only injury distances for activities that would cause disturbance to the marbled murrelet are those at 92dB and above (U.S. Fish and Wildlife Service 2003). The estimated ambient noise levels for a forest setting are at 40 dB. Hamer and Nelson (1998) measured mean decibel levels of some equipment in a forested environment at a distance of 25 m. They reported mean decibel levels of 58 dB for automobiles, 67 dB for trucks, and 72 dB for chainsaws. U.S. Fish and Wildlife Service (2003) reported higher dB levels for chainsaws used in timber harvest. The maximum 1-minute reading for the largest chainsaw (Stihl 38) was 90.8 dB, with a peak reading of 104.2 dB. Therefore, some equipment used to treat invasive weeds could exceed the 92 dB level for injury disturbance to the marbled murrelet.

Decibel readings from engines used for roadside boom spraying were measured, as discussed previously in the Northern Spotted Owl discussion. Roadside spraying equipment produced readings of 72-75 decibels within 10 yards, dropping to 64-67 decibels at 35 yards (observations in the project file). No measurements exceeded 92 dB.

Marbled murrelets have been documented in the Mineral Block area of the Gifford Pinchot National Forest. This includes invasive plant treatment area 35-13. Only one other location has been confirmed (using radar): the southern boundary of Mount Rainier National Park (treatment area 35-17). Critical habitat for the marbled murrelet is also present in these two areas.

***<u>Effects of the Proposed Action to Marbled Murrelet</u>***

### Direct and Indirect Effects

#### *Manual, Mechanical, and Cultural Methods*

Potential effects of invasive plant treatment methods on marbled murrelets are associated with disturbance that may occur during the nesting season. Direct effects from invasive plant treatment include disturbance caused by noise, people and vehicles. However, the potential for visual disturbance to cause harassment of marbled murrelets is low. Noise-generating activities above ambient could potentially cause enough disturbance to result in harassment of marbled murrelets during the breeding season. Noise or visual stimuli may interrupt or preclude essential nesting and feeding behaviors, cause flushing from the nest or missed feedings of young (U.S. Fish and Wildlife Service, 2003). Projects that generate noise or activity above ambient levels and occur within the disturbance distances specified in **Table 19** from an active murrelet nest may cause these harassment effects (U.S. Fish and Wildlife Service, 2003). Some equipment used to treat invasive plants could create noise above ambient levels, depending upon site-specific conditions.

Equipment used for roadside spraying of invasive plants is not likely to cause adverse effects to marbled murrelets, for reasons stated above for the northern spotted owl. Mowing and brushing uses machinery that can create louder noise, so treatment areas with these methods may disturb murrelets. There is no murrelet habitat on the north side of the Columbia River Gorge National Scenic Area and no murrelet habitat on the Gifford Pinchot National Forest in a treatment area has brushing or mowing proposed. For future project sites, the mandatory PDC for marbled murrelets requires that these methods, or others that generate sufficient noise, be conducted farther away than 35 yards for heavy equipment or motorized hand tools, and 45 yards for chainsaws, or outside the breeding season. This will minimize any potential disturbance. This PDC has been included in several Biological Opinions throughout the region and is expected to be effective at minimizing effects to marbled murrelets because it minimizes or eliminates the source of disturbance near nests or suitable habitat. Therefore, mechanical and manual methods to control invasive plant treatments on the Columbia River Gorge National Scenic Area and Gifford Pinchot National Forest are not likely to adversely affect marbled murrelets.

***Herbicides***

Exposure scenarios used to analyze potential effects from herbicides are discussed in USDA Forest Service 2005b, Appendix B. None of the herbicides proposed for use in this EIS nor NPE surfactants, applied at typical application rates, pose a risk to marbled murrelets.

Marbled murrelets are not likely to be directly sprayed, or encounter vegetation that has been directly sprayed, because no aerial applications are proposed. No ground applications of herbicide would reach the upper canopies of mature trees where murrelets nest.

Murrelets feed on marine fish, which will not be exposed to herbicides or NPE from control of invasive plants on lands administered by the Forest Service. It is not plausible for their primary prey to be exposed to herbicides or NPE considered in this analysis. However, some murrelets in some locations have been reported to feed upon some freshwater fish (Carter and Sealy 1986). Therefore, in order to investigate a worst-case scenario for exposure, a scenario involving the consumption of contaminated fish was analyzed. The potential for the herbicides included in the action alternatives to adversely affect marbled murrelets was determined using quantitative estimates of exposure from worst-case scenarios. The dose estimates for fish-eating birds were calculated using herbicide or NPE concentrations in fish that have been contaminated by an accidental spill of 200 gallons into a small pond.

Assumptions used include no dissipation of herbicide, bioconcentration is equilibrium with water, contaminant level in whole fish is used, and upper estimate assumes 15 percent of body weight eaten/day. For chronic exposures, we used a scenario where the bird consumes fish from water contaminated by an accidental spill over a lifetime. All estimated doses used in effects analysis were the upper levels reported in the Forest Service/SERA risk assessments.

The following interpretations of the exposure scenario results are made with the reservation that toxicity data was generated from laboratory animals that may not accurately represent potential effects to free-ranging wildlife. The results of the exposure scenarios indicate that no herbicide or NPE surfactant poses any plausible risk to birds from eating contaminated fish. All expected doses to fish-eating birds for all herbicides and NPE are well below any known NOAEL (see USDA Forest Service (2005b, Appendix B). Even if they fed, for a lifetime, upon fresh-water fish that had been contaminated by an accidental spill of herbicide or NPE, they would not receive a dose that exceeds any known NOAEL. Therefore, marbled murrelets would not be adversely affected by herbicide use in the proposed action.

**Critical Habitat**

Invasive plants are not common within old growth forests that provide habitat for the marbled murrelet. The invasive plants occur primarily along roads or in other disturbed areas. Treatment projects using any method would not affect any primary constituent element of marbled murrelet critical habitat. Invasive plant treatment does not involve removing individual trees with potential nesting platforms, or forested areas within 0.5 miles (0.8 kilometers) of individual trees with potential nesting platforms and with a canopy height of at least one-half the site-potential tree height. Therefore, conducting invasive plant treatment projects consistent with the standards and project design criteria will not affect critical habitat for the marbled murrelet.

### Determination of Effects to Marbled Murrelet

Disturbance by humans and vehicles during project implementation is the primary adverse effect that is plausible for marbled murrelets. There are no treatment sites within marbled murrelet habitat that propose using machinery or other methods likely to cause loud noise. Project design criteria for activities conducted within or adjacent to occupied or un-surveyed suitable habitat will minimize adverse effects from disturbance. There are no invasive plant locations or species that cannot be adequately treated using the project design criteria. All new locations treated under the Early Detection/Rapid Response approach would also be conducted with the project design criteria. If the EDRR site could not be adequately treated with the project design criteria, it would be considered outside the scope of the EIS and this consultation. New NEPA analysis and consultation would be conducted.

Conducting invasive plant treatments “may effect, but is not likely to adversely affect” the marbled murrelet.

This determination is based on:

- ❖ The project design criteria required for marbled murrelet sites or potential habitat will eliminate adverse effects from disturbance.
- ❖ Exposure of marbled murrelets or their prey to herbicides or NPE is not plausible because:
  - Marine prey of marbled murrelets will not be exposed to herbicides or NPE from proposed use on the Gifford Pinchot National Forest or north side of the Columbia River Gorge National Scenic Area.
  - Even if they fed, for a lifetime, upon fresh-water fish that had been contaminated by an accidental spill of herbicide, they would not receive a dose that exceeds any known NOAEL for birds.
- ❖ Invasive plant treatment projects conducted according to the project design criteria will not affect critical habitat for the marbled murrelet. This determination is based on:
  - No primary constituent elements are affected by invasive plant treatments.

### Cumulative Effects

Cumulative effects to marbled murrelet, within the action area, would be the same as those described for northern spotted owl. Effects to murrelets that occur in their off-shore habitat would not be included because they occur far from the action area. The proposed action has such a low probability of creating any effect that potential effects are discountable and could not be added to effects from State, Tribal, or private activities in a meaningful way.

It is unlikely that there would be negative cumulative effects to marbled murrelets from the proposed action when added to actions from Tribes, local Counties, State, or private activities because the proposed action creates only discountable or no effects from disturbance or herbicide exposure and does not remove or degrade marbled murrelet habitat. The probability of an effect from the proposed action is so low that it could not be added to those from State, Tribal, or private activities in a meaningful way. Therefore, the proposed action will not create any cumulative effects to marbled murrelets.

### *Conclusion*

Table 20 contains, for federally listed wildlife species within the action area that may be affected by the proposed action, a summary of listing status, effect determinations for the species, status of critical habitat, and the effect determination for critical habitat.

Table 20 - Listed Wildlife Species and Effects Determinations

| Species | Listing Status | Species Effect Determination[1] | Critical Habitat | Habitat Effect Determination |
|---|---|---|---|---|
| **Birds** | | | | |
| Bald eagle | Threatened | NLAA | No | N/A |
| Northern spotted owl | Threatened | NLAA | Designated | No Effect |
| Marbled murrelet | Threatened | NLAA | Designated | No Effect |
| **Mammals** | | | | |
| Grizzly bear | Threatened | No effect | No | N/A |
| Gray wolf | Endangered | No effect | No | N/A |

1 NLAA (Not Likely to Adversely Affect); LAA (Likely to Adversely Affect), N/A (Not Applicable).

Invasive plant treatment projects will have no effect on grizzly bear or gray wolf.

Effects analysis indicates that disturbance is the only likely effect to bald eagle, northern spotted owl, or marbled murrelet. The potential for disturbance during critical seasons is avoided through use of mandatory project design criteria. Therefore, the Proposed Action may affect, but is not likely to adversely affect the bald eagle, northern spotted owl and marbled murrelet.

Critical habitat is designated for the northern spotted owl and marbled murrelet. The Proposed Action will have no effect on designated critical habitat for the northern spotted owl and marbled murrelet because invasive plant treatments do not affect or remove any primary constituent elements of critical habitat.

# IV. FISHERIES

This chapter discusses the general effects of herbicide use for invasive plant treatments to fish and other aquatic organisms, and then discusses the status of federally listed fish species found on GPNF and CRGNSA and effects of the Proposed Action. The environmental baselines for watersheds on GPNF and CRGNSA are included in Appendix D of this BA. Subbasin descriptions are included in Appendix E of this BA.

## A. General Effects of Herbicide Use for Invasive Plant Treatments

Fish and other aquatic organisms have the potential to be adversely affected by contact with concentrations of herbicide that exceed levels of concern in water. For example, herbicides applied near a stream could inadvertently contact aquatic invertebrates that rely on terrestrial plants to fulfill their life cycle and thus reduce the availability of food for fish. Herbicides can alter the structure and biological processes of both terrestrial and aquatic ecosystems; these effects of herbicides may have more profound influences on communities of fish and other aquatic organisms than direct lethal or sublethal toxic effects (Norris et al. 1991). Herbicides used for aquatic invasive plant control have been shown to affect aquatic ecosystem components, however concentration of herbicides coming in contact with water following land-base treatments are unlikely to be great enough to cause such changes (ibid).

Sublethal effects can include changes in behaviors or body functions that are not directly lethal to the aquatic species, but could have consequences to reproduction, juvenile to adult survival, or other important components to health and fitness of the species. Or, sublethal effects could result from effects to habitat or food supply.

Residues in food from direct spraying are likely to occur during and shortly after application. Drift from herbicides considered for use may affect aquatic vegetation at low concentrations, however they show little tendency to bioaccumulate and are likely to be rapidly excreted by organisms as exposure decreases (Norris et al. 1991). Therefore, while the herbicides considered for use in this project may kill individual aquatic plants, aquatic habitats and the food chain would not be adversely impacted because the amount of herbicide that could be delivered is relatively low in comparison with levels of concern from SERA Assessments and the duration to which any non-target organism (including aquatic plants) would be exposed is very short-lived and impacts to aquatic plants would be very localized.

The application rate and method, along with the behavior of the herbicide in the environment, influence the amount and length of time an herbicide persists in water, sediment, or food sources. Once in contact, the herbicide must be taken up by the organism and moved to the site of biochemical action where the chemical must be present in an active form at a concentration high enough to cause a biological effect (Norris et al. 1991).

Herbicides vary in their environmental activity and physical form. Some may be oil- or water-soluble molecules dissolved in liquids, or attached to granules for dry application to soil surface. Herbicides may move from their location of application through leaching (dissolved in water as it moves through soil), volatilization (moving through air as a dissolved gas), or adsorption (attached by molecular electrical charges to soil particles that are moved by wind or water).

In soil and water, herbicides may persist or decompose by sunlight, microorganisms, or other environmental factors. Soil properties, rainfall patterns, slope, and vegetative cover greatly influence the likelihood that an herbicide will move off-site, once applied.

In combination with other site and biological factors, these characteristics influence both the probability of meeting site-specific goals for invasive plant control, and the potential of impacting non-target components of the environment.

The effects from the use of any herbicide depends on the toxic properties (hazards) of that herbicide, the level of exposure to that herbicide at any given time, and the duration of that exposure. Risk to aquatic organisms can be reduced by choosing herbicides with lower potential for toxic effects when exposure may occur. Exposure of federally listed fish to herbicides can be greatly reduced or increased depending on site-specific implementation techniques and timing used in herbicide application projects. Exposure can be reduced by such methods as streamside buffer zones, timing applications to avoid sensitive seasons, varying application methods used, and combining herbicide treatments with non-herbicide treatments to reduce overall use. Project design criteria included in the proposed action are expected to minimize potential exposures to federally listed fish.

The hazards associated with each herbicide active and inert ingredients, impurity or metabolite were determined by a thorough review of available toxicological studies. For a background discussion of all toxicological tests and endpoints considered in Forest Service Risk Assessments, refer to SERA, 2001.

Herbicides are not pure compounds and they contain the active ingredient, impurities, adjuvants, inert ingredients, and may also contain surfactants. The effects of inert ingredients, adjuvants, impurities, and surfactants to wildlife (includes fish) are discussed first, followed by a discussion of the effects of the active ingredients.

The movement, persistence, and fate of an herbicide in the environment determines the likelihood and the nature of the exposure fish and other aquatic organisms will receive. Stream and lake sediments may be contaminated with herbicides by deposition of soils carrying adsorbed herbicides from the land or by adsorption of herbicides from the water (Norris et al. 1991). Persistence of the herbicide is the predominant factor affecting its presence in the soil. Stream and lake sediments may be contaminated with herbicides by deposition of soils carrying adsorbed herbicides from the land or by adsorption of herbicides from the water (Norris et al. 1991).

### *Effects of Active Ingredients in Herbicide to Aquatic Organisms*

The most sensitive effect from the most sensitive species tested was used to determine the toxicity indices for each herbicide. Quantitative estimates of dose from each exposure scenario were compared to the corresponding toxicity index to determine the potential for adverse effect. Doses below the toxicity indices resulted in discountable effects. Table 21 lists the toxicity indices for fish used for the R6 2005 FEIS BA. Values in red/bold are the values used to assess risk to fish from acute exposures.

Table 21 - Toxicity Indices for Listed Fish

Indices represent the most sensitive endpoint from the most sensitive species for which adequate data are available. Numbers in red indicate the toxicity index used in calculating the hazard quotient for exposures to listed fish. Generally, the lowest toxicity index available for the species most sensitive to effects was used. Measured chronic data (NOEC) was used when they were lower than 1/20th of an acute LC50 because they account for at least some sublethal effects, and doses that are protective in chronic exposures are more certain to be protective in acute exposures.

| Herbicide | Duration | Endpoint | Dose | Species | Effect Noted at LOAEL |
|---|---|---|---|---|---|
| Chlorsulfuron | Acute | NOEC | **2 mg/L** (1/20th of LC50) | Brown trout | LC50 at 40 mg/L |
| | Chronic | NOEC[1] | 3.2 mg/L | Brown trout | rainbow trout length affected at 66mg/L |
| Clopyralid | Acute | NOEC | **5 mg/L** (1/20th of LC50) | Rainbow trout | LC50 at 103 mg/L |
| | Chronic | | | | none available |
| Glyphosate (no surfactant) | Acute | NOEC | **0.5 mg/L** (1/20th/LC50) | Rainbow trout | LC50 at 10 mg/L |
| | Chronic | NOEC | 2.57 mg/L[2] | Rainbow trout | Life-cycle study in minnows; LOAEL not given |
| Glyphosate with POEA surfactant | Acute | NOEC | **0.065 mg/L** (1/20th of LC50) | Rainbow trout | LC50 at 1.3 mg/L for fingerlings (surfactant formulation) |
| | Chronic | NOEC | 0.36 mg/L | salmonids | estimated from full life-cycle study of minnows (surfactant formulation) |
| Imazapic | Acute | NOEC | 100 mg/L | all fish | at 100 mg/L, no statistically sig. mortality |
| | Chronic | NOEC | **100** mg/L | fathead minnow | No treatment related effects to hatch or growth |
| Imazapyr | Acute | NOEC | **5 mg/L** (1/20th LC50) | trout, catfish, bluegill | LC50 at 110-180 mg/L for North American species |
| | Chronic | NOEC | 43.1 mg/L | Rainbow | "nearly significant" effects on early life stages at 92.4 mg/L |
| Metsulfuron methyl | Acute | NOEC | 10 mg/L | Rainbow | lethargy, erratic swimming at 100 mg/L |
| | Chronic | NOEC | **4.5 mg/L** | Rainbow | standard length effects at 8 mg/L |
| Picloram | Acute | NOEC | **0.04 mg/L** (1/20th LC50) | Cutthroat trout | LC50 at 0.80 mg/L |
| | Chronic | NOEC | 0.55 mg/L | Rainbow trout | body weigh and length of fry reduced at 0.88 mg/L |
| Sethoxydim | Acute | NOEC | **0.06 mg/L** (1/20th LC50) | Rainbow trout | LC50 of Poast at 1.2 mg/L |
| | Chronic | NOEC | | | none available |
| Sulfometuron methyl | Acute | NOEC | 7.3 mg/L | Fathead minnow | No signs of toxicity at highest doses tested |
| | Chronic | NOEC | **1.17 mg/L** | Fathead minnow | No effects on hatch, survival or growth at highest doses tested |

| Indices represent the most sensitive endpoint from the most sensitive species for which adequate data are available. Numbers in red indicate the toxicity index used in calculating the hazard quotient for exposures to listed fish. Generally, the lowest toxicity index available for the species most sensitive to effects was used. Measured chronic data (NOEC) was used when they were lower than 1/20th of an acute LC50 because they account for at least some sublethal effects, and doses that are protective in chronic exposures are more certain to be protective in acute exposures. | | | | | |
|---|---|---|---|---|---|
| **Herbicide** | **Duration** | **Endpoint** | **Dose** | **Species** | **Effect Noted at LOAEL** |
| Triclopyr acid | Acute | NOEC | **0.26 mg/L** (1/20th LC50) | Chum salmon | LC50 at 5.3 mg/L[3] |
| | Chronic | NOEC | 104 mg/L | Fathead minnow | Reduced survival of embryo/larval stages at 140 mg/L |
| Triclopyr BEE | Acute | | **0.012 mg/L** | Bluegill sunfish | LC50 at 0.25 mg/L |
| | Chronic[4] | NOEC | 104 mg/L | Fathead minnow | Reduced survival of embryo/larval stages at 140 mg/L |
| NPE Surfactants | Acute[5] | NOEC | **0.2 mg/L** (1/20th LC50) | fathead minnow, rainbow trout | LC50 at 4.0 mg/L |
| | Chronic[6] | NOEC | 1.0 mg/L | trout | no LOEL given |

1 Chronic value for brown trout (sensitive sp.) was estimated using relative potency in acute and chronic values for rainbow trout, and the acute value for brown trout.
2 Estimated from minnow chronic NOEC using the relative potency factor method (SERA Glyphosate 2003).
3 Using Wan et al. (1989) value for lethal dose.
4 Chronic and subchronic data for triclopyr are limited to triclopyr TEA. No data is available for triclopyr BEE.
5 Exposure includes small percentage of NP and NP1-2E (Bakke, 2003).
6 Chronic exposure is from degredates NP1EC and NP2EC, because NPE breaks down rapidly and NPEC's are more persistent (Bakke, 2003).

Results of the exposure scenarios as applied to listed fish on the GPNF and CRGNSA are displayed below in **Table 22**. The R6 2005 FEIS Fish BA displayed the results by placing stars (*) and diamonds (♦) where there was an exceedence in the level of concern (LOC). For purpsoses of this BA, the table of stars and diamonds has been modified to show the hazard quotients (HQ) value in order to exemplify the magnitude of difference between typical and high application rates, and aquatic and non-aquatic formulations. Where there is a "—" and no number means that there was no exceedence in level of concern (LOC). The LOC exceedences occur when the HQ value exceeds 1. Exceedences in LOC indicate occasions where the expected exposure concentration (EEC) is greater than the no observable effect concentration (NOEC) value used for that aquatic species group, which may lead to an indirect effect to listed aquatic species if conditions were similar to what was modeled in the SERA risk assessments. To calculate a HQ, simply take the ratio of EEC/NOEC values. Toxicity indices used in the R6 2005 FEIS for aquatic organisms are NOEC values, refer to table above. Two types of indirect effects are possible, those toxic to the listed aquatic species, and those mediated by toxic effects to an ecosystem component that is part of the Primary Constituent Elements (PCE) or associated essential habitat features.

Table 22 - Hazard Quotient Values for Acute Exposure Estimates for Sensitive Aquatic Organisms Broadcast Spray Scenarios

| Aquatic Species Group / Application Rate | Chlorsulfuron | Clopyralid | Glyphosate w/o surfactant* | Glyphosate with surfactant | Imazapic | Imazapyr* | Metsulfuron Methyl | Picloram | Sethoxydim | Sulfometron Methyl | Triclopyr TEA* | Triclopyr BEE | NPE surfactant |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fish High | -- | -- | 6 | 43 | -- | -- | -- | 5 | 3 | -- | 15 | 125 | -- |
| Typical | -- | -- | 2 | 12 | -- | -- | -- | 2 | 2.5 | -- | 1.5 | 13 | -- |
| Aquatic invertebrates High | -- | -- | -- | 2.5 | -- | -- | -- | -- | -- | -- | -- | 1.8 | -- |
| Typical | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Algae High | 5 | -- | -- | 3.1 | -- | 5 | -- | -- | -- | 3 | 9.5 | 214 | -- |
| Typical | -- | -- | -- | -- | -- | 2 | -- | -- | -- | -- | -- | 21 | -- |
| Aquatic macrophytes High | 1064 | -- | -- | -- | 1.4 | 8 | 9 | 2 | -- | 36 | 9.5 | 214 | -- |
| Typical | 234 | -- | -- | -- | -- | 3 | 2 | -- | | 4 | | 21 | |

'--' Predicted concentrations less than or equal to the estimated or measured 'no observable effect concentration' at both typical and high application rates.
'*' Aquatic formulations analyzed in the R6 2005 FEIS.

The exposure scenarios do not account for factors such as timing of application, animal behavior and feeding strategies, animal presence within a treatment area, or other relevant factors such as site-specific conditions. However, the SERA risk assessments do represent a worst-case scenario that is a good benchmark for assessing true concerns with actual application. Results of triclopyr exposures take into account the strict limitations on use identified in the forest plan standards, which makes the exposure scenarios implausible or impossible. **Table 22** displays the results of exposure if all "worst-case" conditions reflected in the scenario occur, which is highly unlikely for Olympic National Forest.

### *Chronic and Acute Exposures*

The toxicity metric values (estimated or measured NOEC values) used in the R6 2005 FEIS analysis were selected as the most likely to protect against acute sub-lethal effects. For assessing potential risk to listed fish, while accounting for uncertainty regarding sub-lethal effects, the $1/20^{th}$ of the acute $LC_{50}$ (U.S. EPA 2004) or a lower chronic NOEC value was used for the acute toxicity index. Therefore, a LOC exceedence listed in **Table 22** represents at least a greater than discountable risk of acute sub-lethal effects at the R6 2005 FEIS scale. For the proposed action, effects analysis tiers to the results of the R6 2005 FEIS for chronic and acute exposures, and analyzes the potential for more than a discountable risk of acute sub-lethal effects as well as indirect effects from impacts to the food web.

Results of the R6 2005 FEIS analysis indicates that chronic exposures to fish are not plausible, in other words not mathematically possible. Therefore, chronic exposures to fish for the proposed action are unlikely to occur. It is safe to assume that it is highly unlikely to reach a LOC for chronic exposures herbicide treatments on GPNF and CRGNSA.

The R6 FEIS identified three herbicides that mathematically exceeded the LOC for aquatic plants: Imazapyr, Metsulfuron, and Chlorsulfuron. The R6 2005 FEIS concluded that exposure of aquatic plants to chronic toxicity concentrations of imazapyr may be mathematically possible, but not plausible. Therefore, it is not plausible for the proposed action to result in chronic toxicity of imazapyr for aquatic plants. For metsulfuron, the peak modeled stream concentration reported in the SERA risk assessment is 0.006 mg/l, which is approximately equal to the 0.005 mg/l that was calculated as the mathematically highest possible average stream concentration (with direct input). This indicates that the true 21 day concentration for non-fish species is likely much lower. Based on this, it is unlikely that exposure to chronic toxicity of metsulfuron to plants will occur for the proposed action, even if there were no buffers. The risk assessment for chlorsulfuron lists the highest average modeled stream concentration as 0.0022 mg/l, approximately 46 times higher than the estimated acute NOEC of 0.000047 mg/l. However, chronic toxicity to plants is unlikely to occur for the proposed action because of project design criteria that limits broadcasting chlorsulfuron.

The sections that follow below focus on the probability and magnitude of acute exposures from herbicide treatments based on results from the SERA risk assessments, refer to **Table 22** above. It must be made clear that the risk categories for herbicides identified in the R6 2005 FEIS Fish BA is risk to aquatic organisms (fish, invertebrates, algae, aquatic macrophytes) among the herbicides analyzed for the R6 2005 ROD. The herbicides analyzed in the R6 2005 FEIS were compared to each other and placed in a risk level category according to results from worst-case acute exposure scenario used in the SERA risk assessments. Herbicides analyzed in the R6 2005 FEIS were displayed in the following category of risk:

- Lowest risk: *results from SERA risk assessments indicated no risk or a plausible risk to aquatic macrophytes only*,
- Moderate risk: *results from SERA risk assessments indicated a plausible risk to algae or invertebrates, in addition to plants*,
- Highest risk: *results from SERA risk assessments indicated a plausible risk to fish (may or may not be a risk to algae, invertebrates, or macrophytes)*

The lowest risk group contains those herbicides for which LOCs were either not exceeded, or only exceeded the LOC for aquatic macrophytes. The moderate risk group contains those herbicides for which LOCs were exceeded for two aquatic species groups other than fish. The higher risk group contains those herbicides for which LOCs for fish were exceeded, refer to **Table 22** above while reading the section below.

The ability of herbicides to come in contact with water once in the soil depends on complex toxicological properties and environmental parameters. Below is a summary of herbicide characteristics in soil in order to gain a better understanding on the probability of adverse effects to aquatic organisms should the herbicide come in contact with water. These characteristics were considered for the analysis of effects from the proposed action on federally listed fish and their habitat.

***Clopyralid (Lowest Risk Category)***

Studies of clopyralid effects on soil invertebrates have been conducted, including field studies on the effects to microorganisms.

- Soil concentrations from USDA Forest Service applications are expected to be 1,000 less than concentrations that would cause toxic effects. Therefore, no effects to soil invertebrates or microorganisms are expected from use of clopyralid.
- Clopyralid is degraded by soil microbes, with an estimated half-life of 14 to 29 days, meaning that one-half of the amount applied remains in the soils after 90 days, one-fourth of the applied amount remains after 28 to 58 days, one –eight after 42 to 87 days, and so on.
- Increased soil moisture decreases degradation time.
- Clopyralid is weakly adsorbed and has a moderate leaching potential overall but high leaching potential in sandy soils.
- Modeling results indicate clopyralid runoff is highest in clay soils with peaks after rainfall events.
- Clopyralid percolation is highest in sandy loam soils.

There is no probability of exceeding levels of concern for aquatic organisms under the proposed action because expected exposure concentrations in the SERA risk assessments did not exceed any NOEC value for any aquatic organisms analyzed. In addition, there would be no impact to the food web.

***Imazapic (Lowest Risk Category)***

Imazapic is a relatively new herbicide, and there are no studies on the effects of imazapic on either soil invertebrates or soil microorganisms.

- If imazapic was extremely toxic to soil microorganisms, it is reasonable to assume that secondary signs of injury to microbial populations would have been reported.
- Imazapic degrades in soil, with a half-life of about 113 days.
- Half-life is decreased by the presence of microflora.
- Imazapic is primarily degraded by microbes and it does not degrade appreciably under anaerobic conditions.
- Imazapic is weakly adsorbed in high soil pH, but adsorption increases with lower pH (acidic soils) and increasing clay and organic matter content.
- Field studies indicate that imazapic remains in the top 12 to 18 inches of soil and do not indicate any potential for imazapic to move with surface water.
- Modeling results indicate imazapic runoff is highest in clay and loam soils with peaks after the first rainfall.
- Imazapic percolation is highest in sandy soils.

There is no probability of exceeding levels of concern for fish, invertebrates, or algae under the proposed action because expected exposure concentrations in the SERA risk assessments did not exceed NOEC values. However, at the high application rate (keeping in mind worst-case scenario assumptions) the peak modeled stream concentration of 0.0018 Mg/L did exceed the

NOEC value of 0.00127 Mg/L for aquatic macrophytes. The magnitude of difference between these two concentrations is extremely small, a difference of 0.00053. This indicates that the true concentration for aquatic macrophytes is likely to be much lower under the proposed action, even if there were no buffers. Therefore, it is nearly impossible to indirectly adversely affect fish via the food web under the proposed action.

***Metsulfuron methyl (Lowest Risk Category)***

Studies on the effects of metsulfuron methyl on soil biota are limited to Pseudomonas species, though there are a few studies of insects that live in soil. The lowest observed effect concentration is 5 mg/kg, based on the Psuedomonas study. At recommended use rates, no effects are expected for insects.

- Effects to soil microorganisms appear to be transient
- Metsulfuron methyl degrades in soil, with a variable half-life up to 120 days.
- Half-life is decreased by the presence of organic matter though microbial degradation of metsulfuron methyl is slow.
- Non-microbial hydrolysis is slow at high pH but rapid at lower pH.
- Adsorption to soil particles, which affects the runoff potential of metsulfuron methyl, increased with increased pH and organic matter.
- Metsulfuron methyl has low adsorption to clay.
- Modeling results indicate that off-site movement due to runoff could be significant in clay soils.
- Metsulfuron methyl percolates in sandy soils.

There is no probability of exceeding levels of concern for fish, invertebrates, or algae under the proposed action because expected exposure concentrations in the SERA risk assessments did not exceed NOEC values. However, at the high and typical application rates (keeping in mind worst-case scenario assumptions) the peak modeled stream concentration of 0.0015 Mg/L for high application rate and 0.0003 Mg/L for typical did exceed the NOEC value of 0.00016 Mg/L for aquatic macrophytes. The magnitude of difference between these two concentrations is very small, a difference of 0.00053 for high application rates and 0.00284 for typical. Therefore, there is a very low probability of indirectly adversely affecting fish via the food web under the proposed action.

***Chlorsulfuron (Moderate Risk Category)***

Studies on the effects of chlorsulfuron on soil biota include lab and field studies on nematodes; fungi; populations of actinomycetes, bacteria, and fungi; and soil microorganisms.

- No effects of chlorsulfuron were found for soil biota at recommended application rates, with the exception of transient decreases in soil nitrification.
- The ‘no observable effects concentration’ for soil is 10 mg/kg, based on cellulose and protein degradation.
- Chlorsulfuron degrades in aerobic soil.
- Non-microbial hydrolysis plays an important role in chlorsulfuron breakdown, and hydrolysis rates increase as pH increases.

- Adsorption to soil particles, which affects the runoff potential of chlorsulfuron, is strongly related to the amount of organic material in the soil.
- Chlorsulfuron adsorption to clay is low.
- Chlorsulfuron is moderately mobile at high pH.
- Leaching is reduced when pH is less than six.
- Modeling results indicate that runoff would be negligible in sandy or loamy soils.
- In clay soils, off-site loss could be substantial (up to about 55 percent of the applied amount) in regions with annual rainfall rates of 15 to 250 inches.

There is no probability of exceeding levels of concern for fish or invertebrates under the proposed action because expected exposure concentrations in the SERA risk assessments did not exceed NOEC values. However, at the high application rate the peak modeled stream concentration of 0.05 Mg/L did exceed the NOEC value of 0.01 Mg/L for algae. For aquatic macrophytes, the NOEC value of .000047 Mg/L was exceeded at both typical and high application rates (keeping in mind worst-case scenario assumptions). The NOEC value used in the SERA risk assessment for aquatic macrophytes is $1/10^{th}$ of the EC50, indicative of a conservative approach in the SERA risk assessments. The magnitude of difference between the expected exposure concentrations and the NOEC value for algae is small and unlikely to be reached under the proposed action because of PDCs and buffers, as well as label directions.

There is a large magnitude of difference for aquatic macrophytes because of the NOEC value used and the sensitive nature of aquatic macrophytes. Under the proposed action, there is a low risk of impacting aquatic macrophytes, however, impacts would be localized and directed at the individual macrophyte where chlorsulfuron comes in contact with water. However, it is very unlikely that chlorsulfuron would come in contact with water at peak modeled concentrations under the SERA risk assessment because of PDCS and buffers, and label direction. If it were to come in contact with water under the proposed action, impacts would not be of any magnitude that would lead to an adverse affect on fish. Therefore, there is a very low probability of indirectly adversely affecting fish via the food web under the proposed action.

***Imazapyr (Moderate Risk Category)***

There are no studies on the effects of imazapyr on soil invertebrates, and incomplete information on the effects on soil microorganisms.

- One study indicates cellulose decomposition, a function of soil microorganisms, can be decreased by soil concentrations higher than concentrations expected from USDA Forest Service applications.
- There is no basis for asserting adverse effects to soil microorganisms.
- Imazapyr degrades in soil, with a half-life of 25 to 180 days.
- Degradation rates are highly dependent on microbial action.
- Anaerobic conditions slow degradation.
- Adsorption increases with time as soil dries and is reversible.
- Field studies indicate that imazapyr remains in the top 20 inches of soil and do not indicate any potential for imazapyr to move with surface water.
- In forest field studies, imazapyr did not run off and there was no evidence of lateral movement.

- Modeling results indicate imazapyr runoff is highest in clay and loam soils with peaks after the first rainfall.
- Imazapyr percolation is highest in sandy soils

There is no probability of exceeding levels of concern for fish or invertebrates under the proposed action because expected exposure concentrations (EEC) in the SERA risk assessments did not exceed NOEC values. However, at high application rates the peak modeled stream concentration of 1.0 Mg/L did exceed the NOEC value of 0.02 Mg/L for algae and 0.013 Mg/L for aquatic macrophytes. At typical application rates the peak modeled stream concentration of 0.036 Mg/L also exceeded the NOEC values for algae and aquatic macrophytes. The NOEC value used in the SERA risk assessment for aquatic macrophytes is 1/10$^{th}$ of the EC50, indicative of a conservative approach in the SERA risk assessments. The magnitude of difference between the expected exposure concentrations and the NOEC values for algae and aquatic macrophytes is relatively small and unlikely to be reached under the proposed action because of PDCs and buffers, as well as label directions.

The Washington State Department of Agriculture has been conducting water quality monitoring to record any residual concentrations of the aquatic herbicides that are used to treat various freshwater emergent noxious weed species in or near the waters of Washington State (WDOA 2004, 2005). A laboratory accredited by the Washington State Department of Ecology was used for the analysis of all samples. Four sites between 2004 and 2005 were monitored for imazapyr. Two resulted in some level of detection below State standards and toxicity indices used in the R6 2005 FEIS, and the remainder had no detection. A no detection indicates that herbicide residue was not detected above the listed practical quantitation limit (PQL). The PQL is the lowest level that can be achieved within specified limits of precision and accuracy during routine laboratory conditions.

Results from these monitoring data are relevant to this analysis because sites monitored are more representative of treatment methods that would take place within the aquatic influence zone under the proposed action and ground conditions on GPNF AND CRGNSA. For example, in 2004 an area of approximately 0.25 acrs of Japanese knotweed was treated along the margins of the Naches River, just east of the city of Naches. A 1% solution of imazapyr was applied with a hand held backpack sprayer. There was no detection of imazapyr 1 hour after treatment or 24 hours after treatment. However, a 12.2 acre site of Japanese knotweed plants growing along the Willapa River in the Pacific County treated with a tank mix of 0.5% imazapyr using pressurized spray equipment resulted in a 0.0022 Mg/L 24 hours after treatment. The detection level of 0.0022 Mg/L is well below the toxicity indices for fish, invertebrates, algae, and aquatic macrophytes.

In 2005, yellow flag iris plots along Buena Creek in Yakima County were treated with imazapyr using a $C0_2$-pressurized backpack sprayer equipped with a 5-nozzle boom. Twelve test plots, each measuring approximately 8 feet by 20 feet were treated. The applications were part of a study by Washington State University to determine the efficacy of imazapyr in controlling yellow flag iris. Results showed a detection of 0.205 Mg/L one hour after treatment and no detection 24 hours after treatment. When compared to the toxicity indices used in the SERA risk assessments for algae and macrophytes, the differences suggest that there may have been some impact to algae or aquatic macrophytes at a localized level and of very short duration. Thus, concluding that there was no likelihood of impacting fish or invertebrates indirectly because of the no detection 24 hours later.

Under the proposed action, there is a risk of impacting algae and aquatic macrophytes, however, impacts would be localized and of short duration, directed at the individual organism where imazapyr comes in contact with water. It is unlikely that impacts would be of a magnitude that would lead to an adverse affect on fish or invertebrates. Therefore, there is a very low probability of indirectly adversely affecting fish via the food web under the proposed action.

***Sulfometuron methyl (Moderate Risk Category)***

There are no studies on the effects of sulfometuron methyl on soil invertebrates. However, it is toxic to soil microorganisms. Microbial inhibition is likely to occur at typical application rates and could be substantial. Soil residues may alter composition of soil microorganisms. Sulfometuron methyl applied to vegetation at rates to control undesirable vegetation would probably be accompanied by secondary changes in the local environment that affect the soil microbial community more certainly than direct toxic action of sulfometuron methyl on microorganisms.

- The typical half-life for sulfometuron methyl varies from 10 to 100 days, depending on soil texture. Half-life decreases as soil particle size decreases. Presence of soil microorganisms also decreases half-life, though microbial breakdown occurs slowly. Sulfometuron methyl degradation occurs most rapidly at lower pH soils where rates are dominated by hydrolysis.
- Sulfometuron methyl mobility is generally greater at higher soil pH and lower organic matter content.
- Modeling results indicate sulfometuron methyl runoff is highest in clay and loam soils with peaks after the first rainfall. Sulfometuron methyl percolation is highest in sandy soils. Monitoring results generally support modeling results.
- Sulfometuron methyl applied to vegetation at typical application rates would probably be accompanied by secondary changes to vegetation that affect the soil microbial community more certainly than direct toxic action of sulfometuron methyl on soil microorganisms.

There is no probability of exceeding levels of concern for fish or invertebrates under the proposed action because expected exposure concentrations (EEC) in the SERA risk assessments did not exceed NOEC values. However, at high application rates the peak modeled stream concentration of 0.0076 Mg/L did exceed the NOEC value of 0.0025 Mg/L for algae and 0.00021 Mg/L for aquatic macrophytes. At typical application rates the peak modeled stream concentration of 0.0009 Mg/L exceeded the NOEC value of 0.00021 Mg/L for aquatic macrophytes. The magnitude of difference between the expected exposure concentrations at the high application rates for aquatic macrophytes is 9 times that of the typical application rate. It comes as no surprise as sulfonureas are quite toxic to non-target vegetation. There was no concern for algae at the typical application rate. There is a very low likelihood of impacting algae and aquatic macrophytes under the proposed action because of PDC and buffers, as well as label directions. If any sulfometuron methyl were to come in contact with water, impacts to aquatic macrophytes under the proposed action would be localized and of short duration, directed at the individual organism where the herbicide comes in contact with water. It is unlikely that impacts would be of a magnitude that would lead to an adverse affect on fish or invertebrates. Therefore, there is a very low probability of indirectly adversely affecting fish via the food web under the proposed action..

***Sethoxydim (Poast product, Higher Risk Category)***

Sethoxydim was associated with some levels of concern in the R6 2005 FEIS, however risk assessments incorporated the toxicity of the naptha solvent in the Poast formulation of this herbicide. The toxicity of the sethoxydim alone is about 100 times less for fish than that of the Poast formulation. Since the naptha solvent tends to volatilize or adsorb to sediments, using Poast formulation data to predict effects from runoff may overestimate potential effects (SERA 2001). Adverse affects to fish and other aquatic organisms are not likely because the amount of sethoxydim used for this project would be lower than toxic levels, even if the Poast formulation were used.

- Sethoxydim is degraded by soil microbes, with an estimated half-life of 1 to 60 days. Adsorption of sethoxydim varies with organic material content.

- Modeling results indicate sethoxydim runoff is highest in clay and loam soils with peaks after the first rainfall.

There is no probability of exceeding levels of concern for invertebrates, algae, or aquatic macrophytes under the proposed action because expected exposure concentrations (EEC) in the SERA risk assessments did not exceed NOEC values. However, at both high and typical application rates the peak modeled stream concentrations of 0.19 Mg/L and 0.15 Mg/L, respectively, did exceed the NOEC value of 0.06 Mg/L for fish and were nearly equal in difference between the EEC and NOEC value. There is very little concern for the magnitude of difference between the EEC and NOEC because it is highly unlikely that sethoxydim (Poast formulation) would come in contact with water at toxic levels due to the restricted use in riparian areas. Therefore, there is a very low probability of adversely affecting fish.

***Picloram (Higher Risk Category)***

Picloram is a restricted use pesticide in the state of Washington. The persistence of picloram increases with soil concentration, thus increasing the likelihood that it becomes toxic to soil microorganisms in the short-term.

- Since picloram is toxic to microorganisms at low levels, toxic effects can last for some time after application.

- Persistence in soils could affect soil microorganisms by decreasing nitrification.

- Long-term effects to soil microorganisms are unknown.

- Picloram applied at a typical application rate is likely to change microbial metabolism, though detectable effects to soil productivity are not expected.

- Field studies have not noted substantial adverse effects associated with the normal application of picloram that might be expected if soil microbial activity were substantially damaged.

- Substantial effects to soil productivity from the use of picloram over the last 40 years have not been noted.
- Picloram has been studied on a number of soil invertebrates.
- Metabolites may increase toxicity for some soil microorganisms
- Picloram has a typical half-life of 90 days.
- Soil degradation rates vary in soil, depending on application rate and soil depth.
- Picloram is water soluble, poorly bound to soils that are low in clays or organics, has a high leaching potential, and is most toxic in acidic soil.
- Picloram should not be used on coarse-textured soils with a shallow water table, where groundwater contamination is most likely to occur.
- Picloram percolation is highest in loam and sandy soils. However, modeling results indicate picloram runoff (not percolation) is highest in clay soils.

There is no probability of exceeding levels of concern for invertebrates or aquatic macrophytes under the proposed action because expected exposure concentrations (EEC) in the SERA risk assessments did not exceed NOEC values. However, at high and typical application rates the peak modeled stream concentrations of 0.20 Mg/L and 0.07 Mg/L, respectively, did exceed the NOEC value of 0.04 Mg/L ($1/20^{th}$ LC50) for fish. The HQ at typical application rate is 2 compared to 5 at the high application rate for fish, suggesting that exceedances are within the same low range of difference.

Acute exposures can affect fish development, growth, swimming response, and liver histopathology; all referred to as sublethal effects. To account for the potential of sublethal effects, the $1/20^{th}$ of the LC50 was used in the SERA risk assessment. Exposures that lead to such sublethal effects use an amount of picloram much greater than what would be applied at each treatment site on the Olympic National Forest.

Acute toxicity of picloram varies considerably with formulation and with fish species. Formulations like Tordon 22K (potassium salt) is known to be considerably less toxic to several fish species compared to ester formulations. Although leached picloram may be transported to aquatic ecosystems as a result of rainfall, studies have shown that less than 5 percent of the picloram applied to a watershed are transported in surface runoff (Norris et al. 1991). Where soil compaction has occurred or where intermittent streams have been treated, residues of picloram could be mobilized following heavy rainfalls.

Adverse affects to fish from the use of picloram under the proposed action are not likely to occur because the probability of picloram to contact water at levels of concern is low. The PDCs and buffers established for picloram greatly reduce the potential for drift, leaching, and runoff. Any amount of picloram in water as a result of drift from spot spray or hand/select applications would be negligible and more than likely not detected because of vegetation interception and distance from the ordinary high water line or bankfull.

For aquatic macrophytes, only the high application rate exceeded the NOEC value of 0.10 (LOEC), resulting in a HQ of 2. Given the low magnitude of difference in EEC and NOEC, as well as the low range of HQs for picloram, it is unlikely that NOEC values for fish and aquatic macrophytes would be exceeded under the proposed action because of the PDCs and buffers established for streams and roads with high potential for herbicide delivery.

***Glyphosate (Higher Risk Category)***

Glyphosate has been extensively studied and is commonly used by State and Federal agencies within riparian areas. This section includes more information than for previous herbicides because of it's proposed use within aquatic influence zones with spot and hand/select applications of aquatic formulations.

Glyphosate is highly soluble in water but much less so in organic solvents. In general, it is very immobile in soil, being rapidly adsorbed by soil particles, and subject to some degree of microbial degradation. The degree of glyphosate decomposition varies by soil types. Glyphosate is readily metabolized by soil microorganisms and some species can use glyphosate as a sole source of carbon.

- It is degraded by microbial action in both soil and water.
- Glyphosate degrades in soil, with an estimated half-life of 30 days.
- Glyphosate is highly soluble, but adsorbs rapidly and binds tightly to soil.
- Glyphosate has low leaching potential because it binds so tightly to soil.
- Modeling results indicate glyphosate runoff is highest in loam soils with peaks after the first rainfall.

The SERA 2003 risk assessment provides results for two formulations of glyphosate; glyphosate with surfactant (terrestrial formulation, most toxic formulation) and glyphosate without surfactant (aquatic, less toxic formulation).

In aquatic species, the acute lethal potency of glyphosate and glyphosate formulations has been relatively well-defined. The formulation of glyphosate with surfactants, especially the POEA surfactant commonly used in glyphosate formulations, has a pronounced effect on the acute lethal potency of glyphosate.

The primary hazards to fish appear to be from acute exposures to the more toxic formulations. At high and typical application rates, the hazard quotients for the more toxic formulation at the upper ranges of plausible exposure indicate that the 1/20$^{th}$ $LC_{50}$ values for listed fish will be exceeded under worst-case conditions. The more toxic formulation did exceed the toxicity endpoints for invertebrates and aquatic plants at the high aplication rate of 7 lbs a.e./acre. In the worst-case scenarios, the exposure estimates are based on a severe rainfall (about 7 inches over a 24 hour period) in an area where runoff is favored – a slope toward a stream immediately adjacent to the application site. This is a standard worst-case scenario used in Forest Service risk assessments to guide the Forest Service in the use of herbicides. The SERA 2003 risk assessment strongly suggests that the use of the more toxic formulations near surface water is not prudent. Therefore, the proposed action has included a 100 ft buffer for broadcast applications and a 50 foot buffer for spot and hand/select applications for the more toxic formulations of glyphosate. In addition, no broadcasting is permitted on roads with high potential for herbicide delivery. This greatly lowers the probability of toxic formulations of glyphosate coming in contact with water at levels of concern.

The less toxic formulation did slightly exceed the toxicity endpoint used for fish at high and typical application rates, 6 and 2 respectively. However, there are no exceedances for invertebrates or aquatic plants. Exceedance is based on the 1/20$^{th}$ LC50 value rather than a NOEC. Thus, the use of less toxic formulations of glyphosate near bodies of water where salmonids may be found is limited to spot spray up to the edge of water and hand/select application methods for emergent weeds.

*Effects of Surfactants*. Appendix 3c of the SERA 2003 risk assessment summarizes the available ecological information from all of the Material Safety Data Sheets (MSD's) for the formulations that are labeled for forestry applications. It is apparent that these formulations fall into relatively clear groups. The most toxic formulations appear to be Credit Systemic, Credit, Glyfos, Glyphosate, glyphosate Original, Prosecutor Plus Tracker, Razor SPI, Razor, Roundup Original, Roundup Pro Concentrate, and Roundup UltraMax. It may be presumed that these formulations contain the most toxic surfactants. Other formulations such as Aqua Neat, Aquamaster, Debit TMF, Eagre, Foresters' Non-Selective Herbicide, Glyphosate VMF, and Roundup Custom are much less acutely toxic.

For the SERA 2003 ris risk assessment, the uncertainties involving the presence or absence of a surfactant and the possibly differing effects of using various surfactants cannot be resolved with certainty. Toxicity of glyphosate is characterized based on the use of a surfactant, either in the formulation or added as an adjuvant in a tank mixture. The R6 2005 FEIS addresses this uncertainty through Standard #18.

The polyethoxylated tallow amine (POEA) surfactant used in some glyphosate formulations is substantially more toxic to aquatic species than glyphosate and substantially more toxic than other surfactants that may be used with glyphosate. Two aquatic toxicity studies (Folmar et al. 1979, Wan et al. 1989) have been conducted on glyphosate, the POEA surfactant, and a Roundup formulation which permit a quantitative assessment of the relative toxicities of glyphosate and POEA as well as an assessment of potential for toxicologic interactions (i.e., synergism or antagonism) in combined exposures to these agents. Both of these studies indicate that POEA is substantially more toxic than glyphosate and that POEA surfactant is the primary toxic agent of concern. Therefore, the proposed action PDC F3 does not allow the use of POEA within 150 feet of surface water, wetlands, or on roads with high potential for herbicide delivery.

Toxicity of Roundup to aquatic organisms because of the POEA surfactant was known by Monsanto when Roundup was originally labeled in 1978 and data were provided to the Environmental Protection Agency (EPA). This is why the formulation was not registered for aquatic use; nor are glyphosate-containing products with POEA now registered for aquatic use. Most glyphosate-containing products that are registered for aquatic use are manufactured without surfactant. Standard #18 of the R6 2005 FEIS states that only those surfactants reviewed in

Forest Service hazard and risk assessment documents would be approved for use.

Nonyphenol polyethoxylate (NPE) based surfactants were also analyzed under the R6 2005 FEIS and did not exceed any LOC for fish, invertebrates, algae, or aquatic macrophytes.

*Sub-lethal Effects*. In the SERA 2003 risk assessment, the term "sub-lethal" is intended to designate effects that may impact reproduction, behavior, or the ability to respond to other stressors. For chronic exposures to glyphosate, the most relevant study remains the life cycle toxicity studies done in fathead minnow. As summarized in the U.S. EPA/OPP (1993c), no effect on mortality or reproduction was observed at a concentration of 25.7 mg/L using 87.3% pure technical grade glyphosate. The full life-cycle toxicity study was conducted in fathead minnow, a standard chronic toxicity that was required by and accepted by the U.S. EPA (1993a). In this study, the NOEC was 25.7 mg/L (U.S. EPA, 1993a, p. 41). It is important to note that the NOEC from this full life-cycle toxicity study not only indicates a lack of mortality but also indicates that the fish were able to reproduce normally. The life cycle NOEC of 25.7 mg/L was used as the most appropriate basis for risk characterization in the SERA 2003 risk assessment.

To account for uncertainty regarding sub-lethal effects, an amount of 0.5 Mg/L was used as the toxicity threshold for listed fish under the R6 2005 FEIS. This amount is the $1/20^{th}$ of the acute LC50 (U.S. EPA, 2004) for glyphosate, which is 51 times less than the chronic (long-term exposures) toxicity threshold of 25.7 Mg/L. If a full life-cycle of fish showed no adverse affects at a long-term exposure of 25.7 Mg/L (NOEC endpoint), the probability of a fish adversely affected at short-term exposure of 0.5 Mg/L is low.

*Field Monitoring Results*. A factor that must be considered in assessing the potential for adverse affects to fish is the information from field studies. The Washington State Department of Agriculture (DOA) has been conducting water quality monitoring to record any residual concentrations of the aquatic herbicides that are used to treat various freshwater emergent noxious weed species in or near the waters of Washington State (WDOA 2004, 2005). A laboratory accredited by the Washington State Department of Ecology was used for the analysis of all samples.

Eleven sites between 2003 and 2005 were monitored for glyphosate, which was applied from boat mounted power equipment, backpack sprayer, and hand held injection gun. Seven resulted in some level of detection below State standards and toxicity indices used in the R6 2005 FEIS, and the remainder had no detection. A no detection indicates that herbicide residue was not detected above the listed practical quantitation limit (PQL). The PQL is the lowest level that can be achieved within specified limits of precision and accuracy during routine laboratory conditions.

Results from these monitoring data are relevant to this analysis because sites monitored are more representative of treatment methods that would take place within the aquatic influence zone under the proposed action and ground conditions on GPNF and CRGNSA. The highest amount detected was 0.343 Mg/L 1 hour after treatment in 2003 in a pond near Yakima River with less than 1/3 acre treated with 6 oz of glyphosate per gallon of water. This may be due to the relatively small size of the pond and very little water movement as opposed to a river or creek where any residual herbicide is more quickly diluted and washed downstream. These results indicate that very little, if any, glyphosate remains in the water near treatment sites (WDOA 2003) under spot and hand/select applications. The results are below the $1/20^{th}$ of the LC50 (0.5

Mg/L) and State drinking water standards (0.700 Mg/L). Hence, there is a probability of glyphosate coming in contact with water under the proposed action and the potential amounts would not exceed any level of concern.

*Off-site drift.* Estimates of drift for ground applications are included in the SERA risk assessments. In ground broadcast applications, glyphosate will typically be applied by low boom ground spray and thus these estimates are used in the SERA risk assessment. Drift associated with backpack (directed foliar applications) are likely to be much less than from broadcast.

In typical backpack ground sprays, droplet sizes are greater than 100 µ, and the distance from the spray nozzle to the ground is 3 feet or less. In mechanical sprays, raindrop nozzles might be used. These nozzles generate droplets that are usually greater than 400 µ, and the maximum distance above the ground is about 6 feet. In both cases, the sprays are directed downward.

For most applications, the wind velocity will be no more than 5 miles/hour, which is equivalent to approximately 7.5 feet/second (1 mile/hour = 1.467 feet/second). Assuming a wind direction perpendicular to the line of application, 100 µ particles falling from 3 feet above the surface could drift as far as 23 feet (3 seconds @ 7.5 feet/second). A raindrop or 400 µ particle applied at 6 feet above the surface could drift about 3 feet (0.4 seconds @ 7.5 feet/second). This suggests that there is a reasonable probability of some off-site drift from spot applications that occur up to the water's edge. Label requirements as well as PDCs F5-F7 and buffer distances account for significant off-site drift that could occur from broadcasting under the proposed action. For spot applications, the amount of drift is likely to be significantly less than from broadcast, therefore, the magnitude of effects on fish, invertebrates, and aquatic plants as a result of drift is very low. When spot treatments of herbicide using hand-held equipment are made, the applicator has direct control of where the spray solution is applied and little, if any, herbicide comes in contact with standing water.

*Runoff.* Glyphosate or any other herbicide may be transported to off-site soil by runoff or percolation. Both runoff and percolation are considered in estimating contamination of ambient water. For assessing off-site soil contamination, however, only runoff is considered. This is similar to the approach used by U.S. EPA (1995) in their exposure assessment for terrestrial plants. The approach is reasonable because off-site runoff will contaminate the off-site soil surface and could impact non-target plants. Percolation, on the other hand, represents the amount of the herbicide that is transported below the root zone and thus may impact water quality but should not affect off-site vegetation.

Based on the results of the GLEAMS modeling for the Coastal Mountain Ecotype, the proportion of the applied glyphosate lost by runoff was estimated for clay, loam, and sand at rainfall rates ranging from 5 inches to 250 inches per year. Results indicate that there is the potential for glyphosate to reach streams at or above the toxicity value for fish, invertebrates, and aquatic plants under the worst-case scenario model.

In the flatter areas of GPNF and CRGNSA, such as valley bottoms, slope is likely to be less than the 10% modeled, decreasing the potential for stream herbicide concentrations. In the upper portions of the watersheds on GPNF and CRGNSA slopes exceed the 10% modeled, therefore there would be an increase of the potential for herbicide delivery from broadcast situations. However, it is highly unlikely that estimates from the GLEAMS model scenarios would be reached under the proposed action because actual application does not match well the scenario used in the model. Examples of scenario inputs that would differ at actual treatment sites include, interception of herbicide by vegetation, prohibited use of broadcasting in riparian areas, and the presence of organic matter in the soil. The presence of organic matter in soil significantly reduces delivery of glyphosate to streams.

*Dose Response Assessment.* The U.S. EPA/OPP (1993c) classified technical grade glyphosate as non-toxic to practically non-toxic in freshwater fish and LC50 values for glyphosate are in the range of 70 to 170 mg/L. In addition, the U.S. EPA/OPP (1993c) used the NOEC of 25.7 mg/L from life cycle toxicity study on technical grade glyphosate using fathead minnow and concluded that: "technical glyphosate should not cause acute or chronic adverse effects to aquatic environments. Therefore, minimal risk is expected to aquatic organisms from the technical glyphosate".

The selection of the 1/20$^{th}$ of the LC50 as the toxicity values by U.S. EPA (2004) addresses the higher sensitivity of some species of fish to technical grade glyphosate. Trout and other salmonids have much lower LC50 than those cited by U.S. EPA/OPP in 1993, with the lowest LC50 value for salmonids of 10 mg glyphosate/L, for trout in soft-water. The use of 0.5 Mg/L for the less toxic formulation was used as the toxicity value for listed fish and accounts for potential sub-lethal effects. For the more toxic formulation a toxicity value of 0.065 Mg/L was used.

There is a magnitude of difference in toxicity between glyphosate without surfactant and glyphosate with surfactant. Using the toxicity values, glyphosate with surfactant is more toxic than glyphosate without surfactant by a factor of about 8 (HQ 43 ÷ HQ 6). It is unlikely that the proposed action would result in HQ of 6 for the less toxic formulation because of the limitations on application methods. In addition, field studies done by DOA support the expectation that amounts would not exceed any level of concern.

Eyed eggs of fish seem to be a resistant life stage, with sensitivity increasing as the fish enters the sac-fry and swim-up stages.

For invertebrates and algae, there is a very low probability of adverse affects at the highest application rates for glyphosate with surfactant. Results for the worst-case scenario using the 1/10$^{th}$ of the LC50 for invertebrates (1.1 Mg/L) and 0.89 NOEC for aquatic plants are not likely to be reached because there will be no broadcasting within riparian areas.

### ***Triclopyr (Higher Risk Category)***

Five commercial formulations of triclopyr, either as the triethylamine (TEA) salt or the butoxyethyl ester (BEE) are currently registered for forestry applications and are covered in the SERA 2003 risk assessment. An additional formulation of the TEA salt of triclopyr has been labeled for aquatic weed control and is also considered in the SERA 2003 risk assessment. Physical, chemical, and biochemical properties of triclopyr can be found on page 2-10 and 2-11 in the SERA 2003 Triclopyr Risk Assessment. This section includes more information than for previous herbicides because of it's proposed use within aquatic influence zones with spot and hand/select applications of aquatic formulations. For aquatic formulations, there is a 15 ft buffer on waterbodies for spot applications and no buffer for hand/select methods.

Triclopyr BEE is much more toxic to aquatic organisms than triclopyr TEA. A breakdown product, TCP (3,5,6-trichloro-2-pyridinol), is more toxic than either form of triclopyr. In forestry applications, the primary concern is the formation of TCP as a soil metabolite. TCP is more persistent than triclopyr in soil and is relatively mobile in soil, thus able to come in contact with water near the site of application. TCP is of concern to the SERA 2003 risk assessment both because it is a metabolite of triclopyr and because the aggregate risks of exposure to TCP from the breakdown of both triclopyr and chlorpyrifos (insecticide) must be considered.

Data indicate that Garlon 3A (the triethylamine salt of triclopyr) is only slightly toxic or practically non-toxic to organisms tested. Garlon IV (butoxyethyl ester of triclopyr), however, is highly toxic to fish, whereas unformulated triclopyr is only slightly toxic. Project design criteria do not allow the use of Garlon IV within 50 feet of surface waters, thereby reducing the probability of fish coming in contact with Garlon IV. The long-term persistence of triclopyr does not seem to be a significant problem in forest settings because of its rapid disappearance. Photo-degradation is a major reason for the disappearance of triclopyr from water (Norris et al. 1991).

Exposure scenarios modeled in the SERA risk assessments are likely to significantly overestimate the risk of acute adverse affects from the application of triclopyr because triclopyr would only be applied by spot or hand methods (as per R6 2005 ROD standard 16), and not broadcast sprayed over 10 acres as depicted in the model scenario. The likelihood of toxic levels of triclopyr coming in contact with water is very low.

- Triclopyr has an average half-life in soil of 46 days, while TCP has an average half-life in soil of 70 days. Warmer temperatures decrease the time to degrade triclopyr.

- Soil adsorption is increased as organic material increases and decreased as pH increases. Triclopyr is weakly adsorbed to soil, though adsorption varies with organic matter and clay content. Both light and microbes degrade triclopyr.

*Fish*. There is a substantial difference between the toxicity of triclopyr acid and the toxicity of triclopyr BEE formulations, and the difference is reflected in the toxicities of the Garlon formulations (SERA 2003). As shown by Wan et al. (1989), Garlon 4 is more toxic than Garlon 3A by a factor of about 200 (150-230). This difference in toxicity is substantially greater than the difference in toxicity between triclopyr BEE and triclopyr acid. As indicated by Wan et al. (1989), the increased difference appears to be attributable to the toxicity of Garlon 3A, based on the level of triclopyr acid in this formulation. The level of triclopyr BEE in Garlon 4 appears to account for practically all of the toxicity of Garlon 4 (i.e., the ratios of observed to predicted LC50 values do not vary remarkably from unity for Garlon 4). Although Garlon 4 contains kerosene (see section 2.2 of the SERA 2003), the toxicity of kerosene to aquatic species is approximately 100-1,000 fold less than triclopyr BEE [LC50 values of approximately 200-3,000 mg/L (SERA 2003)], supporting the observation that the toxicity of Garlon 4 can be completely accounted for by the toxicity of triclopyr BEE.

*Sub-lethal Effects*. The sublethal effects of Garlon 4 on salmonid (rainbow trout) has been examined by Johansen and Geen (1990) using flow-through systems. Fish were found to be lethargic at concentrations of 0.32-0.43 mg/L. At levels $\leq$0.1 mg/L, fish were hypersensitive over 4-day periods of exposure. This is reasonably consistent with the threshold for behavioral changes in rainbow trout for Garlon 4 of 0.6 mg/L (Morgan et al. 1991). The corresponding threshold for behavioral changes to Garlon 3A was 200 mg/L (Morgan et al. 1991) is consistent with the relative acute lethal potencies of these two agents (SERA 2003).

Subchronic toxicity data are available only on the triethylamine salt of triclopyr and only in fathead minnows (Mayes et al. 1984; Mayes 1990c). In this study, fathead minnow eggs were exposed to concentrations of 26, 43, 65, 104, 162, and 253 mg/L for 28 days covering the development from egg to fry. The survival of fathead minnows (embryo-larval stages) was significantly reduced at 253 mg/L compared with control animals. At 162 mg/L, there was a slight decrease in body length. No effects were noted at any of the lower concentrations (SERA 2003). Janz et al. (1991) noted that sublethal exposures of coho salmon to various formulations of triclopyr do not appear to cause signs of physiological stress.

To account for uncertainty regarding sub-lethal effects from triclopyr acid and triclopyr BEE, the toxicity values of 0.26 Mg/L and 0.012 Mg/L, respectively, was for the R6 2005 FEIS. Both amounts are the 1/20th of the acute LC50 (U.S. EPA, 2004) for triclopyr, compared to the chronic NOEC of 104 Mg/L.

*Aquatic Invertebrates* - The available LC50 values cited in SERA 2003 suggest that most invertebrates are about equally or somewhat less sensitive than fish to the various forms of triclopyr. Some families of invertebrates (Ephemeroptera, Plecoptera, Trichoptera, Odonata) are much more resistant than fish to Garlon 4 (SERA 2003). The 1/10th of the LC50 (0.855 Mg/L) was used for the R6 2005 FEIS and was barely exceeded by 0.645 for triclopyr BEE at the high application rate.

*Aquatic Plants* - Triclopyr and triclopyr formulations have been subject to a standard set of bioassays in aquatic plats, both algae and macrophytes, that are required for the registration of herbicides. Based on EC50 values, triclopyr TEA is about equally toxic to both algae (lowest EC50 of 5.9 ppm a.i.) and macrophytes (lowest EC50 of 8.8 ppm a.i.). As with toxicity to fish and invertebrates, triclopyr BEE is more toxic with EC50 values as low as 0.88 ppm a.i. for macrophytes and 0.1 ppm for algae (SERA 2003). The R6 2005 FEIS used a toxicity value of 0.007 Mg/L (1/10th of EC50) for triclopyr BEE and 0.42 Mg/L (1/10th of EC50) for aquatic plants. There is a magnitude of difference between the exposures of triclopyr BEE and triclopyr acid at high application rates.

*Field Monitoring Results*. A factor that must be considered in assessing the potential for adverse affects to fish is the information from field studies. The Washington State Department of Agriculture (DOA) has been conducting water quality monitoring to record any residual concentrations of the aquatic herbicides that are used to treat various freshwater emergent noxious weed species in or near the waters of Washington State (WDOA 2004, 2005). A laboratory accredited by the Washington State Department of Ecology was used for the analysis of all samples.

In 2005, 0.25 acres of garden loosestrife plants on Foster Island in King County was treated with a 1.5% solution of triclopyr with a canoe-mounted sprayer. Results showed a level of detection of 0.0036 Mg/L 1 hour after treatment, and 0.0026 Mg/L 24 hours after treatment. Both concentrations are significantly below State drinking water standards (0.700 Mg/L) and toxicity index of 0.26 Mg/L for listed fish. The use of triclopyr by DOA for emergent weeds began in 2004 and will more than likely continue to be monitored on a random basis.

Results from these monitoring data are relevant to this analysis because sites monitored are more representative of treatment methods that would take place within the aquatic influence zone under the proposed action and ground conditions on GPNF and CRGNSA.

*Off-site Drift*. Same as glyphosate. Under the proposed action, spot applications have a 15 foot buffer from the ordinary high water mark or bankfull.

*Run-off*. Same as glyphosate. There are also substantial differences in the environmental fate of triclopyr TEA and triclopyr BEE. Both of these factors were considered in the SERA risk assessment. Triclopyr TEA will dissociate almost instantaneously to triclopyr acid in water. Thus, the toxicity of triclopyr TEA and triclopyr acid are essentially the same when expressed as acid equivalents. Triclopyr BEE, on the other hand, will degrade quickly but not instantaneously to triclopyr acid. This makes a substantial difference in the results from acute toxicity bioassays because, as summarized in the SERA 2003 risk assessment, the octanol water partition coefficient for triclopyr BEE (about 10,233) is higher than that of triclopyr acid (about 0.35 at pH 7) by a factor of nearly 30,000 [10,233÷0.35=29,237]. The much higher octanol water partition coefficient for triclopyr BEE will lead to much more rapid uptake of this form relative to triclopyr acid and this probably accounts for the much higher acute toxicity of triclopyr BEE relative to triclopyr acid.

Both forms of triclopyr will rapidly leach in very sandy soils after heavy rainfall. Since the maximum concentrations from the GLEAMS modeling is based on a rainfall event that occurs one day after application, relatively little triclopyr BEE is transformed to triclopyr acid and the peak concentrations are essentially equivalent. For both clay and loam soils, the maximum concentrations of triclopyr BEE (66 ppb in clay and 92 ppb in loam) are less than that of triclopyr acid (428 ppb for clay and 308 ppb for loam) because of the somewhat higher binding to organic matter in soil and consequent lesser runoff of triclopyr BEE relative to triclopyr acid in these soils. Triclopyr BEE will rapidly hydrolyze to triclopyr acid in water and “chronic” exposure to triclopyr BEE is not possible.

*Dose Response Assessment*. The acute risks associated with the use of triclopyr TEA are extremely low but the risks associated with the use of triclopyr BEE are obvious. TCP is about as acutely toxic to fish as triclopyr BEE.

Although triclopyr BEE is much more toxic to aquatic species than triclopyr TEA or triclopyr acid, the potential for exposure under the proposed action is much less because of the rapid hydrolysis of triclopyr BEE to triclopyr acid as well as the lesser runoff of triclopyr BEE because of it’s lower water solubility and higher affinity for soils. Buffers and PDCs will reduce the likelihood of triclopyr BEE coming in contact with water.

*TCP*. TCP (3,5,6-trichloro-2-pyridinol) is a major metabolite of triclopyr and is found in both soil and water. In mammals, TCP has about the same toxicity as triclopyr. Whereas, in fish TCP is substantially more toxic than either triclopyr acid or triclopyr TEA, with acute LC50 values in the range of about 2 to 10 ppm, similar to the toxicity of triclopyr BEE. An early life-stage study has been conducted in rainbow trout by Marino et al. 1999 (SERA 2003). The most sensitive endpoint involved growth – i.e., length and weight– with an NOEC of 0.0808 mg/L and an LOEC of 0.134 mg/L. Thus, TCP appears to be much more toxic than triclopyr TEA, for which the corresponding values in an early life stage study in the fathead minnow are 104 mg/L and 162 mg/L.

Because triclopyr and chlorpyrifos degrade at different rates, maximum concentration in soil, and hence maximum runoff to water, will occur at different times. Thus, in order to provide the most conservative estimate of exposure to TCP, the maximum concentrations reported in SERA 2003 reflect applications of triclopyr and chlorpyrifos spaced in such a way as to result in the maximum possible concentrations of TCP in water. This extremely conservative approach is discussed further in SERA 2003.

There are substantial differences in the toxicity of triclopyr TEA and triclopyr BEE to aquatic species and substantial differences in the environmental fate of triclopyr TEA and triclopyr BEE. Thus, the SERA Risk Assessment for Triclopyr ran a separate set of GLEAMS models using triclopyr BEE as the parent compound and triclopyr acid as the metabolite.

Barron et al. (1991) investigated the pharmacokinetics and metabolism of triclopyr (BEE) in yolk-sac fry of the coho salmon (Oncorhynchus kisutch) and found that the accumulation of triclopyr BEE was limited in the fish due to rapid hydrolysis to triclopyr acid, which was the principal metabolite in fish and water, accounting for over 99% of total residue.  No TCP was detected in any residue or in test water.

The risk assessment by EPA does not specifically address concerns for contamination of water wit TCP as a soil metabolite of triclopyr and chlorpyrifos.  Concentrations of TCP in a small stream could reach up to 11 ppb from the use of triclopyr at a rate of 1 lb/acre and up to 68 ppb in a small stream from the use of triclopyr at a rate of 1 lb/acre and chlorpyrifos at a rate of 1 lb/acre.  Much lower peak concentrations would be expected in small ponds.

There is very little monitoring data with which to assess the plausibility of the modeling for TCP (SERA 2003).  As discussed by U.S. EPA/OPP (1998a, p. 65ff), TCP is seldom detected in surface water after applications of triclopyr that result in triclopyr concentrations of up to about 25µg/L, with a limit of detection (LOD) for TCP of 10 µg/L. Thompson et al. (1991) examined the formation of TCP from triclopyr in a forest stream. Consistent with the results reported by U.S. EPA, these investigators failed to detect TCP (LOD=50 µg/L) in stream water with concentrations of triclopyr up to 140 µg/L. This is at least consistent with the GLEAMS modeling of both triclopyr and TCP. As shown in SERA 2003, the maximum modeled concentrations of triclopyr in stream water range from about 161 to 428 µg/L (for sandy and clay soils respectively) and the corresponding maximum modeled concentration of TCP in stream water range from about 5 to 11 µg/L. Thus, given the LOD of 50 µg/L in the study by Thompson et al. (1991), the failure to find TCP in stream water is consistent with the GLEAM modeling (SERA 2003).

## B.  Federally Listed Fish

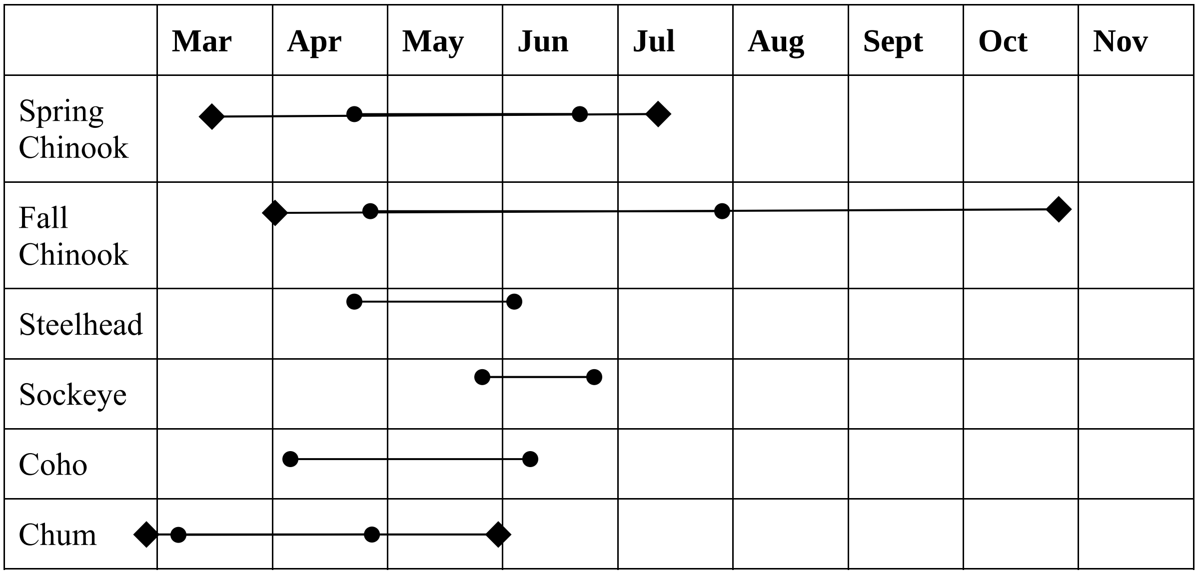
The Gifford Pinchot National Forest (GPNF) and the Columbia River Gorge National Scenic Area, Washington side (CRGNSA) has a total of 12 fish species that are either Endangered or Threatened, see the table below.  No fish species or critical habitat on GPNF or CRGNSA are currently proposed for federal listing.  Steelhead, Chinook, coho, chum, and sockeye are under the jurisdiction of NOAA Fisheries, and bull trout under US Fish and Wildlife Service.  Juvenile fish migration and timing at Bonneville Dam located on the mainstem of the Columbia River is in.  Table 23 Fish distribution data is from WDFW and local Forest fish biologists

## Table 23 – Listed Fish Species and Designated Critical Habitat on GPNF and CRGNSA, Washington side

| Species | DPS or Critical Habitat | Status | Federal Register | 5th Field Watersheds on GPNF and CRGNSA |
|---|---|---|---|---|
| Steelhead | Lower Columbia | Threatened | 63 FR 13347 3/19/98 | Wind River, Columbia Gorge Tributaries, Washougal, EF Lewis River, Clearfork Cowlitz River, Upper Cowlitz River, Middle Cowlitz River, Upper Cispus River, Lower Cispus River, Tilton River, NF Toutle River, Green River |
| | Middle Columbia River | Threatened | 64 FR 14517 3/25/99 | CRGNSA: Lower Klickitat River, intermittent use in the lower ½-1 mile of Catherine and Major Creeks, Lower White Salmon River. |
| | Upper Columbia River | Endangered | 62 FR 43937 | Columbia River Gorge National Scenic Area – mainstem Columbia River migration only |
| | Critical Habitat for Lower Columbia Steelhead | Designated | 70 FR 52629 09/02/05 | Wind River, Columbia Gorge Tributaries, Washougal, EF Lewis River, Clearfork Cowlitz River, Upper Cowlitz River, Middle Cowlitz River, Upper Cispus River, Lower Cispus River, Tilton River, NF Toutle River, Green River |
| | Critical Habitat for Middle Columbia Steelhead | Designated | 70 FR 52629 09/02/05 | GRGNSA: Lower Klickitat River, intermittent use in the lower ½-1 mile of Catherine and Major Creeks, Lower White Salmon River. |
| | Critical Habitat for Upper Columbia Steelhead | Designated | 70 FR 52629 09/02/05 | Columbia River Gorge National Scenic Area – mainstem Columbia River migration only |
| Chinook Salmon | Snake River Spring/Summer-run | Threatened | 57 FR 14653 4/22/92 | Columbia River Gorge National Scenic Area – mainstem Columbia River migration only |
| | Snake River Fall-run | Threatened | 57 FR 14653 4/22/92 | Columbia River Gorge National Scenic Area – mainstem Columbia River migration only |
| | Upper Columbia River Spring-run | Endangered | 64 FR 14308 3/24/99 | Columbia River Gorge National Scenic Area – mainstem Columbia River migration only |
| | Lower Columbia River | Threatened | 64 FR 14308 3/24/99 | Wind River, Columbia Gorge Tributaries, Clearfork Cowlitz River, Upper Cowlitz River, Middle Cowlitz River, Upper Cispus River, Lower Cispus River, Green River |
| | Critical Habitat for Snake River Spring/Summer Chinook salmon | Designated | 58 FR 68543 12/28/93 | Columbia River Gorge National Scenic Area – mainstem Columbia River migration only |
| | Critical habitat for Snake River Fall Chinook salmon | Designated | 58 FR 68543 12/28/93 | Columbia River Gorge National Scenic Area – mainstem Columbia River migration only |
| | Critical Habitat for | Designated | 70 FR 52629 | Columbia River Gorge Tributaries, |

| Species | DPS or Critical Habitat | Status | Federal Register | 5th Field Watersheds on GPNF and CRGNSA |
|---|---|---|---|---|
| | Lower Columbia River Chinook | | 09/02/05 | Wind River |
| | Critical Habitat for Upper Columbia River Spring-run Chinook | Designated | 70 FR 52629 09/02/05 | Columbia River Gorge National Scenic Area – mainstem Columbia River migration only |
| Coho Salmon | Lower Columbia River | Threatened | 70 FR 37160 6/28/05 | Columbia Gorge Tributaries, Clearfork Cowlitz River, Upper Cowlitz River, Middle Cowlitz River, Upper Cispus River, Lower Cispus River, Tilton River, Green River |
| Chum Salmon | Columbia River | Threatened | 70 FR 37160 6/28/05 | Columbia Gorge Tributaries, Lower White Salmon River |
| | Columbia River Critical Habitat | Designated | 70 FR 52630 09/02/05 | Same as Threatened |
| Bull Trout | Columbia River | Threatened | 64 FR 58910 11/01/99 | Columbia River Gorge National Scenic Area, Muddy River, Swift Reservoir-Lewis River, Yale Reservoir-Lewis River, Upper Lewis River and tributaries below lower falls on mainstem, |
| | Coastal Puget Sound | Threatened | 64 FR 58910 11/01/99 | Puyallup River (presumed) |
| | Critical Habitat for Columbia River Bull Trout | Designated | 70 FR 56212 09/26/05 | Does not include NF lands |
| | Critical Habitat for Coastal Puget Sound Bull Trout | Designated | 70 FR 56212 09/26/05 | Does not include NF lands |
| Sockeye Salmon | Snake River | Endangered | 56 FR 58619 11/20/91 | Columbia River Gorge National Scenic Area – mainstem Columbia River migration only |
| | Snake River Sockeye Salmon Critical Habitat | Designated | 58 FR 68543 12/28/93 | Columbia River Gorge National Scenic Area – mainstem Columbia River migration only |

Table 24 – Juvenile Fish Migration and Timing, At or Below Bonneville Dam (2001-2005).




Source: Fish Passage Center

Subbasin plans have been completed for areas within the Lower Columbia River region, Washington side. These subbasin plans are amendments to the Fish and Wildlife Program for the Northwest Power Planning Council. Under the Northwest Power Act, Congress charged the Northwest Power and Conservation Council with developing and periodically amending a fish and wildlife program for the Columbia River Basin to protect, mitigate and enhance fish and wildlife affected by the development and operation of hydroelectric facilities while assuring the Pacific Northwest an adequate, efficient, economical and reliable power supply. Subbasin plans that cover watersheds on Gifford Pinchot National Forest and Columbia River Gorge National Scenic Area, Washington side, are: Cowlitz, Kalama, Lewis, Washougal, Wind River, Little White Salmon, and Columbia Gorge Tributaries. Extensive information on individual stocks of fish species and limiting factors can be found at: (http://www.nwcouncil.org/fw/subbasinplanning/lowerColumbia/plan/). See Appendix E for subbasin descriptions.

Salmon and steelhead populations have plumetted in may watersheds due to a variety of factors, including fish passage barriers (Cowlitz Creek, Toutle Creek, Kalama Creek, Lewis Creek, Wind River, Little White Salmon River, and Columbia River). A summary of watershed conditions relative to fish habitat and populations is in the analysis files.

All anadromous salmonid life stages occur within the Columbia River and its tributaries within the Columbia River Gorge National Scenic Area. Adult salmonids migrate in the main channel of the Columbia River, generally in mid-channel and in the upper 25 feet (range 1-50 feet) of the water column. Juveniles (less than1 year age class) generally use near shore and off-channel habitats and occur throughout the water column, at depths ranging from 1 to 20 feet. Older juveniles, in the 1-plus age class, tend to use near shore and off-channel habitat, but will also use mid-channel and deeper water habitats where the velocity is greater. Migration behavior varies greatly depending on species, age, season, photoperiod and habitat availability. Downstream migration times for various species of salmonid stocks past Bonneville dam are summarized below.  Data for chum salmon (of which most populations are below Bonneville dam) are from seining data at various locations below Bonneville Dam.  Table 25 illustrates migration timing for adults and juveniles in the mainstem of the Columbia River within boundaries of the Columbia River Gorge National Scenic Area.

Below are brief summaries regarding the life history and other information for each of the species listed above, compiled from a variety of sources.  Additional information related to life history and status of populations at the Evolutionary Significant Unit (ESU) or Distinct Population Segment (DPS) scale can be found in the following sources:

- R6 2005 FEIS and Fisheries Biological Assessment (BA),
- NMFS and USFWS Federal Register documents (http://www.nwr.noaa.gov/ESA-Salmon-Listings/Salmon-Populations/Index.cfm), (http://www.fws.gov/pacific/bulltrout/),
- Lower Columbia Salmon Recovery and Fish and Wildlife Plan (http://www.nwcouncil.org/fw/subbasinplanning/lowerColumbia/plan/
- Draft Columbia River and Puget Sound Bull Trout Recovery Plans (http://www.fws.gov/pacific/bulltrout/recovery.html)

Maps of fish distribution on GPNF and CRGNSA have been given to NOAA Fisheries and USFWS Level 1 team members for the GPNF and CRGNSA DEIS.

## Pacific Salmon

Below are brief discussions of the status and life histories of listed pacific salmon found within the action area.  In an effort to reduce duplication and effort, this section incorporates by reference status and life history information found in the above mentioned Federal Registers, Recovery Plans, and the R6 2005 FEIS and Fisheries Biological Assessment.

### *Lower Columbia River Steelhead (Oncorhynchus mykiss)*

The Columbia River Gorge National Scenic Area and Gifford Pinchot National Forest are located within the Lower Columbia River Steelhead ESU in Oregon and Washington.  The Lower Columbia River steelhead ESU was listed as threatened on March 19, 1998 (63 FR 13347).  The Lower Columbia River ESU encompasses all steelhead runs in tributaries between and including the Cowlitz and Wind Rivers to the Little White Salmon River on the Washington side of the Columbia River, and the Willamette and Hood Rivers on the Oregon side.  Recovery planning for Lower Columbia River steelhead is ongoing, and recovery planning status can be reviewed online at:  http://research.nwfsc.noaa.gov/trt/trt_wlc.htm

The populations of steelhead that make up the Lower Columbia River ESU are distinguished from adjacent populations by genetic and habitat characteristics.  The ESU consists of summer and winter coastal steelhead runs in the tributaries of the Columbia River as it cuts through the Cascades.  These populations are genetically distinct from inland populations (east of the Cascades), as well as from steelhead populations in the Upper Willamette River basin and coastal runs north and south of the Columbia River mouth.  The following runs are not included in the ESU: the Willamette River above Willamette Falls (Upper Willamette River ESU), the Little and Big White Salmon rivers (Middle Columbia River ESU), and runs based on four imported hatchery stocks (early-spawning winter Chambers Creek/Lower Columbia River mix, summer run Skamania Hatchery stock, winter Eagle Creek National Fish Hatchery stock, and winter run Clackamas River ODFW stock) (NOAA Fisheries 1998). This area has at least 36 distinct runs (Busby et al.1996), 20 of which were identified in the initial listing petition. In addition, numerous small tributaries have historical reports of fish, but no current abundance data.

The major runs in the ESU for which there are estimates of run sizes and trends are the Coweeman River winter runs, North and South Fork Toutle River winter runs, Kalama River winter and summer runs, East Fork Lewis River winter run, Wind River summer runs, Clackamas River winter run, and Sandy River winter run.

***Action Area Information***

National Forest lands within the project area are found within two 4th HUC sub-basins identified for this ESU: Lower Cowlitz and and Lewis. This ESU does overlap into other basins found on other Nationl Forest lands outside the project area, such as the Lower Columbia/Hood sub-basin.

Lower Cowlitz sub-basin, approximately 15 percent of which is within Gifford Pinchot NF, has 1 major stream, NF Toutle River, which contains more than five miles of anadromous fish habitat inside the National Forest land. NF Toutle River holds roughly 12 miles of anadromous fish habitat inside the NF land.

Lower Columbia/Clatskanie sub-basin (with only 30 percent as part of the ESU area, approximately 10 percent of which is within Gifford Pinchot NF) does not have any major streams that contain more than five miles of anadromous fish habitat inside the National Forest land.

Lower Columbia/Sandy sub-basin, approximately 10 percent of which is within Columbia River Gorge National Scenic Area, and another few percent of which is within Gifford Pinchot NF. The majority of streams that contain more than five miles of anadromous fish habitat are on the Oregon side outside the project area.

Middle Columbia/Hood sub-basin (with only 45 percent as part of the ESU area, approximately 35 percent of which is within Gifford Pinchot NF, and another 5 percent of which is within Columbia River Gorge National Scenic Area) has 4 major streams that contain more than five miles of anadromous fish habitat inside the Gifford Pinchot NF and CRGNSA. The major streams are the mainstem of the Columbia River, Wind River, Trout Cr., and Panther Cr. Wind River contains at least 19 miles of habitat on Gifford Pinchot NF land.

Lewis sub-basin (with only 30 percent as part of the ESU area, approximately 50 percent of which is within Gifford Pinchot NF) has 1 major stream, EF Lewis River, which contains more than five miles of anadromous fish habitat inside the National Forest land. EF Lewis River holds roughly 8 miles of anadromous fish habitat inside the NF land.

### *Middle Columbia Rive Steelhead (O. mykiss)*

Columbia River Gorge National Scenic Area is located within the Middle Columbia River Steelhead ESU in Oregon and Washington. The Middle Columbia River steelhead ESU was listed as threatened on March 25, 1999 (64 FR 14517). The Middle Columbia River ESU encompasses Columbia River basin and tributaries upstream of, and including, the White Salmon River, and exclusive of the Wind River in Washington and the Hood River in Oregon, to and including the Yakima River in Washington. Recovery planning for Middle Columbia River steelhead is ongoing, and recovery planning status can be reviewed online at: http://research.nwfsc.noaa.gov/trt/trt_columbia.htm

Major drainages in this ESU are the Deschutes, John Day, Umatilla, Walla-Walla, Yakima, and Klickitat river systems. Almost all steelhead populations within this ESU are summer-run fish, the exceptions being winter-run components returning to the Klickitat and Fifteen Mile Creek watersheds. A balance between 1- and 2-year-old smolt emigrants characterizes most of the populations within this ESU. Adults return after 1 or 2 years at sea.

Most fish in this ESU smolt at two years and spend one to two years in salt water before re-entering fresh water, where they may remain up to a year before spawning. Age-2-ocean steelhead dominate the summer steelhead run in the Klickitat River, whereas most other rivers with summer steelhead produce about equal numbers of both age-1- and 2-ocean fish. Juvenile life stages (i.e., eggs, alevins, fry, and parr) inhabit freshwater/riverine areas throughout the range of the ESU. Parr usually undergo a smolt transformation as 2-year-olds, at which time they migrate to the ocean. Subadults and adults forage in coastal and offshore waters of the North Pacific prior to returning to spawn in their natal streams. A non-anadromous form of O. mykiss (redband trout) co-occurs with the anadromous form in this ESU, and juvenile life stages of the two forms can be very difficult to differentiate. In addition, hatchery steelhead are also distributed within the range of this ESU.

Recent estimates of the proportion of natural spawners of hatchery origin range from low (Yakima, Walla Walla, and John Day Rivers) to moderate (Umatilla and Deschutes Rivers). Most hatchery production in this ESU is derived primarily from within-basin stocks. The John Day River system is a large river basin supporting an estimated five steelhead populations. The Yakima River system also includes four to five populations.

***Action Area Information***

Columbia River Gorge National Scenic Area is found within Middle Columbia/Hood 4th HUC sub-basin identified for this ESU. This species uses the mainstem of the Columbia River as migration to other 4$^{th}$ HUC subbasins in the Middle Columbia ESU.

### *Upper Columbia River Steelhead (O. mykiss)*

The mainstem of the Columbia River within boundaries of the Columbia River Gorge National Scenic Area is used as a migration corridor by the Upper Columbia River steelhead. The Upper Columbia River steelhead ESU was listed as endangered on August 18, 1997 (62 FR 43937). The Upper Columbia River ESU encompasses Columbia River basin and tributaries upstream from and exclusive of the Yakima River in Washington, to the U.S.-Canadian border.

Recovery planning for Upper Columbia River steelhead is ongoing, and recovery planning status can be reviewed online at: http://research.nwfsc.noaa.gov/trt/trt_columbia.htm

***Action Area Information***

The Columbia River Gorge National Scenic Area includes the mainstem of the Columbia River, which provides migratory habitat to Upper Columbia River steelhead.

### *Snake River spring/summer chinook salmon (O. tshawytscha)*

The Snake River spring/summer chinook salmon ESU uses the mainstem of the Columbia River as migration in order to reach Snake River. The species was listed as threatened on April 22, 1992 (57 FR 14653), includes all natural-origin populations in the Tucannon, Grande Ronde, Imnaha, and Salmon Rivers. Some or all of the fish returning to several of the hatchery programs are also listed including those returning to the Tucannon River, Imnaha, and Grande Ronde hatcheries, and to the Sawtooth, Pahsimeroi, and McCall hatcheries on the Salmon River. This ESU includes production areas that are characterized by spring-timed returns, summer-timed returns, and combinations from the two adult timing patterns. Runs classified as spring chinook are counted at Bonneville Dam beginning in early March and ending the first week of June; runs classified as summer chinook return to the Columbia River from June through August. Returning fish hold in deep mainstem and tributary pools until late summer, when they emigrate up into tributary areas and spawn. In general, spring type chinook tend to spawn in higher elevation reaches of major Snake River tributaries in mid- through late August, and summer run Snake River chinook spawn approximately 1 month later than spring-run fish.

Recovery planning for Snake River spring/summer chinook is ongoing, and recovery planning status can be reviewed online at: http://research.nwfsc.noaa.gov/trt/trt_columbia.htm

***Action Area Information***

The Columbia River Gorge National Scenic Area includes the mainstem of the Columbia River, which provides migratory habitat to Snake River spring/summer chinook salmon.

### *Snake River fall Chinook (O. tshawytscha)*

The Snake River fall Chinook use the mainstem of the Columbia River as migration in order to reach Snake River. The Snake River fall chinook salmon ESU, listed as threatened on April 22, 1992, (57 FR 14653), includes all natural populations of fall chinook salmon in the mainstem Snake River below Hell's Canyon Dam, and the Tucannon, Palouse (to Palouse Falls), Grande Ronde, Imnaha, Salmon, and Clearwater Rivers. Fall chinook from the Lyons Ferry Hatchery are included in the ESU but are not listed.

Recovery planning for Snake River fall chinook is ongoing, and recovery planning status can be reviewed online at: http://research.nwfsc.noaa.gov/trt/trt_columbia.htm

***Action Area Information***

The Columbia River Gorge National Scenic Area includes the mainstem of the Columbia River, which provides migratory habitat to Snake River fall Chinook.

### *Upper Columbia River Spring-Run Chinook (O. tshawytscha)*

The Upper Columbia River Spring-Run Chinook use the mainstem of the Columbia River as migration in order to reach the upper region of the Columbia River. The Upper Columbia River chinook salmon ESU, listed as endangered on March 24, 1999 (64 FR 14308), includes all natural populations of spring-run chinook salmon spawning in all river reaches accessible to chinook salmon in Columbia River tributaries upstream of the Rock Island Dam and downstream of Chief Joseph Dam in Washington, excluding the Okanogan River

Recovery planning for Upper Columbia River chinook is ongoing, and recovery planning status can be reviewed online at: http://research.nwfsc.noaa.gov/trt/trt_columbia.htm

***Action Area Information***

The Columbia River Gorge National Scenic Area includes the mainstem of the Columbia River, which provides migratory habitat to Upper Columbia River Spring-Run Chinook.

### *Lower Columbia River Chinook (O. tshawytscha)*

The Columbia River Gorge National Scenic Area, and Gifford Pinchot National Forest are located within the Lower Columbia River Chinook ESU in Oregon and Washington. The Lower Columbia River chinook salmon ESU, listed as threatened on March 24, 1999 (64 FR 14308), includes all natural populations of chinook salmon spawning below impassable natural barriers from the mouth of the Columbia River to the crest of the Cascade Range, just east of the Hood River in Oregon and the White Salmon River in Washington. This ESU excludes populations above Willamette Falls and in the Clackamas River and Hood River.

Recovery planning for Lower Columbia River chinook is ongoing, and recovery planning status can be reviewed online at: http://research.nwfsc.noaa.gov/trt/trt_wlc.htm

***Action Area Information***

Lower Cowlitz sub-basin, approximately 15 percent of which is within Gifford Pinchot NF, has 1 major stream, NF Toutle River, which contains more than five miles of anadromous fish habitat inside the National Forest land. NF Toutle River holds roughly 12 miles of anadromous fish habitat inside the NF land.

Lower Columbia/Clatskanie sub-basin, less than 5 percent of which is within Gifford Pinchot NF, does not have any major streams that contain more than five miles of anadromous fish habitat inside the National Forest land.

Lower Columbia/Sandy sub-basin, approximately 10 percent of which is within Columbia River Gorge National Scenic Area, and another few percent of which is within Gifford Pinchot NF. The majority of streams that contain more than five miles of anadromous fish habitat are on the Oregon side outside the project area.

Middle Columbia/Hood sub-basin (with only 45 percent as part of the ESU area, approximately 35 percent of which is within Gifford Pinchot NF, and about 5 percent of which is within Columbia River Gorge National Scenic Area) has 4 major streams that contain more than five miles of anadromous fish habitat inside National Forest land. The major streams are the mainstem of the Columbia River, Wind River, Trout Cr., and Panther Cr. Wind River contains at least 19 miles of habitat on Gifford Pinchot NF land.

Lewis sub-basin (with only 30 percent as part of the ESU area, approximately 50 percent of which is within Gifford Pinchot NF) has 1 major stream, EF Lewis River, which contains more than five miles of anadromous fish habitat inside the National Forest land. EF Lewis River holds roughly 8 miles of anadromous fish habitat inside the NF land.

The LCR chinook salmon ESU has been subject to intensive hatchery influence. Hatchery programs to enhance chinook salmon fisheries in the lower Columbia River began in the 1870s, releasing billions of fish over time. That equals the total hatchery releases for all other chinook ESUs combined (Myers et al. 1998). Although most of the stocks have come from inside the ESU, more than 200 million fish from outside the ESU have been released since 1930 (Myers et al. 1998). In addition, the exchange of eggs between hatcheries in this ESU has led to the extensive genetic homogenization of hatchery stocks (Utter et al. 1989).

### *Lower Columbia River Coho (O. kisutch)*

Originally part of a larger Lower Columbia River/Southwest Washington ESU, Lower Columbia River coho were identified as a separate ESU and listed as threatened on June 28, 2005. The ESU includes all naturally spawned populations of coho salmon in the Columbia River and its tributaries in Washington and Oregon, from the mouth of the Columbia up to and including the Big White Salmon and Hood Rivers, and includes the Willametter River to Willametter Falls, Oregon, as well as twenty-five propagation programs that were determined not to be divergent relative to the local natural population(s) within the ESU.

***Action Area Information***

Lower Cowlitz sub-basin, approximately 15 percent of which is within Gifford Pinchot NF, has 1 major stream, NF Toutler River, which contains more than five miles of anadromous fish habitat inside the National Forest land. NF Toutle River holds roughly 12 miles of anadromous fish habitat inside the NF land.

Lower Columbia/Clatskanie sub-basin, less than 5 percent of which is within Gifford Pinchot NF, does not have any major streams that contain more than five miles of anadromous fish habitat inside the National Forest land.

Lower Columbia/Sandy sub-basin, approximately 10 percent of which is within Columbia River Gorge National Scenic Area, and another few percent of which is within Gifford Pinchot NF. The majority of streams with habitat are outside the project area on the Oregon side.

Middle Columbia/Hood sub-basin (with only 45 percent as part of the ESU area, approximately 35 percent of which is within Gifford Pinchot NF, and another 5 percent of which is within Columbia River Gorge National Scenic Area) has the majority of streams on the Oregon side.

Lewis sub-basin (with only 30 percent as part of the ESU area, approximately 50 percent of which is within Gifford Pinchot NF) has 1 major stream, EF Lewis River, which contains more than five miles of anadromous fish habitat inside the National Forest land. EF Lewis River holds roughly 8 miles of anadromous fish habitat inside the NF land.

### *Columbia River Chum (O. keta)*

The Columbia River Gorge National Scenic Area and Gifford Pinchot National Forest are located within the Columbia River Chum ESU in Oregon and Washington. The Columbia River Chum ESU, listed as threatened on March 25, 1999 (64 FR 14508), includes all natural-origin populations of chum in lower Columbia River tributaries located downstream from Bonneville Dam on the Columbia River and Merwin Dam on the Lewis River. Historically, chum salmon were abundant in the lower reaches of the Columbia River and extended to the Umatilla/Walla Walla River, but currently are primarily limited to the tributaries downstream of Bonneville Dam.

Recovery planning for Columbia River chum salmon is ongoing, and recovery planning status can be reviewed online at: http://research.nwfsc.noaa.gov/trt/trt_wlc.htm

#### ***Action Area Information***

The majority of known natural chum salmon production (less than 1,000 annually) occurs in Grays River, Hamilton Creek (including Hamilton Springs), Duncan Creek, Ives Island complex, St. Cloud area of the Columbia River, and Hardy Creek. Annually, a small number of chum are counted passing Bonneville Dam as well; nothing is known about the behavior of these fish. There is incidental spawning of chum in the lower reaches of White Salmon, and small numbers may be using the mouth of tributaries above Bonneville dam.

Middle Columbia/Hood sub-basin (with only 20 percent as part of the ESU area, approximately 15 percent of which is within Columbia River Gorge National Scenic Area). Streams on CRGNSA, Washington side, include Hamilton Creek (including Hamilton Springs), Duncan Creek, Ives Island complex, St. Cloud area of the Columbia River, and Hardy Creek

Lower Columbia/Sandy sub-basin (with only 55 percent as part of the ESU area, approximately 10 percent of which is within Columbia River Gorge National Scenic Area, and another few percent of which is within Gifford Pinchot NF) does not have any major streams that contain more than five miles of anadromous fish habitat inside the National Forest land.

### *Snake River Sockeye (O. nerka)*

No National Forest in Region Six is contained within the Snake River Sockeye ESU, which is located in Southwest Idaho. However, the Snake River Sockeye does use Columbia River and Snake River within Oregon and Washington as a migration corridor to get to and leave from their ESU area in Idaho. The Snake River sockeye salmon ESU was listed as endangered on November 20, 1991, (56 FR 58619) and includes populations of sockeye salmon from the Snake River basin, Idaho (extant populations occur only in the Salmon River subbasin). Under NOAA Fisheries' interim policy on artificial propagation (58 FR 17573), the progeny of fish from a listed population that are propagated artificially are considered part of the listed species and are protected under ESA. Thus, although not specifically designated in the 1991 listing, Snake River sockeye salmon produced in the captive broodstock program are included in the listed ESU.

Recovery planning for Snake River sockeye is ongoing, and recovery planning status can be reviewed online at: http://research.nwfsc.noaa.gov/trt/trt_columbia.htm

***Action Area Information***

The Columbia River Gorge National Scenic Area includes the mainstem of the Columbia River, which provides migratory habitat to Upper Columbia River Spring-Run Chinook.

## Bull Trout

Information presented in this section is taken from the R6 2005 FEIS Fish BA and the January 2005 Biological Opinion and Letter of Concurrence for USDA Forest Service programmatic activities affecting Columbia River and Coastal Puget Sound bull trout so as not to recreate information.

**Status and Life History**

The FWS BOs for the FS LRMPs as amended by the NWFP and the FS LRMPs as amended by the PACFISH and INFISH provided a general description of the status of bull trout in the NWFP (USDI, 1998 and USDI, 2004). The draft Bull Trout Recovery Plan provides information on the distribution and abundance of bull trout in all Distinct Population Segments (DPS) in the conterminous United States, and offers the most recent status information for the species by recovery unit (USDI, 2002). Of the 23 recovery units for bull trout, 16 extend into NF lands. Chapters 2, 5 to 14, and 20 to 24 of the Draft Recovery Plans describe the current distribution and abundance of the recovery units considered in this BA. Reasons for decline for each recovery unit are identified within draft Bull Trout Recovery Plans.

Detailed accounts of life history, taxonomy and behavior can be found in the final rule listing the Columbia River and Klamath River populations of bull trout as threatened (U.S. Fish and Wildlife Service, 1998b), and in the determination of threatened status for bull trout in the conterminous United States (U.S. Fish and Wildlife Service, 1999a) for Coastal-Puget Sound, and the *Status of Oregon's bull trout; distribution, life history, limiting factors, management considerations, and status* (Buchanan et al., 1997).

The FWS has draft recovery plans for the Columbia River and Klamath River DPSs (U.S. Fish and Wildlife Service, 2002a) and the Coastal-Puget Sound DPS (U.S. Fish and Wildlife Service, 2004c). Through these efforts, the FWS has converted bull trout subpopulations into "core areas." Core areas represent a combination of habitat that provides all elements for the long-term security of bull trout and the presence of bull trout inhabiting core habitat. Thus, core areas form the basis on which to gauge recovery within a recovery unit. Thus, a core area, by definition, is considered habitat occupied by bull trout and serves as a biologically discrete unit upon which to base bull trout recovery. Within core areas, groups of bull trout or local populations which spawn in various tributaries are generally characterized by relatively small amounts of genetic diversity within a tributary but high levels of genetic divergence between tributaries (Chapter 1, recovery plan). Individual local populations may come and go or expand and contract over time, but the focus of the draft recovery plan is maintaining all existing core areas.

**Listing History**

Only the Coastal-Puget Sound population is included witihin the action area covered in this BA. The Coastal-Puget Sound population was listed as threatened on November 1, 1999 (U.S. Fish and Wildlife Service, 1999a).

## Distribution

The historical range of the bull trout includes major river basins in the Pacific Northwest at about 41 to 60 degrees North latitude, from the southern limits in the McCloud River in northern California and the Jarbidge River in Nevada to the headwaters of the Yukon River in the Northwest Territories, Canada (Cavender, 1978; Bond, 1992). To the west, the bull trout's range includes Puget Sound, various coastal rivers of British Columbia, Canada, and southeast Alaska (Bond, 1992). Bull trout occur in portions of the Columbia River and tributaries within the basin, including its headwaters in Montana and Canada. Bull trout also occur in the Klamath River basin of south-central Oregon. East of the Continental Divide, bull trout are found in the headwaters of the Saskatchewan River in Alberta and Montana and in the MacKenzie River system in Alberta and British Columbia, Canada, (Cavender, 1978; Berwin et.al., 1997).

## Life History and Habitat Description

### *Biology*

Bull trout exhibit both resident and migratory life-history strategies (Rieman and McIntyre 1993). Resident bull trout complete their entire life cycle in the tributary (or nearby) streams in which they spawn and rear. Migratory bull trout spawn in tributary streams where juvenile fish rear one to four years before migrating to either a lake (adfluvial form), river (fluvial form) (Fraley and Shepard,1989, Goetz, 1989), or in certain coastal areas, to saltwater (anadromous) (Cavender, 1978; McPhail and Baxter, 1996; WDFW et al., 1997). Resident and migratory life-history forms may be found together but it is unknown if they represent a single population or separate populations (Rieman and McIntyre, 1993). Either form may give rise to offspring exhibiting either resident or migratory behavior (Rieman and McIntyre 1993). The multiple life-history strategies found in bull trout populations represent important diversity (both spatial and genetic) that help protect these populations from environmental stochasticity.

The size and age of bull trout at maturity depends upon the life-history strategy and habitat limitations. Resident fish tend to be smaller than migratory fish at maturity and produce fewer eggs (Fraley and Shepard, 1989; Goetz, 1989). Resident adults usually range from 150 to 300 millimeters (6 to 12 inches) total length (TL). Migratory adults however, having lived for several years in larger rivers or lakes and feeding on other fish, grow to a much larger size and commonly reach 600 millimeters (24 inches) TL or more (Pratt 1985, Goetz, 1989). The largest verified bull trout was a 14.6-kilogram (32-pound) adfluvial fish caught in Lake Pend Oreille, Idaho, in 1949 (Simpson and Wallace, 1982). Size differs little between life-history forms during their first years of life in headwater streams, but diverges as migratory fish move into larger and more productive waters (Rieman and McIntyre, 1993).

Ratliff (1992) reported that bull trout under 100 mm (4 inches) in length were generally only found in the vicinity of spawning areas, and that fish over 100 mm were found downstream in larger channels and reservoirs in the Metolius River basin. Juvenile migrants in the Umatilla River were primarily 100-200 mm long (4 to 8 inches) in the spring and 200-300 mm long (8 to 12 inches) in October (Buchanan et al., 1997). The age at migration for juveniles is variable. Ratliff (1992) reported that most juveniles reached a size to migrate downstream at age 2, with some at ages 1 and 3 years. Pratt (1992) had similar findings for age-at-migration of juvenile bull trout from tributaries of the Flathead River. The seasonal timing of juvenile downstream migration appears similarly variable.

Bull trout normally reach sexual maturity in 4 to 7 years and may live longer than 12 years. The species is iteroparous (i.e., can spawn multiple times in their lifetime) and adults may spawn each year or in alternate years (Batt 1996). Repeat-spawning frequency and post-spawning mortality are not well documented (Leathe and Graham 1982; Fraley and Shepard 1989; Pratt 1992; Rieman and McIntyre 1996) but post-spawn survival rates are believed to be high.

Bull trout typically spawn from late August to November during periods of decreasing water temperatures (below 9 degrees Celsius/48 degrees Fahrenheit). Redds are often constructed in stream reaches fed by springs or near other sources of cold groundwater (Goetz, 1989; Pratt 1992; Rieman and McIntyre, 1996). Migratory bull trout frequently begin spawning migrations as early as April and have been known to move upstream as far as 250 kilometers (km) (155 miles) to spawning grounds in Montana (Fraley and Shepard 1989; Swanberg 1997). In Idaho, bull trout moved 109 km (67.5 miles) from Arrowrock Reservoir to spawning areas in the headwaters of the Boise River (Flatter, 1998). In the Blackfoot River, Montana, bull trout began spring spawning migrations in response to increasing temperatures (Swanberg, 1997). Depending on water temperature, egg incubation is normally 100 to 145 days (Pratt, 1992), and after hatching, juveniles remain in the substrate. Time from egg deposition to emergence of fry may surpass 220 days. Fry normally emerge from early April through May, depending on water temperatures and increasing stream flows (Pratt, 1992; Ratliff and Howell, 1992).

Bull trout are opportunistic feeders, with food habits primarily a function of size and life-history strategy. Resident and juvenile migratory bull trout prey on terrestrial and aquatic insects, macro-zooplankton, and small fish (Boag, 1987; Goetz, 1989; Donald and Alger 1993). Adult migratory bull trout feed on various fish species (Leathe and Graham, 1982; Fraley and Shepard 1989; Brown, 1992; Donald and Alger, 1993). In coastal areas of western Washington, bull trout feed on Pacific herring (*Clupea pallasi*), Pacific sand lance (*Ammodytes hexapterus*), and surf smelt (*Hypomesus pretiosus*) in the ocean (Washington Department of Fish and Wildlife et al., 1997).

### *Habitat affinities*

Bull trout have more specific habitat requirements than most other salmonids (Rieman and McIntyre, 1993). Habitat components that influence the species' distribution and abundance include water temperature, cover, channel form and stability, valley form, spawning and rearing substrate, and availability of migratory corridors (Fraley and Shepard, 1989; Goetz, 1989; Hoelscher and Bjornn 1989; Sedell and Everest 1991; Howell and Buchanan 1992; Pratt 1992; Rieman and McIntyre, 1993, 1995; Rich, 1996; Watson and Hillman, 1997). Watson and Hillman (1997) concluded that watersheds must have specific physical characteristics to provide the habitat requirements necessary for bull trout to successfully spawn and rear and that these specific characteristics are not necessarily present throughout these watersheds. Because bull trout exhibit a patchy distribution, even in pristine habitats (Rieman and McIntyre, 1993), individuals of this species should not be expected to simultaneously occupy all available habitats (Rieman et al., 1997).

Bull trout are found primarily in cold streams, although individual fish are found in larger, warmer river systems throughout the Columbia River basin (Fraley and Shepard. 1989; Rieman and McIntyre. 1993, 1995; Buchanan and Gregory. 1997; Rieman et al.. 1997). Water temperature above 15 degrees Celsius (59 degrees Fahrenheit) is believed to limit bull trout distribution, a limitation that may partially explain the patchy distribution within a watershed (Fraley and Shepard 1989, Rieman and McIntyre, 1995).

Spawning areas are often associated with cold-water springs, groundwater infiltration, and the streams with the coldest summer water temperatures in a given watershed (Pratt, 1992; Rieman and McIntyre, 1993; Rieman et al., 1997; Baxter et al., 1999). Water temperatures during spawning generally range from 5 to 9 degrees Celsius (41 to 48 degrees Fahrenheit) (Goetz, 1989). The requirement for cold water during egg incubation has generally limited the spawning distribution of bull trout to high elevations in areas where the summer climate is warm. Rieman and McIntyre (1995) found in the Boise River Basin that no juvenile bull trout were present in streams below 1613 m (5000 feet). Similarly, in the Sprague River basin of south-central Oregon, Ziller (1992) found in four streams with bull trout that "numbers of bull trout increased and numbers of other trout species decreased as elevation increased. In those streams, bull trout were only found at elevations above 1774 m [5500 feet]."

All life-history stages of bull trout are associated with complex forms of cover, including large woody debris, undercut banks, boulders, and pools (Fraley and Shepard, 1989; Goetz, 1989; Hoelscher and Bjornn 1989; Sedell and Everest, 1991; Pratt, 1992; Thomas, 1992; Rich, 1996; Sexauer and James 1997; Watson and Hillman, 1997). Jakober (1995) observed bull trout overwintering in deep beaver ponds or pools containing large woody debris in the Bitterroot River drainage, Montana, and suggested that, because of the need to avoid anchor ice in order to survive, suitable winter habitat may be more restricted than summer habitat. Maintaining bull trout habitat requires stability of stream channels and of flow (Rieman and McIntyre, 1993). Juvenile and adult bull trout frequently inhabit side channels, stream margins, and pools with suitable cover (Sexauer and James, 1997). These areas are sensitive to activities that directly or indirectly affect stream channel stability and alter natural flow patterns. For example, altered stream flow in the fall may disrupt bull trout during the spawning period, and channel instability may decrease survival of eggs and young juveniles in the gravel from winter through spring (Fraley and Shepard, 1989; Pratt, 1992; Pratt and Huston, 1993).

Preferred bull trout spawning habitat consists of low-gradient stream reaches with loose, clean gravel (Fraley and Shepard, 1989). In the Swan River, Montana, abundance of bull trout redds was positively correlated with the extent of bounded alluvial valley reaches, which are likely areas of groundwater to surface water exchange (Baxter et al., 1999). Survival of bull trout embryos planted in stream areas of groundwater upwelling used by bull trout for spawning were significantly higher than embryos planted in areas of surface-water recharge not used by bull trout for spawning (Baxter and McPhail, 1999). Pratt (1992) indicated that increases in fine sediment reduce egg survival and emergence.

Migratory corridors link seasonal habitats for all bull trout life-history forms. For example, in Montana, migratory bull trout make extensive migrations in the Flathead River system (Fraley and Shepard, 1989), and resident bull trout in tributaries of the Bitterroot River move downstream to overwinter in tributary pools (Jakober 1995). The ability to migrate is important to the persistence of bull trout (Rieman and McIntyre, 1993; M. Gilpin, in litt., 1997; Rieman et al., 1997). Migrations facilitate gene flow among local populations when individuals from different local populations interbreed, or stray, to non-natal streams. Local bull trout populations that are extirpated by catastrophic events may also become re-established by migrants.

## Population Dynamics

Although bull trout are widely distributed over a large geographic area, they exhibit a patchy distribution, even in pristine habitats (Rieman and McIntyre, 1993). Increased habitat fragmentation reduces the amount of available habitat and increases isolation from other populations of the same species (Saunders et al., 1991). Burkey (1989) concluded that when species are isolated by fragmented habitats, low rates of population growth are typical in local populations and their probability of extinction is directly related to the degree of isolation and fragmentation. Without sufficient immigration, growth for local populations may be low and probability of extinction high (Burkey, 1989, 1995).

Metapopulation concepts of conservation biology theory have been suggested relative to the distribution and characteristics of bull trout, although empirical evidence is relatively scant (Rieman and McIntyre 1993; Dunham and Rieman, 1999; Rieman and Dunham, 2000). A metapopulation is an interacting network of local populations with varying frequencies of migration and gene flow among them (Meffe and Carroll, 1994). For inland bull trout, metapopulation theory is likely most applicable at the watershed scale where habitat consists of discrete patches or collections of habitat capable of supporting local populations; local populations are for the most part independent and represent discrete reproductive units; and long-term, low-rate dispersal patterns among component populations influences the persistence of at least some of the local populations (Rieman and Dunham, 2000). Ideally, multiple local populations distributed throughout a watershed provide a mechanism for spreading risk because the simultaneous loss of all local populations is unlikely. However, habitat alteration, primarily through the construction of impoundments, dams, and water diversions has fragmented habitats, eliminated migratory corridors, and in many cases isolated bull trout in the headwaters of tributaries (Rieman et al., 1997, Dunham and Rieman, 1999, Spruell et al., 1999, Rieman and Dunham, 2000). Accordingly, human-induced factors as well as natural factors affecting bull trout distribution have likely limited the expression of the metapopulation concept for bull trout to patches of habitat within the overall distribution of the species (Dunham and Rieman, 1999). However, despite the theoretical fit, the relatively recent and brief time period during which bull trout investigations have taken place does not provide certainty as to whether a metapopulation dynamic is occurring (e.g., a balance between local extirpations and recolonizations) across the range of bull trout or whether the persistence of bull trout in large or closely interconnected habitat patches (Dunham and Rieman, 1999) is simply reflective of a general deterministic trend towards extinction of the species where the larger or interconnected patches are relics of historically wider distribution (Rieman and Dunham, 2000). Recent research (Whiteley et al., 2003) does, however, provide stronger genetic evidence for the presence of a metapopulation process for bull trout, at least in the Boise River basin of Idaho.

In the rules listing bull trout as threatened, the FWS identified subpopulations (*i.e.*, isolated groups of bull trout thought to lack two-way exchange of individuals), for which status, distribution, and threats to bull trout were evaluated. Because habitat fragmentation and barriers have isolated bull trout throughout their current range, a subpopulation was considered a reproductively isolated group of bull trout that spawns within a particular river or area of a river system. Overall, 187 subpopulations were identified in the five distinct population segments, seven in the Klamath River, 141 in the Columbia River, one in the Jarbidge River, 34 in the Coastal-Puget Sound, and four in the St. Mary-Belly River populations. No new subpopulations have been identified and no subpopulations have been lost since listing. More detailed information on the range-wide trend of the bull trout is currently being developed for the 5-year status review and is not yet available.

### Threats

Since listing, no substantial new threats have been identified. Bull trout distribution, abundance, and habitat quality have and continue to decline rangewide. (Bond, 1992; Schill, 1992; Thomas, 1992; Ziller 1992; Rieman and McIntyre, 1993; Newton and Pribyl, 1994; Idaho Department of Fish and Game in litt., 1995; McPhail and Baxter, 1996). These declines result from the combined effects of habitat degradation and fragmentation, the blockage of migratory corridors; poor water quality, angler harvest and poaching, entrainment (process by which aquatic organisms are pulled through a diversion or other device) into diversion channels and dams, and introduced nonnative species. Specific land and water management activities that may depress bull trout populations and degrade habitat include dams and other diversion structures, forest management practices, livestock grazing, agriculture, agricultural diversions, road construction and maintenance, mining, and urban and rural development (Beschta et al., 1987; Chamberlain et al., 1991; Furniss et al., 1991; Meehan, 1991; Nehlsen et al., 1991; Sedell and Everest, 1991; Craig and Wissmar, 1993; Henjum et al. 1994; McIntosh et al., 1994; Wissmar et al., 1994; Montana Bull Trout Scientific Group, 1995a-e; 1996a-f; Light et al., 1996; USDA and USDI 1995, 1996, 1997; Frissell, 1997).

### ***Status of the Columbia River DPS***

The Service recognizes 141 subpopulations of bull trout in the Columbia River DPS within Idaho, Montana, Oregon, and Washington, with additional subpopulations in British Columbia. Of these subpopulations, approximately 79 percent are unlikely to be reestablished if extirpated and 50 percent are at risk of extirpation from naturally occurring events due to their depressed status (USDI 1998). Many of the remaining bull trout occur as isolated subpopulations in headwater tributaries, or in tributaries where the migratory corridors have been lost or restricted. Few bull trout subpopulations are considered "strong" in terms of relative abundance and subpopulation stability. Those few remaining strongholds are generally associated with large areas of contiguous habitats such as portions of the Snake River basin in central Idaho, the upper Flathead Rivers in Montana, and the Blue Mountains in Washington and Oregon. The listing rule characterizes the Columbia River DPS as generally occurring as isolated subpopulations, without a migratory life form to maintain the biological cohesiveness of the subpopulations, and with trends in abundance declining or of unknown status (USDI 1998).

Extensive habitat loss and fragmentation of subpopulations have been documented for bull trout in the Columbia River basin and elsewhere within its range (Rieman and McIntyre 1993). Reductions in the amount of riparian vegetation and road construction in the Columbia River basin due to timber harvest, grazing, and agricultural practices have contributed to habitat degradation through elevated stream temperatures, increased sedimentation, and channel embeddedness. Mining activities have compromised habitat conditions by discharging waste materials into streams and diverting and altering stream channels. Residential development has threatened water quality by introducing domestic sewage and altering riparian conditions. Dams of all sizes (i.e., mainstem hydropower and tributary irrigation diversions) have severely limited migration of bull trout in the Columbia River basin. Competition from non-native trout is also considered a threat to bull trout (USDI 1998).

Generally, where status is known and population data exist, bull trout populations in the Columbia River DPS are declining (Thomas 1992; Pratt and Huston 1993; Schill 1992). Bull trout in the Columbia River basin occupy about 45 percent of their estimated historic range (Quigley and Arbelbide 1997). Quigley and Arbelbide (1997) considered bull trout populations strong in only 13 percent of the occupied range in the interior Columbia River basin. Rieman et al. (1997) estimated that populations were strong in 6 to 24 percent of the subwatersheds in the entire Columbia River basin.

***Status of the Coastal-Puget Sound DPS***

The Service has identified 34[7] subpopulations of native char (bull trout and/or Dolly Varden) within the Coastal-Puget Sound DPS. These subpopulations were grouped into five analysis areas based on their geographic location: Coastal, Strait of Juan de Fuca, Hood Canal, Puget Sound, and Transboundary. These groupings were made in order to identify trends that may be specific to certain geographic areas. In subpopulations where it is not known if the native char that occur there are bull trout, Dolly Varden or both, they are addressed together as Anative char@ in this discussion. This does not imply that both exist within a subpopulation when the words Anative char@ are used, but merely that the subpopulation of char has not been positively identified as bull trout and/or Dolly Varden.

Genetic analysis has been conducted on 9 of the 34 native char subpopulations. Samples from five of the nine subpopulations were determined to contain only bull trout (Green River, Queets River, Upper Elwha River, Cushman Reservoir and Lower Skagit River). Two were determined to contain only Dolly Varden (Canyon Creek and Upper Sol Duc River). The Upper Quinault River subpopulation contained both bull trout and Dolly Varden. No samples had evidence of hybridization.

Within the Coastal-Puget Sound DPS, 12 of the 34 native char subpopulations are known to contain bull trout based on either genetic or morphometric measurement data. In 7 of these 12 subpopulations, Dolly Varden are also believed to be present. In 3 out of the remaining 22 subpopulations, only Dolly Varden is currently known to be present. It should be noted that in most cases, identification was based on a limited number of samples, so it is possible that bull trout may also occur in the three subpopulations that, to date, have only yielded Dolly Varden. The Service believes that the current identification trend of subpopulations within the Coastal-Puget Sound population segment indicates the high likelihood of bull trout being present in the majority of remaining subpopulations.

Within the Coastal-Puget Sound distinct population segment, 4 of the 34 delineated native char subpopulations are rated as Ahealthy@ by WDFW, and the remaining 31 are of Aunknown@ status. Native char subpopulations rated as Ahealthy@ by WDFW are: 1) Queets River, 2) Upper Dungeness River, 3) Cushman Reservoir on the Skokomish River, and, 4) the Lower Skagit River. Currently, all but the Upper Dungeness River subpopulation have been determined to consist of bull trout. The Service believes that the Ahealthy@ status designation for the Queets River, Cushman Reservoir, and Upper Dungeness River subpopulations is not appropriate.

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[7] In the proposed rule to list the bull trout (FR 63 31693), the Service delineated 35 subpopulations. Upon further review, they revised the total number to 34, when they concluded that the Puyallup River Basin had only two subpopulations as opposed to three. This revision was made in order to be consistent with the defined subpopulation criteria.

Because of information indicating recent declines in the Cushman Reservoir subpopulation (WDFW 1998) and the lack of recent information for the Queets River subpopulation (general decline indicated by fish/day seining data between 1977 and 1991, and no trend information for 1991 to 1997) (WDFW 1998), an Aunknown@ rating better describes their status. The Upper Dungeness River subpopulation status is Atentatively considered healthy@ by WDFW based on a single distributional and abundance survey conducted in 1996 (WDFW 1998).

*Changes in status of the Coastal-Puget Sound DPS and the Lower Columbia River Recovery Unit of the Columbia DPS*

The overall status of both the Coastal-Puget Sound DPS and the Lower Columbia River Recovery Unit of the Columbia River DPS has not improved since their respective listings on June 10, 1998, and November 1, 1999. The status of the Coastal-Puget Sound DPS and the Lower Columbia River Recovery Unit in the Columbia River DPS have been affected by a number of actions addressed through BOs prepared under section 7 of the Act, and by several sections 10(a)(1)(B) permits issued for Habitat Conservation Plans (HCP). Appendix D summarizes the BOs addressing bull trout that have been issued for federal actions (excluding those issued for section 10 (a)(1)(B) permits) within the Coastal-Puget Sound DPS and the Lower Columbia River Recovery Unit of the Columbia River DPS since November 1999. Most of these actions resulted in a degradation of the environmental baseline; all permitted the incidental take of bull trout.

A number of HCPs have been completed within the range of the spotted owl in California, Oregon and Washington. Of these, three HCPs have been amended to include bull trout. The three amendments were for the Washington State Department of Natural Resources (WDNR), Plum Creek Timber Company, and the West Fork Timber HCPs.

The WDNRs HCP amendment (USFWS 1998a) to include bull trout allowed for incidental take of bull trout associated with habitat degradation/loss due to 29 miles of road construction and maintenance per year, and 158 acres of selective and thinning harvest per year. This amendment added only the Coastal-Puget Sound DPS and the lower Columbia River downstream from Greenleaf and Hamilton Creeks in the Columbia River DPS.

The Plum Creek Timber Company's HCP amendment (USDI 1998b) added the Columbia River DPS of bull trout to their HCP. The amendment allows the take of bull trout associated with habitat degradation/loss due to 150 acres of selective and thinning/restoration-oriented silvicultural harvest per year; 2 miles of stream restoration per year; and 20.2 miles of road construction, maintenance, and removal per year. The term of the Plum Creek HCP and permit is 50 to 100 years.

The West Fork Timber (previously Murray Pacific Corporation) amendment (USFWS 2002b) added the Coastal-Puget Sound bull trout DPS to their HCP. The HCP ensures that sufficient amounts of habitat types are maintained or enhanced for bull trout on West Fork Timber's land. The term of the West Fork Timber HCP and permit is 100 years.
Three recent HCPs have been completed in the Coastal-Puget Sound Analysis area that include bull trout. The City of Seattle's Cedar River Watershed HCP includes: Chester Morse Reservoir operations and activities associated with restoration planting of about 1,400 acres; restoration thinning of about 11,000 acres; ecological thinning of about 2,000 acres; instream habitat

restoration projects; removal of approximately 240 miles of road over the first 20 years; maintenance of about 520 miles of road per year at the start of the HCP, diminishing as roads are removed over time to about 380 miles per year at year 20; and improvement of about 4 to 10 miles of road per year. The term of the City of Seattle HCP and permit is 50 years.

The Simpson Timber HCP encompasses 261,575 acres, with approximately 354 miles of fish bearing stream habitat in the Chehalis and Skokomish River drainages in western Washington. Bull trout currently utilize lotic waters in the South Fork Skokomish River watershed, but they also may also be found in low numbers within the Wynoochee and Satsop River watersheds (Chehalis River basin). The Service authorized bull trout take as a result of timber harvest and experimental thinning associated with stream habitats on 2,987 acres over the 50 year permit term. In addition, the Service authorized take for bull trout associated with habitat adjacent to 250 acres of new road construction, and with habitat adjacent to potential remediation of 2,001 miles of system roads (during the first 15 years of the proposed permit term, 100 percent of all roads needing remediation would have such work completed). By year 15 of the HCP, effects to bull trout habitat resulting from road remediation should be eliminated. The term of the Simpson Timber HCP and permit is 50 years.

The Tacoma Public Utilities Green River HCP addresses effects to listed species from the management of 15,000 acres of forest in the upper Green River watershed, including approximately 110 stream miles, and Tacoma's municipal water withdrawal from Green River at river mile 61.0. Distribution of bull trout in the upper watershed, above Howard Hanson Dam, has not been documented and only a few individuals have been found in the lower Green River and the Duwamish Waterway (King County 2000; Taylor Associates 2001). The Service permitted the incidental take of bull trout resulting from water withdrawal activities affecting the middle and lower Green River, even-aged harvest of 3,285 acres, uneven-aged harvest of 2,000 acres, and the construction, maintenance, and decommissioning of 113 miles of road. The term of the Tacoma HCP and permit is 50 years.

*Conservation Needs of the Coastal-Puget Sound DPSs and the Lower Columbia River Recovery Unit of the Columbia River DPS*

The recovery of bull trout in the Coastal-Puget Sound DPS and the Lower Columbia River Recovery Unit of the Columbia River DPS will depend on the reduction of the adverse effects that result from dams, timber harvest, agriculture practices, road building, urbanization, fisheries management, and by remedying legacy effects from past activities. The general conservation needs of bull trout include (USFWS 2002a; USFWS 2004c):

- Providing/maintaining stream passage and removing Aman-made@ impassable barriers to allow for recolonization of previously occupied habitat and for the promotion of genetic exchange.

- Screening water control structures and diversions in order to prevent entrapment and injury.

- Implementing land use (i.e. agricultural, forestry, industrial) practices that will minimize chemical and nutrient contaminated run-off and loss of riparian vegetation in order to improve water quality and quantity in streams.

- Improving approaches to urbanization and road building, such as requiring setbacks from stream banks and marine shorelines, and adequately treating stormwater run-off in order to minimize impacts to foraging and migratory habitats.

- Reducing associated incidental mortality of bull trout from commercial, recreational, and tribal salmon and steelhead harvest.

- Restoring suitable habitat for all life history forms of bull trout in areas degraded by past human activities.

***Action Area Information***

For the purposes of this analysis the action area encompasses all major river basins and their associated tributary watersheds located within the administrative boundaries of the GPNF/CRGNSA, including downstream reaches of streams that flow out of the GPNF/CRGNSA. The following discussion will focus on the status and distribution of bull trout in the action area. Much more detailed discussions concerning the status and limiting factors of bull trout in these areas are contained in the draft recovery plans (USFWS 2002a; USFWS 2004c) which are hereby incorporated by reference.

Status of the Columbia River Bull Trout DPS in the Action Area

*Cowlitz River*

The Cowlitz River is a major tributary to the lower Columbia River that drains approximately 2,480 square miles over a distance of 151 miles. Major tributaries to the Cowlitz River within the boundaries of the GPNF include the Toutle, Tilton, Clearfork, and Cispus Rivers. The GPNF encompasses approximately 608,616 acres of the Cowlitz River basin (60 percent), primarily in the upper basin (USFS 2003). Watershed analysis indicates all of the subbasins within Cowlitz system are "functioning at risk," with the exception of the Lower Cispus River, which is "functioning at unacceptable risk" due to high water temperatures in the watershed (USFS 2003). Upstream passage for migratory fish to the Cowlitz basin is blocked at the Barrier Dam at RM 49.5, located below Mayfield Dam (USFS 2003).

There are no known populations of bull trout in the Cowlitz River basin. Despite many fish surveys in the tributaries of the upper Cowlitz basin completed by the GPNF and WDFW (including extensive fish surveys in 1938-1942), no verified bull trout have ever been documented in the upper Cowlitz basin (USFS 2001a; Hiss et al. 2000; McIntosh et al. 1995). No migratory bull trout have been reported at the Barrier Dam fish trap or at fishtraps at the Mossyrock or Mayfield dams (WSCC 2000). Based on this information there appears to be a low likelihood of bull trout presence in the Cowlitz River basin.

Historically the Cowlitz basin would have been accessible to migratory bull trout, and there is some anecdotal evidence that bull trout were present in the Cowlitz basin. Dolly Varden are listed as one of the species caught by the Taitnapam (upper Cowlitz) tribe in subsistence fisheries in the upper Cowlitz River (*in* USFS 1997), however the validity of this account is considered questionable (Hiss et al. 2000). The most recent report of a bull trout in the Cowlitz basin is that of a WDFW biologist who reported catching a small bull trout (6 to 8 inches length) near the mouth of Yellowjacket Creek in 1991 (Hiss et al. 2000). No photographs of this fish are known to exist for species verification. Based on these observations and other anecdotal reports, the bull trout recovery planning team has identified the Cowlitz River as a research needs area (USFWS 2002a). Critical habitat for bull trout has not been proposed or designated in the Cowlitz River basin.

*Kalama River*

The GPNF encompasses approximately 12,092 acres located in the headwaters of the 142,043-acre upper Kalama River watershed (9%) (USFS 2003). The Kalama River watershed is primarily owned and managed by private timber companies. During the 1970s almost the entire watershed, including the riparian zones was logged, most of the instream LWD was removed, and an extensive network of 1,292 miles of roads was constructed (WSCC 2000b).

There are currently no known bull trout populations in the Kalama River watershed. Historically, the lower Kalama River would have been accessible to migratory bull trout. A partial barrier falls located at RM 10 historically blocked most anadromous fish passage, and a barrier falls located at RM 35, blocks all upstream fish passage (WSCC 2000b). A concrete barrier dam and fish ladder constructed at the lower falls traps most salmon and steelhead (*O. mykiss*) returning to the Kalama River (WSCC 2000b). The only documented occurrence of bull trout in the Kalama River is a single bull trout that was captured at this trap in 1997 (Hiss et al. 2000). This fish is believed to be a stray migratory fish that most likely originated from the Lewis River.

Despite many fish surveys in the Kalama River basin conducted by WDFW and GPNF including electrofishing, fyke net sets, snorkel surveys, and a downstream migrant trap, no verified bull trout have ever been documented in the Kalama River with the exception of the single fish described above (Hiss et al. 2000). Based on this, there appears to be a very low likelihood of bull trout presence in the upper Kalama River basin above the barrier falls at RM 35, located approximately 4 miles downriver from the GPNF boundary. Because the historical access and use of this system by bull trout is unknown, the bull trout recovery team has identified the Kalama River as a research needs area (USFWS 2002a). Critical habitat for bull trout has not been proposed or designated in the Kalama River basin.

*Lewis River*

The Lewis River is a major tributary to the lower Columbia River that drains approximately 1,050 square miles over a distance of 93 miles. Major tributaries of the Lewis River basin include the North Fork Lewis (mainstem), East Fork Lewis, Upper Lewis (Lewis River above Swift Reservoir) and the Muddy River. The GPNF encompasses approximately 607,832 acres of the Lewis River basin (52%), primarily in the upper basin (USFS 2003). There are approximately 1,009 miles of National Forest roads located in the upper Lewis River basin (i.e. Swift Reservoir drainages). Road density on the GPNF portion of the upper basin is approximately 2.46 road miles per square mile, but is as high as 3.25 miles per square mile in some subwatersheds (e.g. Tillicum Creek) (USFS 2003). Watershed analysis indicates the subbasins within the GPNF are "functioning at risk" due to a history of riparian timber harvest, extensive road construction, and the effects of the 1980 eruption of Mt. St. Helens which have resulted in degraded aquatic habitats and elevated water temperatures in several subwatersheds (USFS 2003). There are three major dams and reservoirs on the North Fork Lewis including Merwin Dam, Yale Dam, and Swift Dam. Upstream passage for all migratory fish to the Lewis River from the Columbia River is blocked by Merwin Dam located at RM 20 (USFS 2003).

Within the Lewis River system, three local bull trout populations exist, as described in the draft Lower Columbia River bull trout recovery plan (USFWS 2002a.). All three populations are considered adfluvial; that is, they spawn in streams but migrate downstream into lakes before returning to their natal streams to spawn. Merwin, Yale, and Swift dams segment the North Fork Lewis River and do not allow upstream fish passage. The occurrence of limited downstream passage by bull trout over these dams or through the turbines is assumed based on observed adult bull trout in Merwin Reservoir and in the Lewis River below Merwin Dam. No known spawning streams are accessible to bull trout in tributaries to Merwin Reservoir. Therefore, isolated bull trout in Lake Merwin are not considered a subpopulation. Bull trout have not been documented in the East Fork Lewis River, and the East Fork has not been identified by the recovery planning team as a research needs area.

In addition to the three reservoirs, bull trout are currently known to occupy approximately 34 miles of rivers and streams in the North Fork Lewis River. Bull trout spawning habitat is limited to approximately 14.7 miles of tributary streams in Pine, Rush and Cougar Creeks (Figure 3). Other streams in the area, including the Lewis River below Swift Reservoir, two Swift Reservoir tributary streams, and the upper Lewis River from Swift Reservoir upstream 12.83 miles to a natural barrier at Lower Falls, provide foraging, migration, and overwintering habitat for bull trout (Figure 3). The upper Lewis River above Lower Falls has been identified by the recovery planning team as a research needs area (USFWS 2002).

The primary limiting factor for Lewis River bull trout production seems to be the availability of adequate spawning and rearing habitat. The only known bull trout spawning area of the Yale subpopulation occurs in Cougar Creek. The fact that only 1¾ miles of spawning and rearing habitat in Cougar Creek exists for the Yale population may explain the chronically low numbers of spawning adults observed each fall since records have been kept. With the exception of possible rearing habitat in Ole and Rain Creeks, there are limited opportunities for expanding or improving habitat for the Yale bull trout population. Bull trout spawning surveys conducted since 1988 in Cougar Creek are so variable it is impossible to establish a trend (range 0 to 40 spawners per year) (PacifiCorp 2003). Recently implemented trap and haul efforts at the upper end of Lake Merwin (below Yale Dam) resulted in the transfer of 68 adult bull trout to the mouth of Cougar Creek in Yale Lake from 1995 to 2003, significantly increasing the Cougar Creek spawning population in some years (PacifiCorp 2003). The status of the Yale Lake subpopulation is considered to be depressed with an unknown trend (USDI 1998).

The Swift Reservoir subpopulation spawns in Pine and Rush Creeks (WDFW 1998). Radiotelemetry studies conducted on bull trout in Swift Reservoir indicate that migrating adults use both Rush and Pine Creeks with no evidence of reproductive isolation. Bull trout distribution is limited to the lower 1.7 miles of Rush Creek due to an impassable falls, and the expansion of bull trout range within other tributaries in the upper Lewis River watershed may be limited by unsuitable temperature regimes (Faler and Bair 1996; Hiss et al. 2004). Recent spawning surveys on Pine and Rush Creeks show a possible increasing trend in population size, but the variability of the data makes this determination difficult (range 101 to 911 estimated spawners per year) (PacifiCorp 2003).

Unlike the Yale Lake subpopulation, bull trout in Swift Reservoir have a larger spawning area and connectivity between spawning grounds (Pine and Rush Creeks), which may buffer this subpopulation against stochastic events. For example, after the 1980 eruption of Mt. St. Helens when habitat throughout the Pine Creek drainage was severely altered (Faler and Bair 1996; Hiss et al. 2004), migratory bull trout from Swift Reservoir subsequently recolonized Pine Creek. The status of the Swift Reservoir subpopulation is considered to be depressed with a stable trend (USDI 1998).

The current known distribution of bull trout in the upper Lewis River is summarized below. Many other streams in this watershed are potentially accessible to bull trout but the species has not been documented in them, either due to the absence of bull trout or to the scarcity of fish surveys targeted on that species. In the summer of 2003, WDFW personnel sighted three adult bull trout in the Muddy River, approximately 1.5 miles upstream from the Lewis River confluence. It is unknown if these fish spawned in the Muddy River watershed, or to what extent bull trout may occur within the Muddy River watershed (Hiss et al. 2004). For the purposes of this consultation, the Service assumes that all fish-bearing waters that are potentially accessible to migratory bull trout above Swift Reservoir to be potential bull trout habitat.

Bull trout critical habitat in the Lewis River basin is designated only along streams located on non-federal lands that have greater than ½ mile of river frontage (USDI 2004a). The critical habitat designation immediately adjacent to the GPNF includes approximately 1.6 miles of stream along the upper Lewis River (USDI 2004a). This area is known to provide essential foraging and migration habitat for bull trout (USDI 2002). Critical habitat has also been designated on 6 miles of streams along Pine Creek (USDI 2004a). Pine Creek was designated because it provides essential spawning and rearing habitat for the Swift Reservoir subpopulation of bull trout (USDI 2002). This area is comprised primarily of lands owned and managed for timber production by the Plum Creek Timber Company. Due to the combined effects of the 1980 Mt. St. Helens eruption and a history of extensive timber harvest, there is essentially no mature riparian forest in the Pine Creek subwatershed. Road densities on private lands in the lower Pine Creek subwatershed average over 6 miles per square mile, some of the highest in the basin (USFWS 2002a).

*Washougal River*

The GPNF encompasses approximately 7,525 acres located in the headwaters of the 137,369-acre upper Washougal River watershed (5%). This area encompasses a few minor headwater tributary streams. None of the streams located on the GPNF in this watershed are mapped as fish-bearing streams, although fish surveys have documented both resident rainbow and coastal cutthroat trout in the headwater tributaries of the Washougal (USFS 2001b). There are no documented occurrences of bull trout in the upper Washougal River despite nearly 50 years of WDFW hatchery operations, spawning escapement surveys, and a popular sport fishery (USFS 2001b; Hiss et al. 2000; WSCC 2001). Based on this information and limited potential habitat, there appears to be a low-likelihood of bull trout presence in the Washougal River watershed. Critical habitat has not been proposed or designated for any portion of the Washougal River basin, and this watershed has not been identified by the bull trout recovery planning team as a research needs area.

*Lower Columbia River and its Minor Tributaries*

A number of minor Columbia River tributaries are located within the CRGNSA or GPNF. Fish-bearing tributaries within or adjacent to National Forest lands below Bonneville Dam include Goodbear, Archer, Duncan, Woodward, and Hamilton Creeks. Minor tributaries above Bonneville Dam include Rock, Dog, Catherine, and Major Creeks. Although the lower reaches of these streams are accessible to anadromous fish (e.g. steelhead and coho (*O. kisutch*)), there are no documented occurrences of bull trout in these streams with the exception of a single bull trout caught at the mouth of Rock Creek within the area inundated by the Bonneville Pool (WSCC 1999; USFS 2000; WDFW 2000; WSCC 2001). Critical habitat has not been proposed for any of these streams, and this area has not been identified by the bull trout recovery planning team as a research needs area. Based on the limited or marginal habitat area available in these streams, it appears that there is a low likelihood that bull trout are present in these streams above their confluences with the Columbia River.

The lower Columbia River provides foraging, migration, and overwintering habitat for tributary populations of bull trout. Fluvial bull trout in tributaries (e.g. Hood River) are known to migrate downstream to the Columbia River as part of their normal life history (USFWS 2002a).

The primary limiting factor affecting bull trout in the Columbia River are the migratory barriers created by dams. Lack of adequate fish passage facilities has fragmented bull trout populations and limited migration in the lower Columbia River. The operation of Bonneville Dam and the potential impacts to bull trout in the Lower Columbia River is considered a research need (USFWS 2002a). The Columbia River was not included in the final critical habitat designation for bull trout.

*Wind River*

The Wind River is a major tributary to the Bonneville Reservoir on the lower Columbia River. The GPNF encompasses approximately 127,573 acres of the Wind River basin (89%). Watershed analysis indicates the Wind River watershed is "functioning at risk" due to the presence of Hemlock Dam, an extensive road network and past riparian timber harvest, and high water temperatures in the watershed (USFS 2003).

There are no known populations of bull trout in the Wind River basin. Despite many fish surveys in the Wind River basin (including several years of smolt trapping and extensive bull trout surveys in 2000), no verified bull trout have ever been documented in the Wind River above Shipherd Falls located at RM 2.0 (WDFW 2000; Hiss et al. 2000; USFS 2001c). Individual bull trout have been observed in the lower river below Shipherd Falls. These fish are most likely adfluvial migrants that originated from Hood River and migrated into the Bonneville Reservoir to access foraging, migration, and overwintering habitat. Based on this information there appears to be a very low likelihood of bull trout presence in the Wind River basin above Shipherd Falls. Critical habitat has not been proposed or designated for bull trout in the Wind River.

*Little White Salmon River*

The Little White Salmon River is a tributary to the Bonneville Dam Reservoir on the lower Columbia River. The GPNF encompasses approximately 67,955 acres of the 86,809-acre Little White Salmon River watershed (78%). Upstream migration of all migratory fish is blocked by a barrier dam located near the mouth of the river at the Little White Salmon National Fish Hatchery (USFS 2003). Extensive fish surveys conducted throughout the watershed by WDFW, USGS, and GPNF have not detected bull trout in the Little White Salmon River above Drano Lake, located at the mouth of the river (Hiss et al. 2000; WDFW 2000; USFS 2003). To date, there are at least one if not 2 documented bull trout that were tagged in the Hood River and re-captured in Drano Lake. Based on this information, it appears that there is a likelihood of bull trout presence in the Little White Salmon watershed above Drano Lake. Bull trout present in Drano Lake are most likely adfluvial migrants that originated from Hood River and migrated into the Bonneville Reservoir to access foraging, migration, and overwintering habitat (USFWS 2002a). Critical habitat for bull trout has not been proposed or designated in the Little White Salmon River.

*White Salmon River*

The GPNF encompasses approximately 118,543 acres located primarily in the headwaters of the 250,998-acre White Salmon River watershed (47%). This area encompasses several major tributaries including the upper White Salmon River and Trout Lake Creek watersheds. There are no anadromous fish in the upper White Salmon River basin. Condit Dam, located at RM 3.3, has blocked all upstream fish passage since 1913. Watershed analysis indicates the upper White Salmon River watershed is "functioning at risk" due to the presence of an extensive road network, past riparian timber harvest, and high water temperatures in the watershed (USFS 2003).

Currently there are no known populations of bull trout in upper White Salmon River watershed, nor were any known historically. In the lower White Salmon River (approximately 23 miles downstream of the forest boundary) two (1986-1989) sightings of bull trout were reported above Condit Dam at Northwestern Lake, both by WDFW biologists (WDFW 1998). Historic records (1943) indicate bull trout were present above Condit Dam in Rattlesnake Creek (Hiss et al. 2000), however, present habitat conditions in Rattlesnake Creek are believed to be unsuitable for bull trout (WDFW 2000). These occurrences suggest that a remnant population of bull trout may exist above Condit Dam. An impassable falls is present at river mile 16 (13 miles upstream from the Condit Dam) on the White Salmon River. If bull trout populations do currently exist above Condit Dam, they would be limited to the White Salmon River mainstem, or tributary streams between the dam and the falls, or isolated in headwater tributaries in the upper basin.

Despite many fish surveys in the tributaries of the upper White Salmon basin (including extensive bull trout surveys in 2000), no bull trout have ever been documented in the upper White Salmon River basin (Hiss et al. 2000; WDFW 2000; USFS 2001a). Based on this information, it appears that there is a very low likelihood of a bull trout presence in the upper White Salmon River above the barrier falls at RM 16. At least two adult bull trout have been documented in the lower White Salmon River below Condit Dam in recent years (WDFW 1998). These fish are believed to be migratory bull trout originating from Hood River that are utilizing the lower White Salmon River as foraging, migration, and overwintering habitat (WDFW 1998).

Although there is only a limited amount of National Forest along the lower White Salmon River, the 7.7 mile section from Northwestern Lake upstream to BZ Corner is designated as a Wild and Scenic River, managed under the jurisdiction of the CRGNSA. The lower White Salmon River from the confluence with the Columbia River upstream to the barrier falls at RM 16 has been designated as critical habitat for bull trout (USFWS 2004a). Despite recent snorkel surveys on the lower White Salmon River and other fish sampling efforts in Northwestern Lake, there is no evidence to suggest that a bull trout population currently exists in this area. This area is considered core habitat for bull trout recovery (USFWS 2002a). Condit Dam is scheduled to be breached in 2006 -2007, with the ultimate goal of restoring fish passage and natural fluvial processes to the White Salmon River (USDI 2002).

*Klickitat River*

The Klickitat River is the second longest free-flowing river in Washington. The mainstem is nearly 96 miles long, from the Goat Rocks Wilderness Area to the Columbia River. The river has a drainage area of over 1,300 square miles, primarily within the boundaries of the Yakama Indian Reservation. Although there is only a limited amount of National Forest (500 acres) along the Klickitat, the lower 10 miles of the Klickitat River from the confluence with the Columbia River upstream to the confluence of Wheeler Creek is designated as a Wild and Scenic River, managed under the jurisdiction of the CRGNSA.

Little is known about the status of bull trout in the Klickitat River. Based on recent surveys, bull trout are known to occur in the West Fork Klickitat River (WDFW 2000). Tributaries within the West Fork which currently support bull trout include Trappers Creek, Clearwater Creek, Two Lakes Stream, Little Muddy Creek, and an unnamed tributary to Fish Lake (WDFW 2000). Bull trout in the West Fork Klickitat may be restricted to a resident life history form due to a natural barrier falls near the mouth of the West Fork at RM 0.3. Smolt trapping efforts on this stream have failed to catch any outmigrating bull trout, and the population located above the West Fork falls is apparently isolated from other migratory bull trout (USFWS 2002a). Individual bull trout have also been reported in fisheries catches along the lower mainstem and at the mouth of the Klickitat River (WDFW 2000).

The lower Klickitat River from the confluence with the Columbia River upstream to a natural barrier (Castile Falls) at RM 64 has been designated as critical habitat for bull trout (USFWS 2004a). This area is considered to be essential foraging and migration habitat for bull trout (USDI 2002). The critical habitat designation also includes the West Fork and it principle tributaries that are currently occupied by bull trout. The entire Klickitat River area identified in the critical habitat designation is considered a core area for bull trout recovery (USFWS 2002a).

<u>Status of Coastal–Puget Sound Bull Trout in the Action Area</u>

*Puyallup River*

The Puyallup River watershed contains the southern most population of bull trout in the Puget Sound basin (USFWS 2004c). The extreme northern tip of the GPNF west of Mt. Rainier National Park encompasses approximately 4,690 acres in the 117,791-acre Upper Puyallup River watershed (4%), including the headwaters of Deer Creek and an unnamed tributary of the South Puyallup River that drains the Glacier View Wilderness (USFS 2003).

The South Puyallup River is currently known to be occupied by fluvial/resident bull trout, but the overall abundance of bull trout in this system is currently unknown (USFWS 2004c). This local population is isolated from other local populations in the Puyallup core area by Puget Sound Energy's Electron Diversion Dam. The upstream impasse created by the dam has effectively isolated these fish from the rest of the basin for nearly 100 years. A recently constructed fishway has been in operation since October 13, 2000, and is expected to significantly improve connectivity and genetic interaction with other local populations in the Puyallup River core area. However, there are still concerns regarding the potential for downstream interception of bull trout at the diversion facility (USFWS 2004c).

Fish snorkel surveys conducted in Deer Creek by the Puyallup Tribe in 1993 from river mile (RM) 3.9 to 5.9 located both cutthroat trout and rainbow trout above the barrier falls at RM 2.8 (Hiss et al. 2000). No bull trout were located during this survey. It is unknown if this survey effort was comprehensive enough to detect bull trout (Hiss et al. 2000). For the purposes of this consultation, the FWS considers all fish-bearing streams in the Upper Puyallup River to be potential bull trout habitat.

*Nisqually River*

The GPNF encompasses approximately 48,542 acres located in the headwaters of the 185,310-acre Upper Nisqually River watershed (26%). This area encompasses several headwater tributary streams including Berry Creek, Big Creek, Copper Creek, East Creek, Little Nisqually River, and several others. There are approximately 987 miles of roads located in the Upper Nisqually watershed, including 360 miles of roads on the GPNF. Road density on the GPNF portion of the watershed is approximately 4.7 road miles per square mile. Watershed analysis indicates the Upper Nisqually watershed is "functioning at risk" due to a history of extensive timber harvest and road construction in the watershed (USFS 2003).

The lower Nisqually River supports foraging, migration, and overwintering habitat for bull trout. Critical habitat for bull trout has been proposed in the lower 40 miles of the Nisqually River (USDI 2004b), located approximately 4 miles below the GPNF boundary on Alder Reservoir. The bull trout currently observed in this system and those likely to use this system in the future are believed to be from other core areas within Puget Sound (e.g., Puyallup River) (USDI 2004b). LaGrande Dam, located at RM 42.5 and completed in 1910, blocks upstream migration of anadromous fish (USFWS 2004c). A barrier falls may have existed near the location of LaGrande Dam, naturally limiting migratory bull trout use. There is currently no evidence of a remnant bull trout population existing above LaGrande Dam. In the past 5 years, the GPNF has conducted extensive snorkel surveys for bull trout in several tributary streams (e.g. Mesatchee Creek, Catt Creek, S. Fork Catt Creek). No bull trout have been located during these surveys or in past survey efforts conducted by GPNF and WDFW (USFS 2001a; Hiss et al. 2000). Based on this information there appears to be a low likelihood of the bull trout presence in the upper Nisqually watershed.

The upper Nisqually watershed, upstream of LaGrande Dam has been identified as a research needs area by the bull trout recovery planning team (USFWS 2004c). Research needs areas are areas that have the potential to support bull trout based on the known presence of suitable habitat, but have no documented occurrences of bull trout.

*Deschutes River (South Puget Sound)*

The GPNF encompasses approximately 603 acres located in the headwaters of the 59,044-acre Upper Deschutes River watershed (1%). This area encompasses a few minor headwater tributary streams. None of the streams located on the GPNF in this watershed are fish-bearing. Fish surveys conducted in the upper Deschutes River below the GPNF boundary have documented resident coastal cutthroat trout (Hiss et al. 2000). There are no documented occurrences of bull trout in the Deschutes River system. Critical habitat has not been proposed for any portion of the Deschutes River basin, and this watershed has not been identified by the bull trout recovery planning team as a research needs area.

*Chehalis River*

The GPNF encompasses approximately 550 acres located in the headwaters of the 86,878-acre South Fork Newaukum River watershed (<1%), a major tributary of the Chehalis River. This area encompasses Newaukum Lake and few minor headwater tributary streams. Fish surveys conducted in the upper South Fork Newaukum River have located brown trout (*Salmo trutta*), cutthroat, and brook trout (Hiss et al. 2000). Critical habitat has been proposed for foraging, migration, and overwintering bull trout in the lower Chehalis River up to Garrard Creek (USDI 2004b), located over 50 miles downriver from the GPNF boundary. There are no documented occurrences of bull trout in the South Fork Newaukum River, and this watershed has not been identified by the bull trout recovery planning team as a research needs area.

## C. Designated Critical Habitat for Pacific Salmon

Critical habitat for the Coastal Puget Sound and Columbia River bull trout does not incorporate National Forest system lands, but designated critical habitat is likely to exist adjacent to, or in relatively close proximity to National Forest system lands, and the mechanisms for effect could be transported onto that adjacent critical habitat (e.g. sediment carried downstream).

Approximately 55 percent of the total 5th field watersheds on Gifford Pinchot National Forest provide habitat for federally listed pacific salmon under the jurisdication of NOAA Fisheries. The Columbia River Gorge National Scenic Area has streams that are captured in seven 5th fields along the Washington side: Columbia Gorge Tribs, Mid-Columbi-Grays Ck, Mid-Columbia-Eagle Ck, Wind River, Little White Salmon, White Salmon, and Lower Klickitat River. Fish habitat on Gifford Pinchot National Forest and Columbia River Gorge National Scenic Area includes migration, presence, rearing, spawning, refugia, cover, and historical use.

NMFS designates critical habitat based on physical and biological features that are essential to the listed species. Essential features of designated critical habitat are: (1) substrate, (2) water quality, (3) water quantity, (4)water temperature, (5) water velocity, (6) cover/shelter, (7) food for juveniles, (8) riparian vegetation, (9) space, and (10) safe passage conditions (50 CFR 226.212). Table 24 lists the main rivers on the Gifford Pinchot National Forest and Columbia River Gorge National Scenic Area that serve as migration corridors and rearing habitat for adult and juvenile salmonids.

The three freshwater primary constituent elements of critical habitat are:

1. Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation and larval development.

2. Freshwater rearing sites with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; water quality and forage supporting juvenile development; and natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.

3. Freshwater migration corridors free of obstruction with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival.

Recent designated critical habitat on the Gifford Pinchot National Forest and Columbia River Gorge National Scenic Area includes the stream channels in each designated reach, and a lateral extent as defined by the ordinary high water line (Sept. 2, 2005; 70 FR 52629). The primary constituent elements essential for conservation of listed ESUs are those sites and habitat components that support one or more fish life stages, including freshwater spawning sites, freshwater rearing sites, and freshwater migration corridors. Nearly all 5th field watersheds on Gifford Pinchot National Forest and Columbia River Gorge National Scenic Area contain designated critical habitat.

Critical habitat was designated for Lower Columbia River steelhead, Middle Columbia River steelhead, Upper Columbia River steelhead, Upper Columbia River Spring-Run Chinook, Lower Columbia River chinook salmon, Columbia River chum salmon on February 16, 2000 (65 FR 7764), but was vacated by court order on April 30, 2002. Critical Habitat for this species was proposed on December 14, 2004 (69 FR 74572).

Critical habitat was designated for Snake River spring/summer chinook and Snake River fall chinook salmon on December 28, 1993 (58 FR 68543). Critical habitat is designated to include river and tributary reaches presently or historically accessible (except reaches above impassable natural falls, and Dworshak and Hells Canyon Dams) to Snake River spring/summer chinook and Snake River fall chinook salmon in the Snake River basin. Migratory habitat in the Columbia River mainstem from the mouth to the Snake River confluence is also included.

Designated critical habitat for the Snake River Sockeye (58 FR 68543, December 28, 1993) extends from the mouth of the Columbia River upstream to the Snake River confluence, up the Snake River to the Salmon River confluence, and up the Salmon River mainstem and tributaries to the five lakes still accessible (Stanley, Redfish, Yellow Belly, Pettit, and Alturas), and includes the lakes and their inlet creeks. Adult Snake River sockeye salmon enter the Columbia River in late spring and early summer and reach the spawning lakes in late summer and early fall. Smolts begin emigration in April, and are present in the Columbia River estuary through the early summer months.

## D. Designated Critical Habitat for Bull Trout

The FWS proposed to designate critical habitat for the Coastal Puget Sound DPSs on June 25, 2004 (69 FR 35768). A final ruling was made on September 26, 2005 (70 FR 56212) to designate critical habitat for the Klamath river, Columbia River, Jarbridge River, Coastal Puget Sound, and Saint Mary-Belly River populations of bull trout in the coterminous United States. Designated critical habitat for Coastal-Puget Sound and Columbia River bull trout excludes NF lands.

The FWS determined that PACFISH, INFISH, the Interior Columbia Basin Ecosystem Management Project (ICBMP) strategy, and the Northwest Forest Plan (NWFP) Aquatic Conservation Strategy (ACS) provide a level of conservation and adequate protection and special management for the PCEs essential to the conservation of bull trout at least comparable to that achieved by designating critical habitat. As a result, those lands are not being designated critical habitat as they do not meet the statutory definition. In many specific ways these plans are superior to a designation in that they require enhancement and restoration of habitat, acts not required by the designation.

Areas related to the scope of this BA and exempt from designated critical habitat are NF lands under the Northwest Forest Plan. However, downstream impacts from activities on NF lands may affect critical habitat and is therefore assessed in this BA.

Critical habitat extends from the bankfull elevation on one side of the stream channel to the bankfull elevation on the opposite side. Adjacent floodplains are not proposed as critical habitat. The lateral extent of proposed lakes and reservoirs is defined by the perimeter of the water body as mapped on standard 1:24,000 scale maps.

The FWS critical habitat designation identified those physical and biological features of the habitat that are essential to the conservation of the species and that may require special management consideration or protection. These physical and biological features include, but are not limited to: space for individual and population growth, and for normal behavior; food, water, or other nutritional or physiological requirements; cover or shelter; sites for breeding, reproduction, or rearing of offspring; and habitats that are protected from disturbance or are representative of the historic geographical and ecological distribution of a species. All areas proposed as critical habitat for bull trout are within the historic geographic range of the species and contain one or more of these physical or biological features essential to the conservation of the species. The FWS also included a list of known primary constituent elements with the critical habitat description. The primary constituent elements may include, but are not limited to, features such as spawning sites, feeding sites, and water quality or quantity.

The FWS determined the primary constituent elements for bull trout from studies of their habitat requirements, life-history characteristics, and population biology, as outlined above. These primary constituent elements are:

1. Permanent water having low levels of contaminants such that normal reproduction, growth and survival are not inhibited;
2. Water temperatures ranging from 2 to 15 °C (36 to 59 °F), with adequate thermal refugia available for temperatures at the upper end of this range. Specific temperatures within this range will vary depending on bull trout life history stage and form, geography, elevation, diurnal and seasonal variation, shade, such as that provided by riparian habitat, and local groundwater influence;

3. Complex stream channels with features such as woody debris, side channels, pools, and undercut banks to provide a variety of depths, velocities, and instream structures;

4. Substrates of sufficient amount, size, and composition to ensure success of egg and embryo overwinter survival, fry emergence, and young-of-the-year and juvenile survival. A minimal amount of fine substrate less than 0.63 cm (0.25) in diameter and minimal substrate embeddedness are characteristic of these conditions;

5. A natural hydrograph, including peak, high, low and base flows within historic ranges or, if regulated, a hydrograph that demonstrates the ability to support bull trout populations;

6. Springs, seeps, groundwater sources, and subsurface water connectivity to contribute to water quality and quantity;

7. Migratory corridors with minimal physical, biological, or chemical barriers between spawning, rearing, overwintering, and foraging habitats, including intermittent or seasonal barriers induced by high water temperatures or low flows;

8. An abundant food base including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish; and

9. Few or no predatory, interbreeding, or competitive nonnative species present.

## E. Forest Condition

The Project Area encompasses the Gifford-Pinchot National Forest (approximately 1,368,000 acres) and the portion of the Columbia River Gorge National Scenic Area in Washington State (approximately 85,000 acres). Invasive plants have been inventoried on approximately 2,350 acres of the Gifford Pinchot National Forest and 360 acres of the Washington State portion of the Columbia River Gorge National Scenic Area.

Treatment areas lie along road systems and railroads, within range allotments, in agricultural areas (both abandoned and present day), in high public use areas (parking areas, viewpoints), in managed areas such as plantations, and in areas utilized for recreation (campgrounds, dispersed recreation, on the Columbia River, etc.). About 2,000 acres (85 percent of the infestations inventoried on the Gifford Pinchot National Forest) are along roads, and additional acres lie within administrative sites, quarries, and other developed areas.

Invasive plants have been inventoried in four of the ten existing or proposed Research Natural Areas: Thorton T. Munger, Goat Marsh, Smith Butte (proposed) and Monte Cristo. Access points for Wilderness areas (Tatoosh, Goat Rocks, Trapper Creek, Indian Heaven, Mt. Adams and William O. Douglas) and the Pacific Crest Trail Corridor have been affected. Invasive plants have also degraded meadow systems (i.e., Peterson Prairie, Cave Creek, Lost, Gotchen, South Prairie). Plant community functioning has been disrupted and native vegetation has been completely replaced by invasive plants in some places. Without treatment, invasive plants would further displace native plant communities, and spread to new areas.

Appendix A of the GPNF and CRGNSA DEIS (treatment area information) displays the invasive plant species that have been detected on the Gifford Pinchot National Forest and Columbia River Gorge National Scenic Area. The treatment acreage estimates in Appendix A have accounted for expected spread of invasive plants between the time of inventory and the first year of anticipated treatment under this BA (2007).

**Table 25** and **Table 26** displays the 6$^{th}$ field subwatersheds on GPNF and CRGNSA, WA side, with acres of invasive plants, listed fish, and designated critical habitat. Refer to Appendix H of this BA and Appendix A of the GPNF and CRGNSA DEIS for specific locations of treatment areas in CRGNSA. The listing of ESA fish presence by 6$^{th}$ field subwatershed does not indicate fish presence at the treatment sites. Refer to Appendix G and H in this BA, and previous maps for locations of treatment areas relative to fish presence..

Table 25 - Sixth Field Watersheds on GPNF With Acres Of Infestation and ESA Fish Presence

| 5th Field Wastershed | Sixth Field Watershed Name | National Forest Acres | Riparian Reserve Acres on National Forest | Infested Acres | Percent of National Forest Acres Infested | Infested Acres in Riparian Reserves | ESA Fish Present | Critical Habitat |
|---|---|---|---|---|---|---|---|---|
| Wind River | Trout Creek | 20,956 | 7765.7 | 1.2 | 0.01 | 0.5 | LCC*, LCS | LCC, LCS |
| | Middle Wind River | 15,191 | 6457.7 | 2.4 | 0.02 | 1.5 | LCC, LCS | LCC, LCS |
| | Dry Creek-Wind River | 17,370 | 7354.0 | 4.2 | 0.02 | 3.5 | LCC, LCS | LCC, LCS |
| | Upper Wind River | 20,063 | 7894.5 | 4.4 | 0.02 | 1.3 | LCC, LCS | LCC, LCS |
| | Lower Wind River | 5,908 | 2358.2 | 6.1 | 0.10 | 1.4 | LCC, LCS | LCC, LCS |
| | Falls Creek | 13,891 | 3733.8 | 8.2 | 0.06 | 1.8 | LCC*, LCS | LCC, LCS |
| | Bear Creek | 9,095 | 4687.4 | 12.4 | 0.14 | 3.9 | LCC, LCS | LCC, LCS |
| | Panther Creek | 25,107 | 10064.3 | 47.4 | 0.19 | 18.6 | LCC+, LCS | LCC, LCS |
| Washougal River | Headwaters Washougal River | 3,404 | 1104.3 | 3.0 | 0.09 | 0.1 | LCS+ | LCS |
| Upper Lewis River | Rush Creek | 16,874 | 4371.3 | 3.5 | 0.02 | 0.8 | BT | No |
| | Cussed Hollow Creek | 15,281 | 8412.0 | 5.8 | 0.04 | 2.4 | BT | No |
| | Big Creek | 10,136 | 4677.4 | 14.6 | 0.14 | 2.4 | BT* | No |
| | Little Creek | 12,650 | 6,761 | 7 | 0.05 | 3.5 | BT | No |
| Muddy River | Smith Creek | 15,209 | 9178.6 | 1.6 | 0.01 | 0.6 | BT | No |
| | Muddy River | 14,373 | 7803.5 | 5.9 | 0.04 | 2.7 | BT | No |
| | Clear Creek | 12,369 | 6346.7 | 6.4 | 0.05 | 1.9 | BT+ | No |
| | Clearwater Creek | 25,357 | 10886.0 | 9.8 | 0.04 | 3.1 | BT+ | No |
| Swift Reservoir Lewis River | Pine Creek | 7,543 | 3084.1 | 3.2 | 0.04 | 0.5 | BT | No |
| | Upper Swift Reservoir | 1,596 | 1081.2 | 39.1 | 2.45 | 4.4 | BT* | No |
| Yale Reservoir Lewis River | Cougar Creek | 7,174 | 4190.7 | 0.4 | 0.01 | 0.3 | BT* | No |
| East Fork Lewis River | East Fork Lewis River Headwaters | 9,541 | 2797.8 | 0.8 | 0.01 | 0.3 | LCS | LCS |
| | Upper East Fork Lewis River | 9,701 | 3360.6 | 4.2 | 0.04 | 3.0 | LCS | LCS |
| Clearfork Cowlitz River | Ohanapecosh River | 2,036 | 649.5 | 11.0 | 0.54 | 3.2 | LCC*, LCS* | LCC, LCS |
| | Muddy Fork of Cowlitz River | 9,574 | 3555.8 | 18.9 | 0.20 | 6.0 | LCC, LCS | LCC, LCS |
| | Clearfork of Cowlitz River | 38,371 | 13853.5 | 97.8 | 0.25 | 36.0 | LCC, LCS | LCC, LCS |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Upper Cowlitz River | Butter Creek | 9,520 | 3602.2 | 14.3 | 0.15 | 5.1 | LCS*, LCCo* | LCS |
| | Skate Creek | 20,796 | 8241.6 | 18.3 | 0.09 | 7.2 | LCC, LCCo, LCS | LCC, LCS |
| | Lake Creek | 16,303 | 7597.3 | 24.8 | 0.15 | 10.7 | LCS*, LCCo* | LCS |
| | Johnson Creek | 31,039 | 10543.1 | 37.1 | 0.12 | 20.5 | LCC*, LCCo, LCS | LCC, LCS |
| | Hall Creek | 8,050 | 1704.0 | 69.7 | 0.87 | 15.1 | LCC*, LCCo*, LCS* | LCC, LCS |
| | Coal Creek | 10,607 | 3662.3 | 93.8 | 0.88 | 20.2 | LCC*, LCCo* LCS | LCC, LCS |
| Middle Cowlitz River | Silver Creek | 22,828 | 8909.8 | 0.5 | 0.00 | 0.2 | LCC*, LCCo*, LCS | LCC, LCS |
| | Willame Creek | 13,438 | 4479.3 | 0.7 | 0.00 | 0.1 | LCS*, LCCo* | LCS |
| | Kilborn Creek-Cowlitz River | 14,569 | 5912.5 | 0.7 | 0.01 | 0.1 | LCC, LCCo, LCS | LCC, LCS |
| | Davis Creek-Cowlitz River | 12,091 | 5152.4 | 2.0 | 0.02 | 0.8 | LCS*, LCCo* | LCS |
| | Smith Creek | 10,204 | 3087.9 | 7.4 | 0.07 | 2.8 | LCS*, LCCo* | LCS |
| | Siler Creek | 5,897 | 2098.6 | 9.3 | 0.16 | 2.4 | LCS*, LCCo* | LCS |
| Upper Cispus River | Blue Lake-Cispus River | 15,637 | 6718.0 | 14.7 | 0.09 | 8.0 | LCC, LCCo, LCS | LCC, LCS |
| | North Fork Cispus River | 27,908 | 8470.5 | 47.3 | 0.17 | 17.2 | LCC, LCCo, LCS | LCC, LCS |
| | Cat Creek-Cispus River | 18,777 | 5850.2 | 54.6 | 0.29 | 14.8 | LCC, LCCo, LCS | LCC, LCS |
| | East Canyon Creek | 18,307 | 7991.1 | 88.9 | 0.49 | 42.0 | LCC+, LCS+ | LCC, LCS |
| Lower Cispus River | Greenhorn Creek | 9,994 | 4431.2 | 0.9 | 0.01 | 0.2 | LCS | LCS |
| | Quartz Creek | 12,244 | 6717.6 | 3.3 | 0.03 | 1.1 | LCS, LCCo* | LCS |
| | Woods Creek | 6,803 | 2486.1 | 10.5 | 0.15 | 4.5 | LCS, LCCo | LCS |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | McCoy Creek | 12,838 | 4808.2 | 11.0 | 0.09 | 3.6 | LCC*, LCC0*, LCS* | LCC, LCS |
| | Iron Creek | 22,729 | 11498.8 | 15.6 | 0.07 | 8.4 | LCS, LCCo, LCC* | LCS |
| | Yellowjacket Creek | 29,707 | 12665.8 | 15.9 | 0.05 | 6.9 | LCC, LCCo, LCS | LCC, LCS |
| | Lower Cispus River Frontal | 7,863 | 3837.3 | 21.4 | 0.27 | 8.8 | LCC, LCCo, LCS | LCC, LCS |
| | Camp Creek-Cispus River | 10,952 | 3313.1 | 58.9 | 0.54 | 14.5 | LCC, LCCo, LCS | LCC, LCS |
| Riffe Reservoir Cispus River | Goat Creek | 8,022 | 3991.1 | 2.8 | 0.04 | 2.7 | LCC+, LCS+ | LCC, LCS |
| Tilton River | West Fork Tilton River | 2,343 | 620.1 | 0.1 | 0.01 | 0.1 | LCC+, LCCo, LCS | No |
| | North Fork Tilton River | 12,023 | 4380.4 | 0.2 | 0.00 | 0.0 | LCS | No |
| North Fork Toutle River | Coldwater Creek | 30,111 | 12636.0 | 11.4 | 0.04 | 6.4 | LCS* | LCS |
| | North Fork Toutle River | 14,812 | 3994.5 | 11.8 | 0.08 | 2.4 | LCS | LCS |
| Green River | Upper Green River | 16,245 | 5760.7 | 2.3 | 0.01 | 1.6 | LCC, LCCo*, LCS | LCC, LCS |
| South Fork Toutle River | South Fork Toutle River Headwaters | 8,425 | 3221.8 | 9.7 | 0.11 | 4.1 | LCS+, LCC+ | LCC, LCS |
| Puyallup | Puyallup River Headwaters | 4,690 | 1738.1 | 0.2 | 0.00 | 0.2 | BT+ | No |

* Distribution does not go the entire stream length, only approximately 1 mile or less.
+Presumed presence

LCCo = Lower Columbia River Coho, LCC = Lower Columbia River Chinook, LCS = Lower Columbia River Steelhead, BT = Columbia River Bull Trout

Table 26. Sixth Field Watersheds on CRGNSA With Acres Of Infestation and ESA Fish Presence

| 5th Field Wastershed | HUC6 | Sixthfield Watershed Name | Sixthfield Acres within NSA | NSA Riparian Reserve Acres | Proposed Treatment Acres (Area Name) | Percent of NSA acres infested | Proposed Treatment Acres in Riparian Reserves | ESA Fish Present | Critical Habitat |
|---|---|---|---|---|---|---|---|---|---|
| Upper Middle Columbia/Hood | 170701050103 | Middle Columbia/Hells Gate Canyon | 831 | 174.67 | 97.00 | 11.7 | 16.85 | MCS | MCS |
| Middle Columbia/Mill Creek | 170701050404 | Middle Columbia/Threemile Creek | 828 | 287.80 | 22.00 | 2.7 | 11.46 | MCS | MCS |
| White Salmon River | 170701050908 | Middle White Salmon River | 266 | 0.00 | 2.00 | 0.8 | 0.00 | None, site above Condit Dam | No |
| Middle Columbia/Grays Creek | 170701051201 | Major Creek | 1,709 | 618.85 | 3.00 | 0.2 | 2.43 | MCS, LCCo | MCS |
| Middle Columbia/Grays Creek | 170701051202 | Rowena Creek | 4,173 | 1,650.91 | 29.00 | 0.7 | 5.66 | MCS, LCCo | MCS |
| Middle Columbia/Grays Creek | 170701051203 | Grays Creek | 7,179 | 4,183.76 | 13.00 | 0.2 | 5.81 | MCS | MCS |
| Lower Klickitat River | 170701060408 | Mouth of Klickitat River | 358 | 0.00 | 83.00 | 23.2 | 9.24 | BT, MCS | MCS |
| Columbia Gorge Tributaries | 170800010701 | Tanner Creek | 3,840 | 1,825.76 | 4.00 | 0.1 | 2.26 | Chum, LCS, LCC, LCCo | Chum, LCS, LCC |
| Columbia Gorge Tributaries | 170800010702 | Hamilton Creek | 4,953 | 1,700.29 | 26.00 | 0.5 | 5.15 | BT, LCS, LCC, LCCo, Chum | Chum, LCS, LCC |
| Columbia Gorge Tributaries | 170800010703 | Viento Creek | 2,018 | 707.70 | 33.00 | 1.6 | 16.90 | BT, LCS, LCC, LCCo, Chum | Chum, LCS, LCC |
| Columbia Gorge Tributaries | 170800010704 | Latourell Creek | 743 | 351.32 | 47.00 | 6.3 | 8.13 | BT, LCS, LCC, LCCo | LCS, LCC |
| | | | | | | | | | |
| | | **Total Acres** | **26,898** | **11,501** | **359** | | **84** | | |

LCCo = Lower Columbia River Coho, LCC = Lower Columbia River Chinook, LCS = Lower Columbia River Steelhead, MCS = Middle Columbia River Steelhead, CRBT = Columbia River Bull Trout

### Geology and Soils

Geologically the Forest is part of the Cascade mountains and includes Mount Saint Helens, the most active volcano in the United States. Downwind of the volcano the vegetation was removed by eruptions occurring since the 1980's. The bedrock is primarily volcanic, and includes basalts, andesites, rhyolites and ash. The valleys were eroded by glaciation and runoff, leaving deep glacial deposits in the larger valleys. The geology of the Columbia Gorge is primarily Columbia River basalts eroded by the Columbia River and the Missoula Floods. Where fractured basalts are exposed they can have high permeability, which may serve to transfer contaminants from the surface to groundwater. Where these factured basalts surface in a roadcut they may add to surface flow in the winter or spring when water levels are high.

Soils in the Project Area vary from ash soils with high permeability to clay with lower permeability. The soil depth ranges from 0 on rock outcrops to greater than 40 inches in other sites. Many soils are listed as low fertility in the Forest Soil Resource Inventory (SRI) layer with bottom lands and some ashy soils having higher fertility.

Maintenance of soil productivity is essential to sustaining ecosystems and is mandated by every act of Congress directing national forest management. Region 6 Forest Service Manual (2550.3-1, R6 Supplemental # 50) and the Gifford Pinchot National Forest Plan require a minimum of 80 percent of an activity area to have unimpaired soil productivity.

Soils of concern for this project include soils formed in wet meadows and floodplains because these tend to have a high water table which is susceptible to contamination from herbicides. Soils with high water permeability are also of concern because, without proper project design criteria, herbicides that do not attach well to soils and are water soluble may be carried through these soils into ground water. Approximately 30 acres of these soils have been identified on the Forest and 11 acres on the Columbia Gorge as infested with invasives.

Invasive plants can affect soils in many ways. They can cause changes in soil properties such as pH, nutrient cycling and changes in composition or activity of soil microbes. For example, spotted knapweed has been implicated in reducing available potassium and nitrogen (Harvey and Nowierski, 1989). A reduction in soil nutrient levels makes it difficult for native plants to compete with the invasive plants, and probably also affects the soil biotic community. The long-term effects of these changes are not known. A reduction in soil nutrient levels makes it difficult for native plants to compete with the invasive plants, and probably also affects the soil biotic community.

Plants and mycorrhizal fungi are strongly dependent on each other, and species of fungi are associated with specific plants. Presence of non-native plants also leads to changes in the mycorrhizal fungus community (ibid). These changes could increase the difficulty of reestablishing native vegetation after the invasive plants are removed.

### Riparian Condition and Water Quality

Streams are complex and dynamic systems that reflect the balance between stream flow, sediment input and substrate/bank composition. Riparian condition and water quality are the two elements potentially affected by invasive plant treatments.

Approximately 11,160 miles of streams flow on the Forest. Approximately 25 percent are perennial and 75 percent are intermittent. Many of the Scenic Area sites are near the Columbia River or along streams that flow into the Columbia. The Washington State 303(d) list of water quality limited streams lists segments of 21 streams on the Gifford Pinchot Forest, along with segments on Major Creek and the Columbia River on the Columbia Gorge Scenic Area. The listed streams within the Project Area are listed for temperature (see Table 39 of this BA). None of the streams are listed due to chemical contaminants.

Riparian vegetation stabilizes stream banks, and acts as a filter to prevent the run-off of soil into streams. Riparian vegetation also provides large and small wood to streams, adding to habitat complexity and providing cover and food sourced for aquatic organisms. Aquatic ecosystems have evolved with certain vegetation types; invasive plants do not necessarily provide similar habitat.

Approximately 14 acres are estimated to be infested with knotweed; 12 acres on the Gifford Pinchot National Forest and 2 acres on the Columbia River Gorge National Scenic Area (Washington Side). Japanese knotweed has poor bank holding capacity, which leads to more bank erosion and sedimentation of streams in high winter flows (USDA Forest Service, 2005). While knotweed may provide shade, native streamside hardwoods and conifers are much taller, so knotweed dominated areas may be associated with higher water temperatures than areas with native forest communities. While the known extent of knotweed on the forest is small at this time, knotweed spreads rapidly in flood prone areas such as the Pacific Northwest. Knotweeds tolerate a wide variety of substrates from cobbles to fine soils (Tu and Sol, 2004).

While knotweed has only been recognized as a major problem for the last five years in the Pacific Northwest, it is documented as a major invasive plant in many other areas of the U.S., as well as in the British Isles. For example, in the eastern United States, Japanese knotweed has been found along the banks of the Ohio and Allegheny Rivers and in islands of these rivers where it occupies hundreds of acres of wetlands, stream banks and hillsides (http://www.invasive.org).

Approximately 10 acres of reed canary grass are mapped along streams and wetlands on the Forest. Reed canarygrass is extremely aggressive and often forms persistent, monocultures in wetlands and riparian areas. Infestations threaten the diversity of these areas, since the plant chokes out native plants and grows too densely to provide adequate cover for small mammals and waterfowl. Where the reed canary grass grows in water, it can slow the movement of water carrying sediment and lead to increased siltation along drainage ditches and streams. Once established, reed canarygrass is difficult to control because it spreads rapidly by rhizomes (http://www.ecy.wa.gov/programs/wq/plants/weeds/aqua011.html).

Purple loosestrife is on the Nature Conservancy's list of worst invasive species (Steinn and Flack, eds, 1996). Purple loosestrife, nicknamed the purple plague, is another aggressive invasive species that outcompetes native vegetation and forms monocultures. It grows quickly and spreads by roots, stem fragments or seeds (ibid). Like reed canary grass, purple loosestrife can increase fine sediment deposition and decrease channel capacity (USDA Forest Service, 2005). This plant is also found within the project area and occupies streambanks, canals and shallow ponds.

Without treatment, all of these invasive riparian species are expected to continue to spread throughout the Gifford Pinchot National Forest. Where they spread banks could become less stable, leading to changes in suspended sediment, as well as in substrate character and embeddedness. Potentially this could lead to effects on pool frequency and quality if not treated in time.

Invasive plants can adversely affect the functioning of riparian areas. If invasive plants replace riparian conifers and hardwood trees, large woody material inputs could be reduced, affecting stream stability, morphology and fish habitat. Himalayan blackberry and knotweed can act as a sediment trap and fish barrier. For instance, dense thickets of blackberries are presently catching stream substrates with their dense root masses causing excessive aggradation of the streambed. This causes the stream to widen and downcut around the aggraded areas. In some areas, such as the Columbia River Gorge, the berry vines are thick enough to be a physical barrier to fish (Chuti Fiedler, personal communication). Spawning gravels locked up in the root masses are unavailable for fish, and the stream areas around the root masses have such accelerated flows that gravels aren't retained, resulting in a net loss of fish habitat.

### *Lakes, Wetlands and Floodplains*

Lakes, wetlands and floodplain areas are often popular for recreation, and so are at risk from invasive plants brought in by visitors. They are also at risk from invasive plants such as knotweeds that colonize areas downstream of the original infestation along streams. Wetlands can be inundated with water year-round, and others are wet only seasonally. The areas that are wet only seasonally can be infested with upland invasive species, as well as invasive plants specifically adapted to wetlands. Five acres of wetlands are identified as infested with invasives on the Scenic Area. This includes an area where trespass by a adjacent private property owner, who used heavy equipment to change the flow pattern and brought in fill to the wetland. This disturbance allowed many invasives into this site.

There are 104 acres of invasive plants on the Forest listed by site type as meadows. These include both wet and dry meadows. The Forest SRI (soils information) lists 373 acres within treatment areas as soils associated with floodplains or wet meadows. It is estimated that only a portion (about 30 acres) of soils associated with floodplains or wet meadows within treatment areas are infested at this time.

### *Roads Having High Potential for Herbicide Delivery to Streams*

Roads are the primary conduit for invasive plants to enter the forest. On the Gifford Pinchot approximately 85 percent of the identified invasives are along roads or in disturbed areas near roads, such as recreation sites, administrative sites, and skid trails in second growth forest. For the Columbia Gorge Scenic Area the treatment areas are often reclaimed farm land, orchards and railroad beds.

The R6 2005 FEIS describes roadside ditches as an herbicide delivery mechanism; potentially posing a high risk of herbicides reaching concentrations of concern for listed aquatic species. Ditches may function as an intermittent or perennial stream, extending the stream network. Roadside ditches can act as delivery routes or intermittent streams during high rainfalls, or as settling ponds following rainfall events.

To reduce the potential for herbicides to come in contact with water via runoff at or near concentrations of concern, the following restrictions would apply to roadside treatments:

- No broadcasting of any herbicide (PDF H3)
- No use of picloram or Triclopyr BEE (PDF H3)
- Only spot or hand/select methods of lowest and moderate risk herbicides (PDF H4)

- Where there is standing water in a roadside ditch located outside the established buffers of a stream, apply a 15 foot buffer around the standing water and use only low risk herbicides within 15 feet of the edge of a wet roadside ditch. For treatments of target vegetation emerging out of the wet roadside ditch only aquatic labeled herbicides would be used (PDF H4).
- Apply appropriate buffer widths to road sections that cross streams (refer to buffer tables)

The 2002 Gifford Pinchot National Forest Roads Analysis was used to identify roads having a potential for herbicide delivery to streams including roads with a high rate of surface erosion, roads in Riparian Reserves, and a high number of road crossings for a segment of road. A list and map of these road segments is in Appendix A of the GPNF and CRGNSA DEIS. Infestations are scattered within roadside treatment areas; treatments are unlikely to be continuous along any road segment.

Roadside treatment areas include compacted ditch lines, disturbed soil and thin soils near exposed bedrock. Due to the extensive reworking of properties of soils along roads, the SRI may be misleading for roadside treatment areas. As roads and ditchlines are compacted, roadside soils are assumed to function with a high runoff rate and PDC were developed accordingly.

Table 27 displays the infested acres of roadside treatment areas and the acres within Riparian Reserves. The Aquatic Influence Zone is roughly approximated by half the distance of a Riparian Reserve, however actual buffer distances that limit the method and selection of herbicide vary widely. It’s important to note that a large proportion (74%) of the infested acres are roadside areas. Of the roadside areas with infestation, approximately 47% may have a high potential for herbicide delivery but only 28% are actually within the Riparian Reserve, as defined by the NWFP.

Table 27 - Acres of Road Infestations on GPNF

| Gifford Pinchot National Forest<br>Treatment Area Description | Total Infested Acres | Infested Acres Within Riparian Reserve | Infested Acres Along Roads With High Potential to Deliver Herbicide |
|---|---|---|---|
| **Roadside** | 2,000 | 552 | 943 |

## F. Effects of the Proposed Action

This section discusses the potential effects of the Proposed Action to federally listed fish species and their designated critical habitat found within the action area. Much of the herbicide effects discussion is incorporated from Risk Assessments and the Fisheries BA completed for the Region 6 2005 Final Environnmental Impact Statement for the Regional Invasive Plant Program and associated documents. In addition, the Soil and Water section completed by Carol Thornton, Hydrologist, for the Proposed Action was also embedded into this document for a complete analysis of habitat related parameters. Refer to Appendix A of the GPNF and CRGNSA DEIS for manual methods proposed, and Appendix H of this BA for photos of treatment areas on CRGNSA.

## Non-herbicide Treatment Methods

All invasive plant treatments can result in some erosion, stream sedimentation, and disturbance to aquatic organisms if carried out over a large enough area. Sedimentation can cover eggs or spawning gravels, reduce prey availability, and harm fish gills. Soil can also become compacted and prevent the establishment of native vegetative cover. All invasive plant treatments can reduce insect biomass, which would result in a decrease in the supply of food for fish and other aquatic organism. Reductions in cover, shade, and sources of food from riparian vegetation could result from herbicide deposition in a streamside zone (Norris et al. 1991).

Riparian vegetation affects habitat structure in several important ways. Roots of riparian vegetation hold soil, which stabilizes banks, prevents addition of soil run-off to water bodies with subsequent increases in turbidity or filling substrate interstices, and helps to create overhanging banks. Riparian and emergent aquatic vegetation can provide hiding cover or refuge for fish and other aquatic organisms where native plants have been replaced.

### Direct and Indirect Effects

#### *Manual, Mechanical, Site Restoration and Revegetation Methods*

Non-herbicide treatment methods are covered by the 2004 GPNF/CRGNSA Programmatic Biological Opinion from U.S. Fish and Wildlife Service (USFWS) and NOAA Fisheries. The Biological Opinion from USFWS and NOAA Fisheries for programmatic activities on GPNF and CRGNSA expires in 2008. Therefore, this BA will include effects from non-herbicide treatment methods on federally listed fish present in the GPNF and CRGNSA, Washington side.

Manual and mechanical treatments related to the proposed action are described as methods that may include brush cutters, or other machinery with various types of blades to remove plants, see Appendix A of the GPNF and CRGNSA DEIS. Manual methods include the use of hand-operated tools (e.g., axes, brush hooks, hoes, shovels, hand clippers) to dig up and remove noxious species (USDI 2003).

Direct and indirect effects of manual and mechanical treatments were analyzed in the R6 2005 FEIS (Appendix J of the FEIS). Public scoping issues about these treatments were not raised. Manual treatments, such as lopping or shearing, cause an input of organic material (dead roots) into the soil. As the roots are broken down in the soil food web, nutrients will be released. Rainfall may cause these nutrients to be lost to surface runoff or to groundwater. Bare soils combined with high nutrient levels provide ideal conditions for the establishment of many invasive species. In lower intensity infestations, non-target vegetation could provide erosion control as well as a seed source for establishing native vegetation. In areas with larger amounts of bare soil, PDCs require restoration activities to reestablish native vegetation. The intent is to re-establish competitive local, native vegetation post-treatment in areas of bare ground.

The presence of people or crews with hand-held tools along streambanks could lead to localized, sediment/turbidity to fish habitat because of trampling, soil sloughing due to stepping on banks and removal of invasive plant roots. However, amounts of potential localized sediment/turbidity would be negligible because the invasive plant populations on the GPNF and CRGNSA are not extensive enough to result in significant sediment/turbidity. Effective invasive plant treatment and restoration of treated sites would improve the function of riparian areas and lead to improved fish habitat conditions.

The proposed action would benefit aquatic ecosystems to the extent they effectively restore riparian habitats, especially habitats adjacent to fish bearing streams. The impacts of invasive plants on these habitats can last decades, while the impacts of treatment tend to be short term. Passive and active restoration would accelerate native vegetative recovery in treated sites.

Removal of plant roots along a streambank will cause some ground disturbance and may introduce some sediment to streams. For example, weed wrenching of scotch broom may loosen soil and cause minor amounts of erosion for approximately one season until vegetation was reestablished. These minor amounts of erosion would be negligible once contact with water is made. Under the proposed action, significant removal of riparian invasive species would not occur because of the proposed use of herbicides reducing the potential for significant soil disturbance.

Using mowing equipment on existing roads is not expected to impact soils. Soil compaction eliminates soil pores and so reduces water infiltration, aeration, and the ability of plants to root effectively. However, the limited amount of mechanical treatment proposed eliminates risk of extensive soil impacts.

While the relative amounts of manual and mechanical treatments vary, the differences in terms of effects from such treatments are negligible. Other mechanical treatments, such as the use of motorized hand tools, are expected to have effects similar to manual treatments.

*Turbidity and Sediment*

Manual, mechanical, and restoration treatment activities that incorporate substantial ground-disturbing activities in riparian areas may lead to increased erosion and stream sedimentation. Persistence of increased turbidity depends on the size of the suspended particle and velocity of the water. Impacts related to fine sediment depends on the amount of fine sediment introduced and the holding capacity of the surface water. Increased turbidity can reduce feeding ability or gill function in some fish species and fine sediments can cover eggs or spawning gravels. Effects to listed aquatic species will vary with the proximity of the species and their habitat to the treatment area, the sensitivity of the listed species to turbidity and fine sediment, and the size of the area treated.

Scotch Broom occupies up to 781 acres on the Forest and approximately 55 acres on the Scenic Area. Weed wrenching of scotch broom may loosen soil and cause negligible amounts of erosion for approximately one season until vegetation is reestablished. The proposed action requires active and passive restoration to reestablish native vegetation. The intent is to re-establish competitive local, native vegetation post-treatment in areas of bare ground.

Using mowing equipment on existing roads is not expected to impact soils. Mowing off roads has the potential to compact soil. Soil compaction eliminates soil pores and so reduces water infiltration, aeration, and the ability of plants to root effectively. However, the limited amount of mechanical treatment proposed eliminates risk of extensive soil impacts.

While the relative amounts of manual and mechanical treatments may vary, little substantive differences in terms of the context or intensity of effects are predicted. Other mechanical treatments, such as the use of motorized hand tools, are expected to have effects similar to manual treatments.

Manual, mechanical, and restoration treatments include activities such as hand pulling, mowing, brushing, seeding, and planting. A large proportion of the known treatment sites are located along roads, trails, in campgrounds, and administrative sites. Treatments on GPNF and CRGNSA that are within 100 feet of streams with federally listed fish are shown in Table 33 below. A buffer of 100 feet was used to further assess proximity of sites to streams with federally listed fish. The amount of sediment created by non-herbicide treatments on treatment areas listed in Table 33 and new infestations under EDRR is anticipated to be insignificant because the methods of treatments do not include ground disturbing activities by heavy equipment. Ground disturbing activities by hand pulling and planting will cover a relatively small area and any sediment created at these sites would be quickly dispersed by the adjoining streams. Treatment sites that are located entirely out of subwatersheds supporting federally listed fish will have no effect on listed fish because fish will not be exposed to effects from treatments.

Treatment area #22-04 Hot Springs in CRGNSA is located adjacent to Greenleaf Creek, a tributary to the Columbia River, which is known to support Lower Columbia River steelhead and Lower Columbia River coho. Streamnet identifies Greenleaf Creek as spawning habitat for winter steelhead and coho. Columbia River bull trout and Lower Columbia River Chinook are not present in Greenleaf Creek. Greenleaf slough is below the treatment area and is believed to warm waters significantly. An impassible falls is located about a mile upstream from the treatment area. The site is infested with upland weeds, such as Canada thistle, oxtongue hawkweed, meadow knapweed, blackberries, and reed canary grass. Lower Columbia River Steelhead and Lower Columbia River coho at the Hot Springs site will not be exposed to the effects of increased turbidity and sediment from treatments at this site.

Japanese knotweed infestations in the CRGNSA (treatment area #22-06 Collin's slide) are small and scattered in the riparian area of Collin's Creek, a tributary to the Columbia River. This treatment area is the only known site on CRGNSA with a knotweed infestation. Collin's Creek crosses Highway 14 and the railroad, which acts as a barrier to Columbia River bull trout, Lower Columbia River Steelhead and Lower Columbia River coho blocking approximately 2 miles of habitat. Columbia River bull trout are not known to access Collin's Creek. The knotweed infestation is not extensive enough to cause significant sediment increase after treatment when the plants die and are no longer able to hold soil. Because of the small scale of the treatment site and the insignificant amount of sediment expected to be generated, the exposure to Lower Columbia River Steelhead and Lower Columbia River coho is not likely to be measurable.

Treatment area #22-09 (Burdoin /Catherine Cr./Major Cr.) is split into 5 different areas. Major Creek flows through one of the areas and about less than 0.10 of an acre barely lies within the 100 foot buffer of Catherine Creek (according to GIS). Middle Columbia River steelhead intermittently use the lower 1 mile of Catherine and Major Creeks. Middle Columbia River Steelhead at the 22-09 Burdoin /Catherine Cr./Major Cr.) will not be exposed to the effects of increased turbidity and sediment from treatments at these sites.

For treatment area #22-15 South BZ on CRGNSA, there is less than 0.10 acre potentially within the 100 foot buffer of the mainstem of White Salmon River. No federally listed fish are located at this site because of Condit Dam. Condit Dam is located at river mile 3.3 on the White Salmon river and has blocked upstream migration of salmonids since 1918. Therefore, there will be no effect to federally listed fish from treatments at the 22-15 South BZ site.

The 22-10 Balfour and 22-16 Klickitat Rails to Trails treatment areas are adjacent to the Klickitat River. The 22-16 site begins near the confluence of the mainstem of Columbia River and Klickitat River, and follows a trail along the Klickitat River. The mouth of the Klickitat River has steep banks and is canyon-like on either side of the river. There is a steep drop from the trail to the Klickitat River with the trail meandering in and out of a 100 foot buffer of the Klickitat River. The lower Klickitat River provides habitat for Middle Columbia River steelhead and Columbia River bull trout. Impacts from manual, mechanical, restoration treatments along the 22-16 site and in the 22-10 site are minor compared to the size of the Klickitat River. Soil from disturbed ground is not expected to reach the Klickitat River. Middle Columbia River steelhead and Columbia River bull trout will not be exposed to the effects of increased turbidity and sediment from treatments at 22-10 Balfour and 22-16 Klickitat Rails to Trails.

Treatment area #22-13 Miller Island is located in the middle of the mainstem of Columbia River, which is accessed by all migrating pacific salmon and Columbia River bull trout. Migrating pacific salmon and Columbia River bull trout in the mainstem of the Columbia River are "migratory" and non-herbicide treatments on the CRGNSA will not create enough sediment to preclude migration and foraging in portions of the mainstem of the Columbia River.

*Temperature*

Aquatic species have specific needs in terms of water temperature. Increasing water temperature may decrease the dissolved oxygen in water which may affect metabolism and food requirements. Many factors influence water temperature including shade, discharge, channel morphology, air temperature, topography, stream aspect, and interactions with ground water. Shade is the factor that has the potential to be impacted by non-herbicide treatments.

Manual, mechanical, and restoration treatments of some invasive plant species (such as knotweed) may decrease riparian vegetative shading in some areas, and thereby increasing the amount of solar radiation striking the water. This may result in a warming effect but many other factors in addition to shade affect water temperature. A significant amount of vegetation would need to be removed to change water temperature in the stream and shade would have to be provided only by the invasive plant removed. The amount of vegetation that will be removed at treatments shown in Table 33 or treatments areas on CRGNSA discussed above is not enough to significantly impact stream temperature and therefore federally listed fish on GPNF and CRGNSA, WA side, will not be exposed to the effects of increased stream temperature from treatments at these sites. There will be no increased stream temperatures from treatment at sites identified in Table 33 or discussed above.

*Direct Mortality due to Trampling*

People working in water have the potential to impact listed fish by stepping on redds disturbing spawning fish. The extent of these impacts depends on the species present, life stage, number of people in the water, and the amount of time spent in the water. Impacts to redds or spawning fish is unlikely to occur given that fish do not spawn under emergent vegetation and activities would be planned and scheduled to avoid disturbance of spawning fish or damage to redds. Fry, juveniles, and adults are avoided due to their general avoidance of predators and are likely to swim away when people are in the water.

The knotweed infestation at the #22-06 Collin's slide site is along the stream banks up to the water's edge. People conducting treatments at this site will generally be on the banks, although they may occasionally step in the water to ensure proper coverage of treatment. The likelihood of negative impacts to fish during spawning and the possibility of stepping on redds is very low at this site because Collin's Creek crosses Highway 14 and the railroad, which acts as a barrier to Columbia River bull trout, Lower Columbia River Steelhead and Lower Columbia River coho blocking approximately 2 miles of habitat. Columbia River bull trout are not known to access Collin's Creek.

Future treatments under EDRR, including activities that would need to take place below the ordinary high water mark (i.e., manual/physical application of herbicide) for purposes of treating emergent invasive vegetation, would avoid impacts to redds or spawning fish because activities would be planned and scheduled to avoid disturbance of spawning fish or damage to redds. This will minimize the likelihood of negative impacts to fish during spawning and avoid the possibility of stepping on redds. There is the potential for an individual to accidentally step on a redd or displace spawning fish while conducting emergent invasive vegetation treatments, especially in small streams that provide key spawning habitat, should there be a need to wade across a stream or access an island. The larger the stream, the less of a disturbance because of the area available for fish to seek cover or refuge. In smaller streams, the area for cover and refuge is less. Therefore, there is a higher risk of disturbing spawning adults or stepping on redds on smaller streams. There may be instances where a person will need to step along the waters edge or in the outer edges of the wetted perimeter in order to effectively apply herbicide to emergent vegetation during spawning activities.

### *Goat Grazing*

The cultural treatment included in the proposed action is the use of goats for grazing invasive weeds on the 55 acre Saint Cloud/Sam Walker site on the Columbia River Gorge National Scenic Area (treatment #22-03, see GPNF and CRG SA DEIS Appendix A). Two streams (referred to as Goodbear and Archer Creeks) flow through the St. Cloud site. Significant channelization and diking of the delta system, along with flooding, has impacted the streambed at the confluence of Goodbear and Archer Creeks. This has resulted in the removal of native vegetation allowing black berries to grow extensively through the cobbles on the streambed resulting in a fish barrier. The dense thickets of blackberries are presently catching sediment causing excessive aggradation of the streambed, which is causing the stream to widen and downcut around the aggraded areas.

If grazing or other actions of grazing goats (wallowing, wandering) were not controlled, then their presence can cause damage to a stream system, and promote the spread and survival of invasive plants. Overgrazing can reduce native plant cover, disturb soils, weaken native communities, and allow exotic plants to invade. In addition, animals that are moved from one location to another can spread invasive plant seeds. Since the understory vegetation at the St. Cloud site is nearly devoid of native vegetation and fish have partial access to the channel at higher flows, a reduction of cover provided by the invasion of blackberries is not a concern. The overstory canopy is all native vegetation. The 1996 floods has removed productive soils along the streambank, which has allowed the blackberry root system to aggrade the channel with gravel and small cobble, resulting in a partial barrier to fish passage. The lack of soils within the area would not lead to any erosion potential. This site will need follow up restoration work to recover native riparian structure in the long-term. In this case, several years of intensive grazing followed by annual brief periods of grazing by the same grazing species may be required to gain and maintain control of an infestation.

Because goats tend to eat a greater variety of plants than sheep, methods (i.e: herding, fencing, or the placement of salt licks) will be employed to concentrate their grazing activities in the St. Cloud area and used as an educational opportunity.

Some goat manure would get in the stream but this would be a temporary effect as the goats would be kept at the site a short (few weeks) time. Due to heavily wooded and wet conditions, mechanical treatment is not possible here. Goats could be used to reduce the infestation and weaken the plants before hand treatment with herbicides. This would lower the amount of herbicide used within the riparian area. In general, grazing can be effective in reducing a large infestation or eliminating a smaller infestation grazing (TNC 2001). By treating the invasives with grazing first it is hoped to lower impacts on the site from other treatments.

## Herbicide Use

Herbicide treatments proposed for use may result in some minor amounts of herbicide coming in contact with water where there may be federally listed fish present. However, the likelihood of the amount being at a level of concern is low.. The Project design criteria and Buffers minimize or eliminate the potential for any herbicide to reach a threshold of concern for listed fish species. The Proposed Action would not apply herbicides directly to any stream for purposes of treating aquatic weeds that are floating or submerged in any situation, so the potential for high concentrations causing acute toxicity effects is extremely remote.

Although no direct application to water is proposed, treatment for emergent invasives poses a risk of herbicide coming into contact with water. Knotweed, reed canarygrass, and other invasive plants species can be found emergent within or along streams, wetlands, and lakes. Only aquatic formulations of glyphosate, imazapyr, and triclopyr would be permitted. Compared to non-aquatic formulations, these three herbicides pose a lower risk to fish and other aquatic organisms compared to its non-aquatic formulation.

An accidental spill could result in concentrations of herbicides that could harm aquatic organisms. The proposed action includes Project design criteria that would reduce the likelihood and impact of a spill. Human error is unavoidable and if taken to an extreme, can make analysis complicated and unreasonable. The proposed action allows only certified applicators that have gone through various courses and training to properly use herbicides in a safe manner.

The Proposed Action includes limitations on the type and application method of herbicides adjacent to waterbodies and along roads that have high potential for herbicide delivery to streams. The PDCs included in the proposed action apply to known sites and those detected in the future. In both cases, the limitations in the PDCs are expected to ensure that herbicide use will not exceed a level of concern for aquatic organisms tested by the SERA risk assessments.

Buffers act as a safety zone to limit the potential for herbicides coming in contact with water at concentrations of concern for aquatic resources through leaching, run-off, or drift. PDCs and buffers were developed based on label advisories, SERA "worst case" risk assessments, previous Section 7 Consultation for the R6 2005 FEIS and other projects, Neil Berg's 2004 study of broadcast drift and run off to streams, Washington Department of Transportations 2003-2005 study of spot and hand/selective treatments on a stream, and other information.

No broadcast applications of herbicides would occur within 50 feet of perennial and intermittent streams, lakes, or wetlands, or on roads that have a high potential for herbicide delivery. In addition, only aquatic labeled glyphosate and imazapyr would be allowed to be broadcast between 50 ft to 100 ft of waterbodies. The majority of herbicides have 50-foot buffers for spot treatments, except for low risk and aquatic labeled herbicides. Spot applications of aquatic labeled formulations of glyphosate and imazapyr may be used up to the water's edge or within 15 feet of isolated standing water present in roadside ditches that are outside the stream buffer. Spot applications of aquatic labeled triclopyr may not be used within 15 feet of perennial and wet intermittent streams or other waterbodies

The Proposed Action limits broadcast applications of herbicides to the following situations:

- Outside established buffers for perennial/intermittent streams and other waterbodies;
- Outside established buffers when water is present within roadside ditches;
- On roads that do not have a high potential for herbicide delivery; and,

In addition to buffers, herbicides would not be used during or immediately before rainfall as directed by label requirements. For activities that would need to take place below the ordinary high water mark (i.e., manual/spot/hand applications) for purposes of treating emergent invasive vegetation, activities would be planned and scheduled to avoid disturbance of spawning fish or damage to redds. This will reduce the likelihood of negative impacts to fish during spawning and/or when redds are present.

### *Analysis of the Effects*

Herbicide applications may occur near streams utilized by ESA listed fish species found in the project area. Physiological responses from exposure to herbicides proposed for use are probably similar between bull trout and pacific salmon.

Herbicide characteristics and basic hazard identification to aquatic organisms for each herbicide proposed for use is discussed in Section A, "General Effects of Herbicide Use for Invasive Plant Treatments." The herbicides with a greater likelihood of coming in contact with water are the aquatic formulations of glyphosate, imazapyr, and triclopyr. Therefore, the focus of the quantitative analysis included in this BA is on the aquatic formulations. Quantitative analysis of the non-aquatic formulations is covered in the R6 2005 FEIS and is incorporated by reference.

Several quantitative and qualitative analysis steps were conducted to address the magnitude of effect from herbicide exposure to ESA fish and designated habitat from the proposed action. Below is a quantitative and qualitative analysis of two different treatment scenarios used to discuss the rationale for proximity, probability, magnitude, distribution, frequency, duration, timing, and nature of potential effects. Each treatment scenario addresses the potential amount of herbicide coming in contact with water.

### *Higher Risk Treatment Scenarios on GPNF and CRGNSA*

Higher risk treatment scenarios are defined as situations where herbicide exposure could exceed a level of concern for listed fish. Many treatment areas on GPNF and CRGNSA are within riparian areas and along roads with potential to deliver herbicide to streams. As discussed previously, broadcast treatments would not occur within 50 feet of a wet or dry stream or along roads with high potential to deliver herbicide to streams via the ditch network. Spot and hand/select treatment methods and herbicide selection adjacent to waterbodies are far less likely to deliver herbicide at levels of concern than broadcasting. Results from the risk assessments scenarios greatly overestimate the amount of herbicide likely to enter surface waters for proposed treatments because actual treatments will not broadcast spray 10 acres immediately adjacent to the stream; the proposed action contains PDCs that restrict application methods and rates near water. For more information, see PDC table for more information about how risks are abated.

To validate this finding, two higher risk scenarios were studied more closely. The R6 2005 Monitoring Framework acknowledges that lower risk treatments occurring together in a small drainage could result a in higher degree of risk. Thus, Higher Risk Scenario 1includes 6$^{th}$-field watersheds where acres of treatment within Aquatic Influence Zones are estimated to be 10 acres or more within a 6$^{th}$ field watershed. Higher Risk Scenario 2 involves treatment of invasive plants emerging from a stream or wetland. Treatment of emergent vegetation is inherently risky because the treatment occurs in close proximity to surface water. The analysis for scenario 2 incorporates two calculations: The first is known as the “emergent vegetation on 1 acre”. The next calculation takes a closer look at what the potential peak concentration of herbicide would be in 1 ft$^3$ of water.

***<u>Analysis of Higher Risk Scenario 1</u>***

The following six 6$^{th}$-field watersheds contain at least ten acres of estimated treatment within the Aquatic Influence Zones in the upper 70 percent of the watershed, see table below. The upper 70 percent was chosen to reflect the portion of the Forest most likely to contain small, high elevation streams where effects of lower risk project could trigger a higher level of risk (R6 2005 Monitoring Framework). In all cases, the existing treatment sites were found to be small and scattered throughout the watersheds. The PDCs and buffers appear to sufficiently reduce risks to a low level, even if all these treatments were to occur simultaneously (unlikely). Two of the 6$^{th}$ field watersheds listed below contain any federally listed fish or critical habitat

Table 28. Subwatersheds on GPNF and CRGNSA containing at least 10 acres of estimated treatment within the aquatic influence zone.

| Sixth Field Watershed Name | Est. Infested Acres/ Percent of Watershed Area Porportion NF system | Est. Infested Acres in Aquatic Influence Zone | Miles of Road with High Potential For Herbicide Delivery Within Treatment Areas | Special Considerations |
|---|---|---|---|---|
| **Cave/Bear Creek Watershed** | 309/ 1%<br>60% NF | 45 | 39 | Cave Creek meadow complex. No federally listed fish or designated critical habitat. |
| **Upper Trout Lake Creek Watershed** | 139/ 0.5%<br>100% NF | 20 | 27 | Treatments are primarily along roads with treatments in parking areas, campgrounds and quarries also proposed. One campground is in a wetland. Lower Columbia River steelhead and designated critical habitat are present in this subwatershed. |
| **East Canyon Creek** | 89/ 0.5%<br>100% NF | 21 | 30 | Roadside treatment areas. No federally listed fish or critical habitat. |
| **Middle Little White Salmon River** | 87/ 0.8%<br>60% NF | 20 | 15 | Wetlands along the roads proposed for treatment. No federally listed fish or critical habitat. |
| **Clear Fork of the Cowlitz River** | 98/ 0.3%<br>100% NF | 18 | 16 | Most of the treatment areas are roads following streams. However treatments are also proposed in quarries, meadows and La Wis Wis Campground. Lower Columbia River steelhead and Chinook, and designated critical habitat are present in this subwatershed. |
| **Upper White Salmon River** | 76/ 0.3% | 7 | 2 | Roadside treatment areas and landings in managed stands. No federally listed fish or critical habitat |

***<u>Analysis of Higher Risk Scenario 2</u>***

The Cave Creek Meadow (treatment area #33-05ml) on Gifford Pinchot National Forest, and the Hot Springs site (treatment area #22-04) on the Columbia River Gorge National Scenic Area have the greatest likelihood of herbicides coming in contact with water as a result of treatment of emergent vegetation under the Proposed Action. Invasive plants may be growing immediately along the water line (in some cases emergent) in these areas or growing in seasonally or perennially saturated soils. The analysis to estimate the potential concentrations of the three herbicides most likely to be used in close proximity to waterbodies (glyphosate, imazapyr, triclopyr) at the Cave Creek Meadow and Hot Springs sites is a two tiered approach. First, a risk assessment worksheet was completed for each site. Second, an emergent vegetation analysis was conducted and the estimated peak concentrations were calculated for each herbicide.

Spot applications of aquatic formulations of glyphosate and imazapyr would be permitted below bankfull or within wetlands for purposes of treating emergent vegetation such as reed canarygrass and purple loosestrife. Spot sprays of triclopyr TEA is not permitted within 15 feet of perennial or intermittent streams.

Hand/selective applications below the high water mark would be allowed for all aquatic labeled herbicides to treat invasive emergent plants. While treatments would be preferred during dry times of the year, when herbicide is least likely to contact water, these treatment areas may remain wet year round.

*Cave Creek Meadow.* The Cave Creek Meadow is located in the Cave/Bear Creek sub-watershed (White Salmon River fifth field watershed) and is adjacent to Cave Creek, which provides habitat for resident fish. Resident fish are not present in the meadow during high rainfall because it does not provide any type of habitat. Condit Dam is located on the mainstem of the White Salmon River at river mile 3.3 and has blocked upstream migration of Middle Columbia River steelhead and other salmonids since 1918. It is unlikely that salmonids would be able to access Cave Creek when Condit Dam is removed because of a two-tiered waterfall at RM 16.2, that for all practical purposes is the upstream limit of anadromous fish migration.

For purposes of this analysis, it is assumed that salmonids are present in the Cave Creek system in order to assess potential impacts from treatments of new infestations elsewhere on the Forest where there may be federally listed fish present under similar site conditions (e.g. stream with emergent invasive plants).

*Hot Springs*. The Hot Springs site is located adjacent to Greenleaf Creek, a tributary to the Columbia River, which is known to support Lower Columbia River steelhead and Lower Columbia River coho. Streamnet identifies Greenleaf Creek as spawning habitat for winter steelhead and coho. Bull trout and Chinook are not present in Greenleaf Creek. Greenleaf slough is below the treatment area and is believed to warm waters significantly. An impassible falls is located about a mile upstream from the treatment area. The site is infested with upland weeds, such as Canada thistle, oxtongue hawkweed, meadow knapweed, blackberries, and reed canary grass.

<u>SERA Risk Assessment Worksheets</u>

Local conditions at the Cave Creek Meadow and Hot Springs sites were analyzed for the potential amount of herbicide coming in contact with water using the SERA Risk Assessment Worksheets assuming that water at both these locations was at bankfull. Included in the assumptions are those that are listed in Chapter 2. Section D. Assumptions for waterbodies. This analysis addresses the riparian area from bankfull to upland and assumes a 10 acre treatment area (50 foot wide and 1.5 miles long). Local information gathered for the worksheets was soil texture and precipitation. Soil texture at the Cave Creek Meadow site is predominantly sand and an annual precipitation of 50 inches. Hot Springs soil texture is predominantly loam with an annual precipitation of 70 inches. Modeled concentrations of imazapyr, glyphosate, and triclopyr TEA were taken from tables in the respective risk assessments for average and peak water contamination rates based on soil and precipitation, for small streams.

The results of this analysis indicates all hazard quotient (HQ) values were below 1, therefore, no levels of concern were exceeded. The R6 2005 FEIS notes that as HQ increases above 1, the margins of safety decrease, compared to the most sensitive toxic effect shown in laboratory studies. Strategies for further reducing risks include: reducing the application rate of the herbicide; applying buffers; restricting applications to more favorable site conditions and/or using an application method with less exposure. Treatments with estimated HQ's greater than 10 would be of particular concern.

In this case, HQ values below 1 indicate that the modeled concentration of herbicide in water under the risk assessment scenario are not likely to adversely affect federally listed fish. In addition, the worst case assumptions for the scenario are not possible on the ground under the proposed action because there will be no broadcasting within at least 50 feet of streams. No broadcasting would occur on roads that have high risk of herbicide delivery through their ditch networks. In addition, triclopyr would not be broadcast under any conditions. These design criteria greatly reduce the potential for herbicide delivery compared to the modeled predictions (see monitoring results Berg 2004, ODOT 2003-2005).

The water contamination rates (mg/L per lb/acre), peak concentrations in water, and range of Hazard Quotients for worst case scenario in the Cave Creek Meadow and Hot Springs site, for aquatic glyphosate, aquatic imazapyr, and aquatic triclopyr at the typical application rate are shown below in Table 29.

Table 29 – Worksheet results for the Cave Creek Meadow and Hot Springs site.

| **Herbicide/ location** | **Annual Precipitation (inches)** | **Peak Water Contam. Rate (mg/L per lb/acre)** | **Range of Concentration in water (dose) (mg/L)** | **Toxicity Index for Listed Fish (mg/L)** | **Range of Hazard Quotients** |
|---|---|---|---|---|---|
| **Glyphosate (2 lbs/acre)** | | | | | |
| Cave Creek Meadow | 50 | 0.0191 - 0.0985 | 0.0382 - 0.197 | 0.5 | 0.08 - 0.4 |
| Hot Springs | 70 | 0.028 - 0.077 | 0.0561 - 0.154 | 0.5 | 0.1 - 0.3 |
| **Imazapyr (0.45 lbs/acre)** | | | | | |
| Cave Creek Meadow | 50 | 0.000069 – 0.0002 | 0.000069 – 0.0001 | 5.0 | 0.000006 – 0.00002 |
| Hot Springs | 70 | 0.000003 – 0.000081 | 0.00000135 – 0.000036 | 5.0 | 0.0000003 – 0.000007 |
| **Triclopyr TEA (1 lbs/acre)** | | | | | |
| Cave Creek Meadow | 50 | 0.0309 – 0.0713 | 0.0309 – 0.0713 | 0.26 | 0.1 – 0.3 |
| Hot Springs | 70 | 0.09 – 0.168 | 0.0939 – 0.168 | 0.26 | 0.4 – 0.6 |

Sources: Precipitation records from USGS, local site knowledge; SERA 2003, 2004.

It is highly unlikely that the low values modeled in the worksheets would even be approached given that treatment methods for the Cave Creek Meadow and Hot Springs sites are limited to spot and hand/select methods. Hand selective treatment methods have a much less likelihood of herbicides coming in contact with water than spot spray (which far reduces exposure potential compared to broadcast treatment). Under the proposed action, spot treatments using aquatic glyphosate and aquatic imazapyr could occur within the Cave Creek Meadow and Hot Springs sites.

Emergent Vegetation Analysis

A separate analysis was conducted to estimate the potential concentration of aquatic formulations of herbicide for treatments that take place below the ordinary high water mark or bankfull. This analysis addresses emergent vegetation treatments and estimates the peak concentration in1 $ft^3$ of water.

The Level 1 ESA workgroup developed an emergent vegetation analysis method for predicting herbicide concentrations for treatments of emergent weeds. The analysis was completed for each aquatic labeled herbicide using the lowest, typical, and highest application rates. Only results from the typical application rates are shown in this BA because the proposed action limits spot applications within the aquatic influence zone to typical.

The "emergent vegetation" analysis considers the amount of herbicide that would be applied to one acre introduced into two different flows as a point source; 0.25 $m^3$/sec (8.8 cfs) and 1.0 $m^3$/sec (35.3 cfs). In reality, the application is more spread out (1 acre of unspecified shape) and in a patchy distribution. Using a water depth of 1 foot, the "estimated peak concentrations" for the emergent vegetation analysis estimates the potential maximum concentrations within one cubic foot of water (one square foot of the one acre, one foot deep). Together, the "emergent vegetation" analysis and "estimated peak concentrations" analyses provide some insight into potential maximum sustainable concentrations and potential peak concentrations in the 2 hours following application.

Typical application rates in lbs of acid equivalent/acre for aquatic formulations of herbicides included in the proposed action:

Glyphosate = 2 lb a.e./acre
Imazapyr = 0.45 lb a.e./acre
Triclopyr = 1 lb a.e./acre

The immediate treatment area, average depth of stream, and treatment durations for the Cave Creek Meadow and Hot Springs sites are:

4,047 $m^2$, 0.3 meters deep
Area = 1 acre
2 hour length of time for treatment (7,200 seconds)
Range of Flows = 0.25 $m^3$/sec (8.8 cfs), and 1.0 $m^3$/sec (35.3 cfs)

Conversion factors used*:*

| | |
|---|---|
| 1 lb= 0.45359237 kg | 1 acre = 43,560 $ft^2$ |
| 1 kilogram = 1000 grams | 1 $m^2$ = 0.0002471 acre |
| 1000 mg = 1 gram | 28.3 Liters = 1 $ft^3$ |

For a stream example: Use same Mg calculation as in Step 1.
For liters use the following:
Convert cfs ($ft^3$/sec) to ($m^3$/sec)
Convert time to seconds

**Step 1. Calculation of Mg for each aquatic labeled herbicide at the typical rate of application**

(lbs of active ingredient/acre) x (mg/lb) x acre = __Mg

Glyphosate: (2 lbs a.e./acre) x (453592.3 mg/lb) x (1 acre) = 907,184.6 Mg

Imazapyr: (0.45 lbs a.e./acre) x (453592.3 mg/lb) x (1 acre) = 204,116.53 Mg

Triclopyr: (1 lbs a.e./acre) x (453592.3 mg/lb) x (1 acre) = 453,592.3 Mg

**Step 2. Calculation of liters of water for Cave Creek Meadow and Hot Springs site under two different flows using a two hour application time.**

**Stream side treatment below bankfull**:

($m^3$/sec) x __seconds (application time) = _A_$m^3$

_A_$m^3$ x (1000 liters/ 1$m^3$) = __liters

Flow (0.25 $m^3$/sec) x application time (7,200 seconds) = 1,800 $m^3$

1,800 $m^3$ x (1000 liters/$m^3$) = 1.8 E6 liters

Flow (1.0 $m^3$/sec) x application time (7,200 seconds) = 7,200 $m^3$

7,200 $m^3$ x (1000 liters/$m^3$) = 7.2 E6 liters

**Step 3. Calculation of potential stream concentration in Mg/L for each herbicide. Results from step 1 divided by results from step 2.**

Glyphosate (907,184.6 Mg/1.8 E6 Liters) = 0.50 Mg/L (Flow at 0.25 $m^3$/sec)
Glyphosate (907,184.6 Mg/7.2 E6 Liters) = 0.13 Mg/L (Flow at 1.0 $m^3$/sec)

Imazapyr (204,116.53 Mg/1.8 E6 Liters) = 0.11 Mg/L (Flow at 0.25 $m^3$/sec)
Imazapyr (204,116.53 Mg/7.2 E6 Liters) = 0.03 Mg/L (Flow at 1.0 $m^3$/sec)

Triclopyr (453,592.3 Mg/1.8 E6 Liters) = 0.25 Mg/L (Flow at 0.25 $m^3$/sec)
Triclopyr (453,592.3 Mg/7.2 E6 Liters) = 0.06 Mg/L (Flow at 1.0 $m^3$/sec)

**Step 4. Comparison of estimated maximum concentrations from treatment on 1 acre of emergent vegetation to acute toxicity indices for aquatic organisms used in the R6 FEIS,** Table 30

Table 30 - Estimated maximum concentrations for the Cave Creek Meadow and Hot Springs site at two different flows

| Aquatic formulations and two different flows | Estimated maximum concentration | Acute toxicity indices | | | |
|---|---|---|---|---|---|
| | | **Fish** | **Invertebrates** | **Algae** | **Macrophytes** |
| Glyphosate | | 0.5 Mg/L (1/20th of LC50) | 78 Mg/L (1/10th of LC50) | 3 Mg/L (NOEC) | 3 Mg/L (NOEC) |
| 0.25 $m^3$/sec | 0.50 Mg/L | | | | |
| 1.0 $m^3$/sec | 0.13 Mg/L | | | | |
| Imazapyr | | 5 Mg/L (1/20th of LC50) | 100 Mg/L (NOEC) | 0.02 Mg/L (1/10th of EC50) | 0.013 Mg/L (EC25) |
| 0.25 $m^3$/sec | 0.11 Mg/L | | | | |
| 1.0 $m^3$/sec | 0.03 Mg/L | | | | |
| Triclopyr | | 0.26 Mg/L (1/20th of LC50) | 13.3 Mg/L (1/10th of LC50) | 4.2 Mg/L (NOEC) | 0.42 Mg/L (1/10th of EC50) |
| 0.25 $m^3$/sec | 0.25 Mg/L | | | | |
| 1.0 $m^3$/sec | 0.06 Mg/L | | | | |

Calculated levels of glyphosate and triclopyr in Step 4. above (1 acre treatment site) did not exceed any levels of concern for invertebrates, algae, or aquatic macrophytes. However, calculated levels for glyphosate did meet the toxicity value for fish under a 0.25 $m^3$/sec flow. Triclopyr did not exceed the toxicity value for fish but came close. Results for imazapyr did exceed a level of concern for algae and aquatic macrophytes under both flows.

**Step 5. Calculation and comparison of estimated peak concentrations within 1 $ft^3$ of water (1 $ft^2$ of the 1 acre emergent vegetation at a depth of 1 foot deep), Table 31**

$$((\text{lbs/acre} \times \text{mg/lb}) / (\text{ft}^2/\text{acre})) / (\text{Liters/ft}^3) = \text{Mg/L}$$

Glyphosate: ((2 lbs a.e./acre x 453592.3 mg/lb)) / (43,560 $ft^2$/1 acre) x 1 ft= 20.826 Mg/$ft^3$
(20.826 Mg/$ft^3$) / (28.32 $ft^3$/Liter) = 0.735 Mg/L

Imazapyr: ((1.5 lbs a.e./acre x 453592.3 mg/lb)) / (43,560 $ft^2$/1 acre) x 1 ft= 15.620 Mg/$ft^3$
(15.620 Mg/$ft^3$) / (28.32 $ft^3$/Liter) = 0.552 Mg/L

Triclopyr: ((1 lbs a.e./acre x 453592.3 mg/lb)) / (43,560 $ft^2$/1 acre) x 1 ft= 10.413 Mg/$ft^3$
(10.413 Mg/$ft^3$) / (28.32 $ft^3$/Liter) = 0.368 Mg/L

Table 31 - Comparison of Estimated Peak Concentrations within 1ft$^3$ of water to Acute Toxicity Indices

| Aquatic formulations at typical application rate | Estimated Peak concentration on 1 ft$^3$ of water | Acute toxicity indices | | | |
|---|---|---|---|---|---|
| | | Fish | Invertebrates | Algae | Macrophytes |
| Glyphosate | 0.735 Mg/L | 0.5 Mg/L (1/20th of LC50) | 78 Mg/L (1/10th of LC50) | 3 Mg/L (NOEC) | 3 Mg/L (NOEC) |
| Imazapyr | 0.552 Mg/L | 5 Mg/L (1/20th of LC50) | 100 Mg/L (NOEC) | 0.02 Mg/L (1/10th of EC50) | 0.013 Mg/L (EC25) |
| Triclopyr | 0.368 Mg/L | 0.26 Mg/L (1/20th of LC50) | 13.3 Mg/L (1/10th of LC50) | 4.2 Mg/L (NOEC) | 0.42 Mg/L (1/10th of EC50) |

Although Steps 1 through Step 5 above are not a peer-reviewed, scientifically based method for estimating herbicide concentration as a result of treating emergent vegetation, the results were used to provide ONF with an indication of what the estimated peak concentrations would be in 1 ft$^3$ water. Estimated peak concentrations within1 ft$^3$ of water from Step 5 above did result in glyphosate and triclopyr exceeding the level of concern for fish. Imazapyr exceeded the level of concern for algae and macrophytes. The interpretation of results from Step 4 and Step 5 needs to consider site-specific conditions that could influence the estimated concentrations and the reality of application methods under the Proposed Action. Several conditions that influence herbicide concentration down or up were noted and discussed at the September 28, 2006 Level 1 meeting. Site-specific conditions that would reduce the actual herbicide concentrations relative to those estimated here are:

- absorption by vegetation (vegetation interception)
- precise application methods reducing drift or droplets
- degradation over time before inundation and/or immediate rainfall
- assumes solid/continuous application whereas weeds are more patchy in distribution

Site-specific conditions that could reduce dilution or increase the concentration are 1) obstructions to flows that create backwater areas or eddies which may have slower mixing potential, therefore slower dilution of contaminants than in most areas of the stream; and 2) a combination of treatments above bankfull and below bankfull. Conditions that may increase herbicide concentration are expected to be fully offset by the conditions that reduce herbicide concentrations. All herbicide applied does not go directly into the water as assumed by Steps 1 through Step 5 or the SERA risk assessment scenario model. The amount of herbicide added to the water has a very significant influence on the resulting concentrations. Therefore, even with conditions present that could serve to underestimate concentrations, actual herbicide concentrations in the water are not expected to approach the levels of concern for fish.

There is no model or analysis that captures concentrations from a combination of treatments above bankfull and below bankfull, hereto referred to as a simultaneous treatment. A very rough estimate or general ideal of what the concentration would be for a simultaneous treatment can be calculated by adding the SERA risk assessment worksheet concentration to the emergent vegetation concentration. For example, the concentration in water of glyphosate at 2 lb/acre for the Hot Springs site is added to the calculated concentration for a 1 acre emergent vegetation treatment below bankfull.

Table 32 shows that concentrations may mathematically exceed a level of concern for glyphosate. However, such concentrations will not occur operationally. An individual would have to stand in a contained 1 $ft^3$ of water and pour 2 lbs of glyphosate or 1 lb of triclopyr directly into the waterbody for concentrations to conceivably approach the calculated levels. It is unrealistic to expect all 2 lbs of glyphosate would be delivered into 1 $ft^3$ of water when the most amount of glyphosate an applicator can carry for spot application is 2 lb/acre. In addition, the proposed action does not allow broadcasting within 50 ft of waterbodies and prudent application by licensed applicators would minimize the likelihood of herbicide delivery to water

**Table 32 - Ten-Acre Risk Assessment Model plus emergent vegetation**

| Risk Assessment model on 10 acres | Emergent Vegetation Analysis | Simultaneous Treatment |
|---|---|---|
| Upper concentration in water for Glyphosate at 2 lb/acre for Hot Springs is 0.15 mg/l | Calculation for floodplain wedge analysis at 8.8 cfs cfs (0.25 $m^3$/sec) is 0.50 mg/l | 0.15 mg/l + 0.50 mg/l = 0.65 mg/l |

Because the estimated concentrations of glyphosate and triclopyr reached the level of concern for fish for a 1 acre emergent vegetation treatment, an adjacent upland treatment of 10 acres (similar to conditions modeled in GLEAMS) coupled with a 1 acre emergent vegetation treatment has the potential to reach a level of concern. However, the probability of exceeding a level of concern for fish as a result of a simultaneous treatment on ONF is extremely low. Actual infestations most closely mimicking a simultaneous treatment scenario is an infestation of Japanese knotweed. The WSDOA monitored treatments of emergent and adjacent upland invasive vegetation from 2003 to 2005 and indicated that residual glyphosate levels in the water were well below State drinking water standards, which are more restrictive than the toxicity index for fish. The results support the perspective that simultaneous treatments are not likely to result in concentrations that exceed those modeled in the SERA risk assessments or calculated for emergent vegetation treatments because:

- Operationally it is impossible to meet the concentrations calculated above
- No applicator will be pouring 2 lbs of glyphosate or 1 lb of triclopyr into 1 $ft^3$ of water
- Site-specific conditions (factors) that reduce herbicide concentrations (i.e., interception by vegetation, etc.)

*Unknown future infestations (EDRR).* The Early Detection/Rapid Response process under the Proposed Action allows for treatment "within the scope of the EIS" to occur on new, unknown, and unpredicted infestations found over the next five to fifteen years. The analysis for treatments within the aquatic influence zone for unknown future infestations is summarized below into two different sections: Treatments above bankfull and Emergent Vegetation Treatments. Future treatments of unknown infestations will need to meet the scope of the analysis for the existing infestation. This process is outlined in the implementation and planning section of the proposed action. If a treatment method (i.e. aerial spraying) or herbicide type that was not included in this analysis is identified as being more effective, then a separate analysis will need to be conducted. Included below is the basis for treatment caps with respect to unknown future infestations.

1) Treatments above bankfull. The basis of the analysis for treatments from bankfull to upland are the HQ's from the SERA risk assessment scenario worksheets for the Cave Creek Meadow and the Hot Springs site, and the assumptions of the worst-case scenario (10 contiguous acres of broadcast spray, adjacent to a 1.8 cfs stream, sparsely vegetated). The invasive plant inventory on GPNF and CRGNSA is mapped to the 6$^{th}$ field HUC or subwatershed, it would be easier to track treatments at this level for all practical purposes. Ten contiguous acres of treatment in a 6$^{th}$ field subwatershed are not likely to exceed the HQ's calculated for the Cave Creek Meadow and Hot Springs site. Ten acres of infestation spread out in patches (not contiguous) throughout a 6$^{th}$ field sub-watershed are also not likely to exceed the HQ's in the SERA risk assessment scenario because there is more water and less herbicide in each patch area than that estimated in the scenario. Based on knowledge of rainfall patterns, stream sizes, fish species present, it is reasonable to expect that treatments within the riparian/aquatic influence areas within a 6$^{th}$ field subwatershed would not exceed the HQ's estimated by the SERA risk assessment worksheet calculations. To provide a limit on the extent of treatment and herbicide exposure for projects implemented under EDRR where there are federally listed fish or designated critical habitat, no more than 10 acres per year within the riparian area of any 1.5 mile stream reach within a 6$^{th}$ field watershed would be treated at a single time.

2) Emergent Vegetation treatments. The basis for the emergent vegetation analysis, also known as the "floodplain wedge" analysis, is from the 1 contiguous acre of emergent vegetation treatment that assumes no interception or absorption by vegetation. This analysis assumes work below bankfull when water is at bankfull. Treating 1 contiguous acre within a 6$^{th}$ field subwatershed is not likely to exceed the water contamination estimates from the emergent vegetation analysis (2 hour average treatment time) because vegetation would absorb the herbicide, not all herbicide applied would enter the water, degradation could occur before inundation, and herbicides could be applied by specific/precise methods limiting direct water contamination.

For patchy infestations (not contiguous) of 1 acre or less of emergent vegetation within a 6$^{th}$ field subwatershed, contamination is not likely to reach or exceed the amounts estimated in the emergent vegetation analysis or the 1 ft$^3$ of water analysis for reasons stated above, and because larger amounts of water relative to the amount of herbicide applied would dilute concentrations.

The 1 ft$^3$ of water analysis was used to estimate peak concentrations from emergent vegetation treatment. If the site was shallower than 1 ft deep, estimated concentrations theoretically could be higher. If deeper, then theoretically concentrations would be less than those calculated. The 1 ft$^3$ of water analysis does not account for absorption by vegetation, and other factors described above. If infestations are patchy (not contiguous), a total of 7 acres, within a 6th field HUC, are not likely to exceed the estimated water concentrations. The 7 acres was taken from the existing treatment area for the Cave Creek Meadow site and applied as a limitation for EDRR. To limit the extent of emergent vegetation treatment below bankfull where there are federally listed fish or critical habitat, no more than 7 acres of emergent vegetation would be treated annually within a 6th field watershed.

## Proximity, Probability, and Magnitude of Effects from Herbicide Use

By using the quantitative analysis above, the effects to each ESA listed fish species and habitat can be described by further analyzing factors of proximity, probability, magnitude, duration, nature, distribution, frequency, and timing of the proposed action. Habitat pathway indicators discussed in this BA for herbicide use is "chemical contaminants" and "sediment/turbidity". The proposed action had no causal mechanisms to affect any other matrix indicators, therefore this BA will address only those indicators mentioned above. This analysis section complements the designated critical habitat analysis.

### *Chemical Contaminants Indicator*

Baseline information for this indicator within the GPNF and CRGNSA is "properly functioning" for the majority of watersheds. The discussions below compliment the analysis for designated critical habitat.

*Clearfork Cowlitz River*. On April 25, 2002 a small oil spill was detected at Jody's bridge located on fs rd 1270, downstream from confluence of Ohanapecosh and Clearfork of Cowlitz. The source of this pollution was undetermined until April 29, 2002. Because of the presence of development along the Cowlitz River the potential exists for chemical/nutrient contamination of streams. Development in the floodplain of the Cowlitz River includes the town of Randle, ranches, and lumber mills.

*Upper Cowlitz River*. The town of Packwood, which is located in the middle of the watershed, contains septic tanks and lawns that are located near the Cowlitz River. With the exception of stream temperature, there is no water quality data for streams in the watershed. A fuel oil spill originating from a storage tank on National Park lands, entered the Upper Cowlitz River watershed on or about April 26, 2002. In addition, this spill points out the potential for such spills to occur in a developed setting.

*White Salmon River*. There is no known chemical contamination, nutrient enrichment, or active mining activities occurring within the watershed. Cattle and sheep grazing is occurring in the upper portions of the watershed (above anadromy). In 1992 fecal coliform was monitored monthly in the White Salmon River just above the town of Trout Lake throughout the period cattle were on the Mt. Adams allotment. Peak coliform levels measured 40 colonies/100ml, which is within the state water quality standard for fecal coliform which is 50 colonies/100ml for class AA streams. The highest level of coliform was found in May, 1993 when 45 colonies/100 ml was found. This peak occurred prior to cattle entering the allotment, suggesting that other sources are responsible for coliform levels found there. Over the 18 years of fecal coliform monitoring, the coliform levels ranged from 2 - 45.

In Trout Lake Creek fecal coliform levels were collected from 1976 to 1995 on Forest Service land and all were within state standards. However, levels downstream of Forest lands have far exceeded the state standard due to runoff into irrigation ditches (Trout Lake Creek Watershed Analysis, 1996). There are no chemical contamination CWA 303d designated reaches on Forest Service land in the watershed.

Since coliform levels in the White Salmon River were close to not meeting the state standard, this indicator is determined to be Functioning At Risk.

*East Fork Lewis River*. An analysis of the chemical constituents within waters of the East Fork Lewis River Watershed has not been performed. However, based on professional knowledge regarding uses in the watershed and the biological condition of waters in the East Fork Lewis River, chemical water pollution is not likely. It is likely that the waters in the Upper East Fork Lewis River are actually nutrient limited based on the lack of instream wood or low frequency of holding pools that would allow the accumulation of organic material that would contribute to the productivity of the system. Turbidity from sediment delivery via roads has not been measured in the watershed. Some riparian road systems do contribute sediment to the East Fork Lewis River and its tributaries. Spring road maintenance (including blading) along the 42 Road is only permitted after July 1 due to observed turbidity in the East Fork Lewis River, which occurred during a rainstorm that immediately followed surface blading activities. Turbid water has also been observed entering Copper Creek near the 4109 Road, flowing directly from a small channel linking the muddy road surface to the stream. A resource concern in the Copper Creek drainage includes an abandoned system of copper mines near the Miner's Creek and Copper Creek confluence. Several spur roads (4107 system) lead to and radiate from the abandoned site, and lie entirely within riparian reserves. The abandoned road system, which has drainage problems, is recommended for decommissioning in the Gifford Pinchot National Forest Roads Analysis (2002) and the 2nd Iteration Upper East Fork Lewis River Watershed Analysis.

Water samples are collected monthly at the Sunset Campground well and tested for the presence of fecal coliform. Some past tests have indicated unacceptable levels of fecal coliform for consumption. It is unclear how the subsurface water becomes contaminated, and it is recommended that instream monitoring occur in the future up and downstream of the site, which is located approximately 100 feet from the East Fork Lewis River. The river is listed (CWA 303(d)) for fecal coliform exceedances on private lands, downstream of National Forest.

Because of the high density of riparian roads in the Upper East Fork Lewis River, observed turbidity and concerns regarding abandoned mines in the Copper Creek sub-watershed, this indicator is considered to be functioning at risk until planned drainage and surface repairs on the 42 road and proposed road decommissioning, weatherization and maintenance occurs, and an evaluation of the abandoned mining operations at Miner's Creek is made.

*Tilton Watershed.* Parts of the Tilton River and West Fork Tilton had low values for dissolved oxygen. In addition The Tilton River flows by the City of Morton and there are many houses and ranches near the banks of the river, w

It is expected that the baseline condition will not change as a result of the Proposed Action. The discussions below complement the analysis for designated critical habitat.

### ***Proximity of streams to treatment areas***

Many of the treatment areas are on or near roads that cross either perennial or intermittent streams on GPNF and CRGNSA. For the purpose of analyzing close proximity of treatment areas to listed fish, streams containing listed fish that flow through treatment areas were identified, and a width of 100 ft from the stream up into the riparian area was used to identify treatment areas that may be located immediately adjacent to a stream (i.e., up to bankfull) with listed fish, see Table 33. For the GPNF, a total of 24 treatment areas identified in Appendix A of the GPNF and CRGNSA DEIS are within 100 feet of streams with ESA fish and/or designated critical habitat, and for the CRGNSA a total of 7 on CRGNSA, Table 33. The majority of sites on GPNF within 100 feet of streams are either campgrounds or parking areas. Eight of the 24 treatment areas on GPNF are road-related treatments and cross streams with listed fish, and 2 are quarries, Table 33. There are no road-related treatments on CRGNSA. See Appendix F of this BA for a list of roads that cross streams on GPNF where there are listed fish and refer to Appendix A in GPNF and CRGNSA DEIS (pg A-23) for road segments associated with high potential for herbicide delivery.

Out of a total of 102 treatment areas for the GPNF listed in Appendix A of the GPNF and CRGNSA DEIS, a total of 26 treatment areas on GPNF and 2 on CRGNSA are located entirely **outside** of sixth field subwatersheds containing federally listed fish, and are therefore considered to have no effect on federally listed fish species. A total of 51 treatment areas on GPNF are located **inside** sixth field subwatersheds containing federally listed fish and are **outside** of the 100 ft buffer of streams with listed fish. Two sites on CRGNSA are **outside** of the 100 ft buffer of streams with listed fish. See Appendix G of this BA for a list of treatment areas located outside of 100 ft stream buffers.

Sites such as the 33-05m1 (Cave Creek Meadows) in the Upper White Salmon watershed on GPNF, 22-03 St. Cloud/Sam Walker (CRGNSA), 22-04 Hot Springs (CRGNSA), 22-06 Collin's Slide (CRGNSA), and 22-13 Miller Island (CRGNSA) are sites that may include invasive plant treatments below bankfull as well as above bankfull.

The Columbia River provides a migration corridor to all pacific salmon. Tributaries to the Columbia River on the Washington side, Wind River, Lewis River, and Cowlitz Valley River currently provide habitat for pacific salmon. The Lewis River up to the lower falls and Columbia River provide habitat for known populations of bull trout. Herbicide application is expected to occur on the streambanks and gravel bars in immediate proximity to rearing and migration habitat within the rivers listed above. Spring chinook salmon may occasionally utilize some of these stream reaches for spawning, while coho is limited to few streams in the Lower Cispus River. Steelhead and Chinook share a majority of the Wind River, while the lower portions of the Little White Salmon, White Salmon, and Klickitat provide habitat to all species that are able to access habitat. Chum are known to spawn in few tributaries along the mainstem of the Columbia River. Bull trout use is limited to certain streams in the Lewis River (mainstem, Rush Creek, Pine Creek) and the mainstem of the Columbia River and exact spawning habitat is unknown. **(Proximity is high)**

Table 33 - Treatment Areas on GPNF and CRGNSA Within 100 feet of Streams With Listed Fish.

| 5th Field Watershed | Stream Name | Treatment Area Identification | Listed Fish Species and Life Stages found within Stream |
|---|---|---|---|
| Clearfork Cowlitz River | *Clear Fork Cowlitz River* | 35-14a Road-related | LCS = Presence/Migration, Known Spawning LCCo, LCC = Presence/Migration |
| | | 35-18r1 Campground | LCS = Presence/Migration, Known Spawning LCCo, LCC = Presence/Migration |
| | *Cowlitz River* | 35-18 Road-related | LCS , LCCo, LCC = Presence/Migration |
| | | 35-18qa Quarry | LCS , LCCo, LCC = Presence/Migration |
| | | 35-18r1 Campground | LCS , LCCo, LCC = Presence/Migration |
| | *Muddy Fork Cowlitz River* | 35-18 Road-related | LCS , LCCo, LCC = Presence/Migration |
| | *Ohanapecosh River* | 35-18r1 Campground | LCS , LCCo, LCC = Presence/Migration |
| | *Purcell Creek* | 35-18r1 Campground | LCS , LCCo = Presence/Migration |
| East Fork Lewis River | Unnamed Streams | 31-01a Road-related | LCS = Presence/Migration |
| | | 31-01r2 CampDispersed | LCS = Presence/Migration |
| | *East Fork Lewis River* | 31-01a Road-related | LCS = Presence/Migration, Known Juvenile Rearing, Known Spawning |
| | | 31-01r2 CampDispersed | LCS = Presence/Migration, Known Juvenile Rearing, Known Spawning |
| | *Green Fork* | 31-01a Road-related | LCS = Presence/Migration, Known Juvenile Rearing, Known Spawning |
| | | 31-01r2 CampDispersed | LCS = Presence/Migration, Known Juvenile Rearing, Known Spawning |
| | *Little Creek* | 31-01a Road-related | LCS = Presence/Migration, Known Juvenile Rearing, Known Spawning |
| | | 31-01r2 CampDispersed | LCS = Presence/Migration, Known Juvenile Rearing, Known Spawning |
| | *Slide Creek* | 31-01a Road-related | LCS = Presence/Migration, Known Juvenile Rearing |
| | | 31-01r2 CampDispersed | LCS = Presence/Migration, Known Juvenile Rearing |
| Lower Cispus River | Unnamed Streams | 35-16a Road-related | LCS , LCCo, LCC = Presence/Migration |
| | *Camp Creek* | 35-16a Road-related | LCS , LCCo = Presence/Migration |
| | *Cispus River* | 35-16a Road-related | LCS , LCCo, LCC = Presence/Migration |
| | | 35-16r1 Campground | LCS , LCCo, LCC = Presence/Migration |
| | *Covell Creek* | 35-16a Road-related | LCS , LCCo = Presence/Migration |
| | | 35-16r0 Admin | LCS , LCCo = Presence/Migration |
| | *Dry Creek* | 35-16a Road-related | LCCo = Presence/Migration |
| | *Greenhorn Creek* | 35-16a Road-related | LCS = Presence/Migration |
| | *Iron Creek* | 35-16a Road-related | LCS , LCCo = Presence/Migration |
| | | 35-16r1 Campground | LCS , LCCo = Presence/Migration |

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| | | 35-16r3 Parking | LCS , LCCo = Presence/Migration |
| | *Woods Creek* | 35-16a Road-related | LCS , LCCo = Presence/Migration |
| | *Yellowjacket Creek* | 35-16a Road-related | LCS , LCCo, LCC = Presence/Migration |
| Muddy River | Unnamed Streams | 33-12a Road-related | LCS = Presence/Migration |
| | *Clear Creek* | 33-12a Road-related | LCS = Presence/Migration |
| | | 33-12r2 CampDispersed | LCS = Presence/Migration |
| | *Muddy River* | 33-12a Road-related | LCS = Presence/Migration<br>CRBT = Presence/Migration |
| | | 33-12r2 CampDispersed | LCS = Presence/Migration<br>CRBT = Presence/Migration |
| Swift Reservoir - Lewis River | Unnamed Streams | 33-12a Road-related | LCS = Presence/Migration |
| Upper Cispus River | *Cispus River* | 33-11a Road-related | LCS , LCCo, LCC = Presence/Migration |
| | | 35-16a Road-related | LCS , LCCo, LCC = Presence/Migration |
| | | 35-16q Quarry | LCS , LCCo, LCC = Presence/Migration |
| | *North Fork Cispus River* | 35-16a Road-related | LCS , LCCo, LCC = Presence/Migration |
| | | 35-16r1 Campground | LCS , LCCo, LCC = Presence/Migration |
| | *Yozoo Creek* | 35-16a Road-related | LCS = Presence/Migration |
| Upper Cowlitz River | *Coal Creek* | 35-18 Road-related | LCS , LCCo, LCC = Presence/Migration |
| | | 35-14a Road-related | LCS , LCCo = Presence/Migration |
| | *Johnson Creek* | 35-14 Road-related | LCS , LCCo, LCC = Presence/Migration |
| | *Skate Creek* | 35-17r3 Parking | LCS , LCCo, LCC = Presence/Migration |
| | | 35-18 Road-related | LCS , LCCo, LCC = Presence/Migration |
| Upper Lewis River | *Crab Creek* | 33-12a Road-related | LCS = Presence/Migration |
| | *Lewis River* | 33-12a Road-related | LCS, CRBT = Presence/Migration |
| | *Little Creek* | 33-12a Road-related | LCS = Presence/Migration |
| | *Rush Creek* | 33-12a Road-related | LCS = Presence/Migration<br>CRBT = Presence/Migration, Known Juvenile Rearing, Known Spawning |
| Wind River | Unnamed stream | 33-05a Road-related | LCS , LCCo = Presence/Migration |
| | *Cedar Creek* | 33-05a Road-related | LCS = Presence/Migration |
| | *Dry Creek* | 33-03r2 CampDispersed | LCS = Presence/Migration, Known Juvenile Rearing, Known Spawning<br>LCC = Presence/Migration |
| | *Falls Creek* | 33-06r3 Parking | LCS = Presence/Migration, Known Juvenile Rearing, Known Spawning<br>LCC = Presence/Migration |
| | *Layout Creek* | 33-03r2 CampDispersed | LCS = Presence/Migration, Known Juvenile Rearing, Known Spawning |

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| | *Mouse Creek* | 33-05a Road-related | LCS = Presence/Migration, Known Juvenile Rearing |
| | *Panther Creek* | 33-06r1 Campground | LCS = Presence/Migration, Known Juvenile Rearing, Known Spawning |
| | | 33-06r2 CampDispersed | LCS = Presence/Migration, Known Juvenile Rearing, Known Spawning |
| | *Paradise Creek* | 33-06r1 Campground | LCS = Presence/Migration, Known Juvenile Rearing, Known Spawning<br>LCC = Presence/Migration |
| | | 33-03r0 Admin | LCS = Presence/Migration, Known Juvenile Rearing, Known Spawning<br>LCC = Presence/Migration |
| | | 33-03r2 CampDispersed | LCS = Presence/Migration |
| | *Trout Creek* | 33-03r2 CampDispersed | LCS = Presence/Migration, Known Juvenile Rearing, Known Spawning<br>LCC = Presence/Migration |
| | | 33-03r3 Parking | LCS = Presence/Migration, Known Juvenile Rearing, Known Spawning<br>LCC = Presence/Migration |
| | *Wind River* | 33-03r0 Admin | LCS, LCC = Presence/Migration, Known Juvenile Rearing, Known Spawning |
| | | 33-03r1 Campground | LCS, LCC = Presence/Migration, Known Juvenile Rearing, Known Spawning |
| | | 33-06r1 Campground | LCS = Presence/Migration, Known Juvenile Rearing, Known Spawning<br>LCC = Presence/Migration |
| | *Trapper Creek* | 33-03r0 Admin | LCS = Presence/Migration, Known Juvenile Rearing, Known Spawning<br>LCC = Presence/Migration |
| **Columbia Gorge Tributaries | *Duncan Creek* | 22-03<br>St. Cloud/Sam Walker | LCCo, CRC = Presence/Migration<br>LCS = Presence/Migration, Known Spawning |
| | *Greenleaf Creek* | 22-04 Hot Springs site | LCCo = Presence/Migration, Known Spawning<br>LCS = Presence/Migration, Known Juvenile Rearing, Known Spawning |
| | Unnamed streams (referred to as Goodbear and Archer Creeks – Refer to Appendix H) | 22-03 St. Cloud/Sam Walker | LCCo, LCC, CRC = Presence/Migration |
| **Lower Klickitat River | *Klickitat River* | 22-10 Balfour | MCS, CRBT = Presence/Migration |
| | | 22-16 Klickitat Rails to Trails | MCS = Presence/Migration, Known Juvenile Rearing, Known Spawning<br>CRBT = Presence/Migration |
| | *Logging Camp Canyon* | 22-16 Klickitat Rails to Trails | MCS = Presence/Migration |
| | *Knight Canyon* | 22-16 Klickitat Rails to Trails | CRBT = Presence/Migration |
| | *Wide Sky Canyon* | 22-16 Klickitat Rails to Trails | CRBT = Presence/Migration |
| | *Unnamed stream* | 22-10 Balfour | MCS, CRBT = Presumed |
| **Middle Columbia/Grays Creek | *Unnamed stream* | 22-06 Collin's Slide (Refer to Appendix H) | LCS, LCCo = Presence/Migration below fish barrier at Hwy 14 and Railroad (Treatment located above barrier) |
| | *Collin's Creek* | 22-06 Collin's Slide (Refer to Appendix H) | LCS, LCCo = Presence/Migration below fish barrier at Hwy 14 and Railroad (Treatment located above barrier) |

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| | *Major Creek* | 22-09<br>Burdoin/Catherine/Major Cks (furthest east site only – Refer to Appendix H) | LCCo = Presence/Migration, Known Juvenile Rearing<br>MCS = Presence/Migration, Known Juvenile Rearing, Known Spawning |
| | *Catherine Creek* | 22-09<br>Burdoin/Catherine/Major Cks (east site only- Refer to Appendix H) | LCCo = Presence/Migration<br>MCS = Presence/Migration, Known Juvenile Rearing, Known Spawning |
| **White Salmon River | *Lower White Salmon River* | 22-15 South BZ (less than 0.10 acre in buffer- Refer to Appendix H) | MCS = Presence/Migration up to Condit Dam, located below treatment area<br>CRBT = Presumed |
| **Mainstem of Columbia River within CRGNSA | *Columbia River* | 22-13 Miller Island | Upper Columbia River, Middle Columbi River, and Snake River migrating fish |
| | | 22-03<br>St. Cloud/Sam Walker | Upper Columbia River, Middle Columbi River, and Snake River migrating fish |

*LCS = Lower Columbia River Steelhead, MCS = Middle Columbia River Steelhead, LCCo = Lower Columbia River Coho, LCC = Lower Columbia River Chinook, CRC = Columbia River Chum, CRBT = Columbia River Bull Trout
**Refer to Appendix G and H for additional information on CRGNSA sites

***Probability of Herbicide Exposure (increased chemical contaminants)***

The probability that an ESA listed fish will be exposed to non aquatic formulations of herbicide is very low. The probability of being exposed to the aquatic formulation of triclopyr is also very low. However, there is a probability of being exposed to aquatic formulations of glyphosate and imazapyr but the probability of being exposed at levels of concern is very low. Glyphosate and imazapyr have a low propensity for leaching, but can enter water by other means such as overspray, drift, or erosion of contaminated soil. This probability is discussed by potential exposure vector below:

*Water contamination from hand/select methods*: The probability of hand-select methods, such as foliar painting a knotweed leaf, resulting in herbicides coming in contact with water is low. The plant begins to take in the herbicide immediately after it is applied directly to a leaf or stem with the use of approved binding surfactants. Overland transport to the water column from stem injections is unlikely because the injected herbicide is contained within the plant stem. Transfer through the stem to the roots might allow some herbicide to enter the soil, but it is likely to adhere to soil particles or is degraded by soil microbes before leaching into the ground water. In addition, other general protection measures of the applicators themselves result in a very low risk of water contamination. See Chapter 2 of this BA for more information on herbicide properties. (**Probability is very low**).

*Water contamination from drift*: The ability to contaminate water varies with the herbicide application method. For example, spot and hand application methods substantially reduce the potential for loss of non-target vegetation because there is little potential for drift. Drift is most associated with broadcast treatments and can be mitigated to some extent by the applicator. Droplet size is key to drift as larger droplets are heavier and therefore less affected by wind and evaporation. Figure 5 demonstrates the relationship between droplet size and buffer distance. As droplet size increases, the distance herbicide may travel in concentrations sufficient to harm plants decreases.

Dr. Harold Thistle, a physical scientist from the USDA in Morgantown, WV, specializes in computer modeling of herbicide drift. He modeled the potential for glyphosate to impact non-target vegetation from drift. The model predicted a 100-foot broadcast buffer would prevent glyphosate from harming plant species that are further away.

Factors affecting droplet size are nozzle type, orifice size and spray angle, as well as spray pressure, and the physical properties of the spray mixture. Wind speed restrictions also substantially contribute to a reduction in drift (Spray Drift Task Force, 2001). By simply changing the type of nozzle (diameter of pore size) used during broadcast treatments, the drift potential of herbicide can be effectively and substantially decreased as the droplet size forced out the nozzle is increased in size (Dr. Harold Thistle, personal communication, April 2006).

Spray nozzle pressure, the amount of water applied with the herbicide, and herbicide release height are also controllable determinants of drift potential. Weather conditions such as wind speed and direction, air mass stability, temperature and humidity and herbicide volatility also affect drift.

Commercial drift reduction agents are available that are designed to reduce drift beyond the capabilities of the determinants previously described. These products create larger and more cohesive droplets that are less apt to break into smaller particles as they fall through the air. They reduce the percentage of smaller, lighter particles that are the size most apt to drift.

Marrs, R.H., in the 1989 publication, “Assessment of the Effects of Herbicide Spray Drift on a Range of Plant Species of Conservation Interest,” examined the distances drift affected non-target vascular plants using broadcast treatment methods similar to those considered in this BA. Their observations are consistent with drift-deposition models in which the fallout of herbicide droplets has been measured. The maximum safe distance at which no lethal effects were found was 20 feet, but for most herbicides the distance was 7 feet. Generally, damage symptoms were found at greater distances than lethal effects, but in most cases there was rapid recovery by the end of the growing season. No effects were seen to vascular non-target vegetation further than 66 feet from the broadcast treatment zone. Little information is available for how drift distances may effect non-vascular non-target vegetation. The distance spray drift will travel can vary substantially based on wind speed, topography, temperature, the herbicide applied, and the vegetation present, see Figure 4.

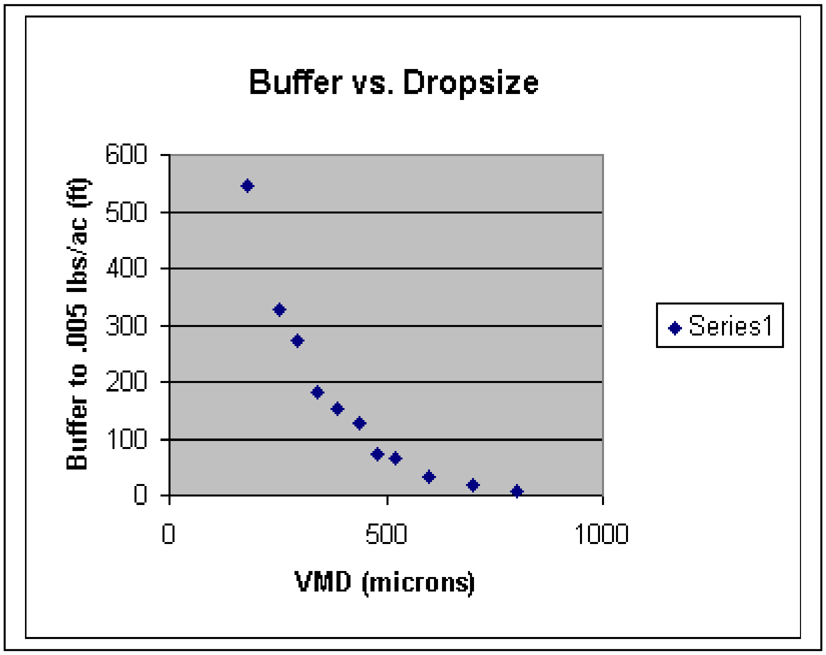


**Figure 4 - Droplet Size and Drift Distance**

Drift is the most likely vector for herbicides coming in contact with water from riparian area or emergent vegetation treatment sites. Some locations may have some invasive plants such as knotweed, reed canary grass, or purple loosestrife growing on exposed gravel bars, shorelines, or streambanks that would be treated with a spot-spray. In other cases, invasive plants may be emerging from water along shorelines year-round. Such areas are limited in spatial extent, and given the distance between target vegetation and water, it is likely that much of the herbicide will have been sprayed on to the plant.

Label restrictions, restrictions on application rate, type of herbicide, application method restrictions, buffers, and the use of a surfactant all factor in to limiting the potential amount of drift. In addition, roads that have a high potential for herbicide delivery have been identified and have added restrictions, such as no broadcasting. Although there will be no herbicide applied directly to the water column for purposes of treating submerged vegetation, there may be some fine droplets from spot applications coming in contact with water as a result of treating emergent vegetation. **(Probability is low**).

*Water contamination from contaminated soil:* Riparian treatments are limited in spatial extent, and given the restrictions noted above, it is likely that much of the herbicide will have either adhered to the soil or broken down not being available for transport into the water. See Chapter 2 of this BA for more information on herbicide properties. **(Probability is low).**

*Water contamination from an accidental spill*: Concentrations of herbicides in the water as a result of an accidental spill depend on the rate of application and the streams' ratio of surface area to volume. The persistence of the herbicide in water depends on the length of stream where the accidental spill took place, velocity of stream flow, and hydrologic characteristics of the stream channel. The concentration of herbicides would decrease rapidly down-stream because of dilution and interactions with physical and biological properties of the stream system (Norris et al.1991). Project design criteria would reduce the potential for spills to occur, and if an accident were to occur, minimizes the magnitude and intensity of impacts. An herbicide transportation and handling plan is a project requirement. This plan would address spill prevention and containment.

Extensive monitoring of herbicide application using similar treatment methods has occurred over the last few years in NW Oregon and Western Washington. All personnel applying the herbicides are well trained and licensed. No accidental spills have been reported. The risk of an accidental spill under the proposed action is extremely low. (**Probability is extremely low**).

*Probability of exposure to aquatic organisms*: Localized effects to individual aquatic plants are possible as a result of treatments that occur within the bankfull channel. These localized effects would not disrupt aquatic ecosystem function of the aquatic food web because of the low potential to reach toxicity levels for each trophic level under spot and hand/select applications with glyphosate and imazapyr. Spot applications of aquatic formulations of glyphosate and imazapyr are not likely to result in harmful amounts coming in contact with water and harming fish, invertebrates, and algae. However, some aquatic plants would be damaged at the immediate spot spray locations if enough herbicide comes in contact with the aquatic plant. It is believed that there will not be enough herbicide coming in contact with water to result in extensive aquatic plant mortality. For example, the use of glyphosate will not be applied directly to water for weed control, but if it does enter the water it is bound tightly to dissolved and suspended particles and to bottom sediments and becomes inactive.

In general, juvenile and adult fish will avoid the presence of human beings and will more than likely swim away from predator like shadows overcasting waterbodies. The possibility of a fish being present in the immediate water column where spot spray applications may be taking place up to the water's edge is low. However, fry avoid faster flows and tend to rear along the shoreline or around large substrate/wood where flow is slower. Fry tend to avoid overcastting shadows as well but can return to their previous location after being disturbed if a human stands still enough near the stream margin. It is unlikely that an applicator will stand still for a period of time when treating emergent vegetation.

Fish may be exposed to aquatic formulations of glyphosate and imazapyr where there is emergent vegetation treatment in smaller streams where they are present. Fish in the mainstem of rivers and streams may not be exposed because of the river's large flow and density of fish during time of treatment. Smaller streams however, do not have as much flow and may not dilute herbicides as quickly. Fish in smaller streams tend to be juveniles and fry, and are also lower in density, thus lowering the potential for exposure. Although there will be no herbicide applied directly to the water column for purposes of treating submerged vegetation, there may be some fine droplets from spot applications coming in contact with water as a result of treating emergent vegetation. See water contamination from drift discussion above. (**Probability is moderate**).

*Direct Mortality due to Trampling:* People working in water have the potential to impact listed fish by disturbing spawning fish or accidentally stepping on redds while conducting the physical application of either spot or hand/select methods. The extent of these impacts depends on the species present, life stage, number of people in the water, and the amount of time spent in the water. Impacts to redds or spawning fish is unlikely to occur because activities would be planned and scheduled to avoid disturbance of spawning fish or damage to redds. Fry, juveniles, and adults generally avoid predators and are likely to swim away when people are present in the water. Treatment sites that include treatments of emergent vegetation or activities below bankfull have the potential for people working in or near water. The knotweed infestation on CRGNSA at the 22-06 Collin's slide area is along the streambank up to the water's edge. People conducting treatments at this site will generally be on the banks, although they may occasionally step in the water to access some of the knotweed stems.

Future treatments under EDRR would avoid impacts to redds or spawning fish because activities would be planned and scheduled to avoid disturbance of spawning fish or damage to redds. This will reduce the likelihood of negative impacts to fish during spawning and minimize the possibility of stepping on redds. There is the potential for an individual to accidentally step on a redd or displace spawning fish while conducting emergent invasive vegetation treatments, especially in small streams that provide key spawning habitat, should there be a need to wade across a stream or access an island. The larger the stream, the less of a disturbance because of the area available for fish to seek cover or refuge. In smaller streams, the area for cover and refuge is less. Therefore, there is a higher risk of disturbing spawning adults or stepping on redds on smaller streams. (**Probability is low**)

***Magnitude of the Effect***

The severity and intensity of herbicides coming in contact with streams containing ESA listed fish is variable due to different application techniques and specific herbicide properties. The severity and intensity of the effect will depend on the size of stream, type of waterbody, herbicide type and it's properties. It is assumed that there will be more unknown future infestations on GPNF and CRGNSA that include treatment of emergent vegetation in close proximity to ESA listed fish.

*Hand/select Methods:* The magnitude of hand-select methods resulting in water contamination is discountable because the application will be directed to a leaf or stem, and the herbicide and surfactant will quickly bind to the plant material. However, spot applications of emergent vegetation may result in some very minor amounts of droplets indirectly entering the water column. It is expected that the total concentration of these minor droplets is insignificant and therefore, discountable. Stem injections will result in very minimal, if any, herbicide entering the water. The injected herbicide is contained within the plant stem, so there is limited potential for herbicide movement through the roots and into the soil. The magnitude is predicted to be extremely low from any droplets that come in contact with water. (**Magnitude is extremely low)**.

*Drift*: Drift is the most likely vector for herbicides coming in contact with water from riparian area or emergent vegetation treatment sites. It is possible that some aquatic formulation of glyphosate and imazapyr may enter the water as fine droplets as a result of treating emergent vegetation, however the magnitude of drift compared to an aerial application or broadcast application, such as what was analyzed above in the SERA risk assessment worksheets, immediately adjacent to a stream is extremely low. Label restrictions, restrictions on application rate, type of herbicide, application method restrictions, buffers, and the use of a surfactant all factor in to limiting the potential amount of drift. In addition, roads that have a high potential for herbicide delivery have been identified and have added restrictions, such as no broadcasting. **(Magnitude is low)**

*Contaminated soil:* Riparian treatments are limited in spatial extent, and given the restrictions on methods and type of herbicide, it is likely that much of the herbicide will have either adhered to the soil or broken down not being available for transport into the water. The intent of the proposed action is to apply herbicide to a plant, not to the soil. Any amount of herbicide that would indirectly come in contact with the soil as a result of drift or droplets is expected to be insignificant. **(Magnitude is low).**

*Accidental spill*: The probability of an accidental spill for this project is very low. If a spill were to occur, the magnitude is limited by project design criteria, where only daily use quantities of herbicides will be transported to the project site, transport via watercraft will require extra precautions, impervious material will be placed over mixing areas in such a manner as to contain any spills associated with mixing/refilling, and the requirement that a spill kit will be on site during all herbicide application. (**Magnitude is Low**).

*Aquatic Organisms*: The potential to reach toxicity levels for each trophic level under spot and hand/select applications with glyphosate and imazapyr is low. Localized effects would not disrupt aquatic ecosystem function of the aquatic food web because spot applications of aquatic formulations of glyphosate and imazapyr are not likely to result in harmful amounts coming in contact with water and harming fish, invertebrates, and algae. However, some aquatic plants would be damaged at the immediate spot spray locations if enough herbicide comes in contact with the aquatic plant. It is believed that the magnitude of effect to fish as a result of local aquatic plant mortality is extremely low because there will not be enough herbicide coming in contact with water to result in extensive aquatic plant mortality. (**Magnitude is extremely low)**.

*Trampling*: The probability of stepping on a redd while wading across a stream to access either the opposite streambank or an island is low. Should an individual wade across a stream and accidentally step on a redd, then there is the possibility of impacting individual eggs in the gravel. The magnitude of effect from accidentally stepping on a redd is limited to a the amount of eggs in the gravel that are impacted from the actual weight of the person and disturbance to the redd itself (i.e., shifting of the gravel, etc), thus leading to a negative impact to individual egg(s). An egg can be dislodged and eaten by a predator, or smashed between gravel or amongst other eggs, which can impede successful development of eggs. Each egg has the potential to contribute to the overall success of a returning population, therefore, the magnitude of effect from accidentally stepping on a redd is high. (**Magnitude is high**)

***Distribution***

Refer to Analysis of higher risk scenario 1. The proposed action would treat approximately 425 acres of riparian infestations within the aquatic influence zone in thirty 5th field watersheds. Effects, if they occur, would be limited in scope and widely scattered due to the patchy nature of the infestations. Appendix A of the GPNF and CRGNSA DEIS lists the treatment sites and provides maps of treatment areas. The distribution of effects will be small and scattered throughout GPNF and CRGNSA.

***Frequency***

The proposed treatments would occur over the next 15 year period and the acreage treated is expected to decline as long as funding is available and patches are eradicated. The programmatic nature of the proposed action is the treatment of future unknown infestations. It is expected that emergent vegetation treatments would be infrequent, thus resulting in very low amounts of herbicides coming in contact with water as a result of spot-spray. Treatments above bankfull can have up to 3 treatments within 1 year, depending on the severity of the infestation and effectiveness of the treatment. It is expected that the frequency of herbicide use will be low given that treatment of invasive plants is an art composed of integrated methods (i.e., mix of non-herbicide and herbicide methods) to facilitate effectiveness.

***Duration***

Any herbicides coming in contact with water are expected to be short-term events that subside quickly due to the stream volumes moving through the area (pulse effect). Herbicides coming in contact with smaller streams containing extensive emergent and riparian infestations is a higher risk because of the need for simultaneous treatment and lower volumes of water. Given the properties of glyphosate and imazapyr, it is unlikely that these two active ingredients would persist long enough in the environment to harm ESA fish. A simultaneous treatment is believed to be a short-term event whose effects subside immediately because of the herbicide properties and factors that push a concentration up would be off-set by those that push the concentration down.

***Timing***

Most of the treatments would likely occur in the summer when eggs of all the listed species would not be in the gravel and only rearing life stages are present. However, there is a potential for some treatments to occur in fall or spring when chinook salmon or steelhead may be spawning adjacent to treatment sites. There is also the potential for some treatments to occur in late summer or early fall when bull trout are spawning. Treatments of emergent vegetation during spawning and/or when redds are present is a high risk and could pose some level of impact, especially on smaller streams with relatively larger infestations. Through the implementation and planning process for treatment of future unknown infestations, activities would be planned and scheduled to avoid disturbance of spawning fish or damage to redds. There is a low probability of accidentally stepping on a redd and displacing spawning fish.

### ***Summary of Effects to the Chemical Contamination Indicator***

Treatment of emergent vegetation with aquatic formulations of glyphosate and imazapyr may lead to some minor amounts of herbicide droplets coming in contact with water. Fish may be exposed to these minor amounts of herbicide in smaller streams, especially when treatment needs to take place during spawning activities. The need to treat during spawning or accidentally stepping on a redd is limited in spatial and temporal extent. Fish in the mainstem of rivers and streams may not be exposed because of the river's large flow and density of fish during time of treatment. Smaller streams however, do not have as much flow and may not dilute herbicides as quickly. Fish in smaller streams tend to be juveniles and fry, and are also lower in density, thus lowering the potential for exposure. Although there is a probability for herbicide to come in contact with water in proximity to ESA fish, the magnitude of the effect from the amount of herbicide ESA fish are exposed to is low. The magnitude of effect from disturbance to breeding/spawning and/or accidentally stepping on a redd during emergent vegetation treatments is greater than the magnitude of potential herbicide exposure.

Restrictions on method, type, and location serve to limit the potential amount of herbicides that may come in contact with water where fish or other aquatic organisms are present, even if an unexpected storm occurred shortly after treatment. The amount of herbicide that would be available for runoff, leaching and/or drift is necessarily limited by restrictions on broadcast use. Spot and hand/select treatments do not have high potential to deliver herbicide because the treatments are directed at target vegetation and herbicide is quickly taken up by the plant.

The likelihood of meeting or exceeding levels of concern for fish is extremely low because herbicide use in the aquatic influence zone is limited to typical application rates, application methods are restricted to spot or hand/select, buffers on broadcast applications and other methods, project design criteria, and low potential for herbicides proposed for use near water to move through soils.

### *Sediment/turbidity*

There is a possibility that some minor bank erosion may occur in locations where knotweed or other invasive plant has taken over a streambank, especially in smaller streams. For example, killing knotweed would devegetate a portion of the streambank and result in a loss of roots that help to hold soil particles together. This may expose streambanks at higher flows and result in some erosion. The total spatial extent of heavy infestations along streambanks within the action area is low. The amount of sediment released into any particular stream reach would depend on how extensive a particular invasive plant patch is and how close the invasive plant is to the actual wetted perimeter of the channel. Exposed streambanks are expected to revegetate during the spring/summer following treatment. In addition, site restoration and revegetation methods preclude erosion as a result of herbicide treatment. It is expected that most patches would be relatively small and any erosion would be very localized and short-term. The probability of effect is moderate, and the magnitude is insignificant. See Effects from Non-Herbicide Treatment Methods.

***Proximity***

All currently known treatment sites are located along roads, trails, in campgrounds, and administrative sites with the exception of the sites on the CRGNSA, Washington side. For treatments below bankfull, the amount of sediment created by the physical application of herbicide treatments is anticipated to be insignificant because the methods of treatments do not include ground disturbing activities by heavy equipment. There will be no ground disturbing activities associated with spot or hand/select methods.

***Probability and Magnitude***

There is a possibility that some minor bank erosion may occur in locations where knotweed or other invasive plant has taken over a streambank, especially in smaller streams. For example, killing knotweed with an herbicide would devegetate a portion of the streambank and result in a loss of roots that help to hold soil particles together. This may expose streambanks at higher flows and result in some erosion. The total spatial extent of heavy infestations along streambanks within the action area is low. The amount of sediment released into any particular stream reach would depend on how extensive a particular invasive plant patch is and how close the invasive plant is to the actual wetted perimeter of the channel. Exposed streambanks are expected to revegetate during the spring/summer following treatment. In addition, site restoration and revegetation methods preclude erosion as a result of herbicide treatment. It is expected that most patches would be relatively small and any erosion negligible.

The probability of sedimentation and turbidity as a result of herbicide treatments is extremely low, therefore the magnitude of effect to listed fish and/or critical habitat is low. See Effects from Non-Herbicide Treatment Methods.

### *GLEAMS Model for Western Cascades Ecotype*

Herbicide effects to stream aquatic resources from ground-based application methods was analyzed by SERA (1997a, 1997b, 1999a, 1999b, 2001a, 2001c, 2003a, 2003b, 2003c, 2003d, 2003e, 2003f) in a hypothetical scenario designed to represent a plausible “worst case” application that was expected to occur in National Forests nationwide. This application scenario was analyzed in risk assessments for herbicides included in the R6 2005 FEIS using the Groundwater Loading Effects of Agricultural Management Systems (GLEAMS) chemical fate model. The GLEAMS Ecotype Analysis in the R6 2005 FEIS attempts to assess how local variation for some of input parameters may influence model output (stream herbicide concentration).

The hypothetical application scenario analyzed in each SERA document was an even application of the herbicide (with no streamside buffers) to a 10 acre site, adjacent to a stream with a discharge of 1.8 cubic feet per second (cfs). Soil type (clay, loam, sand), rainfall (5-250 inches), and herbicide application rates were input parameters that varied in the model in order to display how stream herbicide concentrations varied under different conditions. Fixed default parameters in the model are 10% for slope, rainfall timing of once every 10 days, a single soil layer, sparse grass for ground cover, 1.8 cfs for streamflow, and a 10 acre square for an application site. Typical herbicide application rates were based on reported Forest Service use, while high application rates were either the highest application rate allowed under the label or the highest application rate reported for Forest Service use (R6 2005 FEIS).

The R6 FEIS Fisheries BA considered whether ecosystem conditions associated with a variety of bioregions (ecotypes) might affect herbicide concentrations/hazards predicted using the GLEAMS model. The BA found that scenarios modeled in the risk assessments are likely to overestimate herbicide concentration in most site conditions within the Western Cascades ecotype (GPNF and CRGNSA fit into this ecotype). At higher stream flows (larger stream channels or wet season flow conditions), the risk assessment predictions tend to overestimate the herbicide concentration in most local streams. For smaller streams, other factors considered have a more pronounced effect than for larger streams.

Based on the modification of the SERA GLEAMS stream herbicide concentration predictions by local factors in the Fish Creek watershed located on the Umpqua National Forest, results in the R6 2005 FEIS identified the potential for increase in concern with picloram, glyphosate, and triclopyr for fish. There was also an increased concern for aquatic macrophytes with picloram, metsulfuron methyl, chlorsulfuron, and triclopyr. There was an increased concern for invertebrates with glyphosate and triclopyr. There was in increase for concern for algae with glyphosate, chlorsulfuron, and triclopyr. The R6 2005 Record Of Decision specifically limited triclopyr to spot and hand methods (no broadcast of triclopyr allowed as per standard 16) to avoid scenarios of concern related to triclopyr.
In general, situations that increased concern for potential effects to aquatic species from the level of risk stated in the SERA risk assessments occurred for smaller stream channels with steeper side slopes, with risk increasing at higher altitudes. Conversely, risk lower than that stated in the risk assessments was identified for larger stream channels at lower altitude, and possibly in smaller stream channels with sideslopes less than 10 percent.

Results in the R6 2005 FEIS indicated that in the flatter areas of pumice ash flows soil, slope is likely to be less than the 10 percent modeled, decreasing stream herbicide concentrations. In almost all other terrain in the watershed modeled (Fish Creek Watershed in Umpqua National Forest), slopes exceed or greatly exceed the 10 percent modeled, and herbicide delivery to streams could be expected to increase. However, restrictions on broadcast applications along roads that have a high potential for herbicide delivery would decrease chances of herbicide delivery to streams. Local soil types do not appear to markedly change expected herbicide delivery for most herbicides likely to be applied in watersheds in the Western Cascades, with the possible exceptions of triclopyr and glyphosate in pumice ash soils. Broadcast applications of triclopyr are not permitted under the proposed action.

The GLEAMS model will overestimate herbicide concentrations in streams with flows higher than 1.8 cfs. This is most likely in the spring, which is dominated by snowmelt runoff and flows 10 to 15 times annual low flows. Summer and fall storms can have flows 4 times annual low flows. Only in the smallest perennial streams would spring base flow not exceed 1.8 cfs, and storm flows would further increase flow. The scenarios in the risk assessment modeling would almost certainly overestimate herbicide concentrations in stream in all but the smallest perennial tributaries during the spring. During the summer and fall, a larger portion of the perennial streams would be expected to flow near or slightly below the 1.8 cfs modeled.

In summary, the GLEAMS Western Cascades Ecotype results indicated that toxicity values used for listed fish and other aquatic organisms could be exceeded with picloram, glyphosate, and triclopyr, and that the effect could be greater than estimated if small, higher elevation watersheds were broadcast with these herbicides.

The Proposed Action would treat invasive plants within the small, higher elevation, steep-sided drainages indicated in the BA as an area of concern. However, because the Proposed Action avoids broadcasting within 50 feet of any stream, the scenario used in the GLEAMS model would still overestimate the amount of herbicide that would enter water, because:

a. Broadcast methods are not allowed within 50 feet or more from streams or within any wetland with water present. Spot and selective method substantially reduce potential for off site impacts, drift, and other herbicide delivery mechanisms to water (runoff, leaching). Applicators can immediately respond to site conditions to ensure PDCs are followed as planned.
b. The model does not account for vegetation uptake of herbicide (the entire label rate is assumed to be subject to run off). The herbicides allowed for use within the Aquatic Influence Zone are rapidly taken up by plants and/or bind to soil and would not be available for runoff soon after application.
c. PDCs do not allow broadcast on roads with high potential to deliver herbicide, which also significantly reduces the potential for herbicides to reach streams in concentrations predicted by the GLEAMS model. These restrictions apply to about two-thirds of the roadside treatment areas.

### *Previous Monitoring Studies*

Berg, N. (2004) compiled monitoring results for broadcast herbicide treatments given various buffers along waterbodies. The results showed that any buffer helps lower the concentration of herbicide in streams adjacent to treatment areas. In California, when buffers between 25 and 200 feet were used, herbicides were not detected in monitored streams (detection limits of 1to 3 mg/m3) (ibid).

In South Carolina, buffers of 30 meters (comparable to 100 feet) during ground applications of the herbicides imazapyr, picloram and triclopyr resulted in no detectable concentrations of herbicide in monitored streams (USDA HFQLG EIS, Appendix B, 2003). No detection limits were given.

Even smaller buffers have successfully protected water quality. For example, where imazapyr was aerial sprayed without a buffer, the stream concentration was 680 mg/ml. With a 15-meter buffer, the concentration was below detectable limits (Berg, 2004). No detection limits were given.

Berg collected samples of several herbicides (including sulfometuron methyl and glyphosate) following roadside application one, seven and fourteen days after treatment. Rainfall of one-third inch occurred throughout the period. Berg detected concentrations of sulfometuron-methyl and glyphosate along road shoulders through the period. In the fall the road was again sprayed, and the ditch line of the road was checked during rainstorms for three months. Sulfometuron-methyl was detected along the shoulder in the ditch line, but was below detectable limits in the nearby stream. Glyphosate was not found at the shoulder, ditch line or stream.

This study indicates that the greatest risk of herbicides moving off site is from large storms soon after herbicide application. In addition, this study also indicates that sulfometuron methyl may persist in the environment as it was detectable along the shoulder of the road (but not in the stream) the entire duration (three months) of the study.

Berg also reported that herbicide applied in or along dry ephemeral or intermittent stream channels may enter streams through run-off if a large post-treatment rainstorm occurred soon after treatment. This risk is minimized if intermittent and ephemeral channels are buffered (ibid.) as would occur under the proposed action. If a large rainstorm occurs sediment contaminated by herbicide could be carried into streams. As most ditch lines on the GPNF and CRGNSA are heavily vegetated, this is less likely to occur than in a drier environment.

Project design criteria require no forecast rain for 24 hours after application to allow the herbicide to adhere to the plant, give time for the plant to uptake the herbicide and to minimize risk of herbicide being washed from the plant.

Dry sediment contaminated by herbicide could plausibly be carried by wind and enter a stream or water body. This is an unlikely scenario as most of the forest is heavily vegetated so there is less bare soil for movement by wind.

The Washington State Department of Agriculture (WSDOA) monitored residual concentrations of aquatic labeled herbicides for treatment of emergent noxious and quarantine weeds. Tables 35 - 37 below is a summary of their monitoring results by year. Ten out of the sixteen sites sampled between 2003 and 2005 showed residual herbicide levels (six showed no detectable level), with concentrations far below the level of concern for listed fish.

Table 34 - Summary of WSDOA Monitoring Results for 2003

| 2003 | | |
|---|---|---|
| Method | Location | Results |
| 6 oz of glyphosate per gallon of water | <1/3 acre of parrotfeather<br>Pond near Yakima River | 1 hour before treatment = ND<br>1 hour after treatment = 0.343 Mg/L<br>24 hours after treatment = 0.053 Mg/L |
| Boat mounted power equipment<br>2% Glyphosate | 11 acres of purple loosestrife<br>Along margins of Chehalis River | 1 hour before treatment = ND<br>1 hour after treatment = ND<br>24 hours after treatment = ND |
| Boat mounted power equipment<br>Backpack sprayer<br>1.5% Glyphosate | 3 acres<br>Water lily plants on Spring Lake in King Co.<br>Yellow flag iris and purple loosestrife along banks of Spring Lake | 1 hour before treatment = ND<br>1 hour after treatment = 0.030 Mg/L<br>24 hours after treatment = ND<br><br>Repeat Application:<br>1 hour before treatment = ND<br>1 hour after treatment = 0.120 Mg/L<br>24 hours after treatment = ND |
| Backpack sprayer<br>1.5% Glyphosate | Purple loosestrife plants along Cottage Creek in King Co. | 1 hour before treatment = ND<br>1 hour after treatment = ND<br>24 hours after treatment = ND |
| Backpack sprayer<br>2% Glyphosate | <1/4 acre<br>Purple loosestrife growing near Yakima River | 1 hour before treatment = ND<br>1 hour after treatment = ND<br>24 hours after treatment = ND |

Table 35 - Summary of WSDOA Monitoring results for 2004

| 2004 | | |
|---|---|---|
| Method | Location | Results |
| Boat mounted power equipment<br>1.5% Glyphosate | 0.5 acre of Yellow flag iris on shores of Spring Lake in King Co.<br>Total treatment area spread out over 4 acres – This site treated in 2003 and populations of purple loosestrife/water lily plants reduced enough that it was possible to control them w/out herbicide, reducing acres treated from 3 to 0.5. | 2.5 hours before treatment = ND<br>1 hour after treatment = 0.050 Mg/L<br>24 hours after treatment = ND |
| Backpack sprayer<br>1.0% Imazapyr | 0.25 acres<br>Japanese knotweed along margins of Naches River | 1 hour before treatment = ND<br>1 hour after treatment = ND<br>24 hours after treatment = ND |
| Canoe mounted sprayer<br>1.5% Triclopyr | 0.25 acres<br>Garden loosestrife plants on Foster Island in King Co. | 1 hour before treatment = ND<br>1 hour after treatment = 0.0036 Mg/L<br>24 hours after treatment = 0.0026 Mg/L |
| Pressurized spray equipment<br>Tank mix of 2% glyphosate and 0.5% imazapyr | 12.2 acres<br>Japanese knotweed along Willapa River in Pacific Co. | Analyzed for imazapyr only:<br><br>1 hour before treatment = ND<br>1 hour after treatment = ND<br>24 hours after treatment = 0.0022 Mg/L |
| Glyphosate injection | 6,498 ft2<br>Japanese knotweed along Little Creek in Skamania Co. | 1 hour before treatment = ND<br>1 hour after treatment = 0.050 Mg/L<br>24 hours after treatment = 0.010 Mg/L |

Table 36 - Summary of WSDOA Monitoring results for 2005

| 2005 | | |
|---|---|---|
| Glyphosate injection | Knotweed along Washougal River in Thurston Co. Treated area in cobble adjacent to stream bed | 1 hour before treatment = ND<br>1 hour after treatment = 0.0121 Mg/L<br>24 hours after treatment = 0.0038 Mg/L |
| Backpack sprayers<br>Imazapyr | Small patches of knotweed totaling <1 acre growing near confluence of Willapa River and Trap Creek in Pacific Co. | 1 hour before treatment = ND<br>1 hour after treatment = ND<br>24 hours after treatment = ND |
| Glyphosate injection | Knotweed plants growing near Newaukum River in Lewis Co.<br>Treated area was in rip rap on high side of bank | 1 hour before treatment = ND<br>1 hour after treatment = ND<br>24 hours after treatment = ND |
| CO2-pressurized backpack sprayer equipped with a 5-nozzle boom<br>Imazapyr and glyphosate | Yellow flag iris plots along Buena Ck in Yakima Co.<br>12 test plots measuring 8 ft x 20 ft | Analyzed for imazapyr only:<br><br>1 hour before treatment = ND<br>1 hour after treatment = 0.205 Mg/L<br>24 hours after treatment = ND |
| Glyphosate injection | Knotweed plants growing along Big River in Clallum Co. | 1 hour before treatment = Not available<br>1 hour after treatment = ND<br>24 hours after treatment = 0.011Mg/L |

## Designated Critical Habitat

Invasive plant treatment would have many beneficial effects on critical habitat for federally listed fish species. In the long-term, treatment of invasive weeds on GPNF and CRGNSA would increase native vegetation growth and successional patterns leading to cover and food. Thus, it improves freshwater PCE or essential habitat features for federally listed fish species. Potential downstream effects to critical habitat for bull trout are not likely given the PDCs that limit the potential for herbicide concentrations coming in contact with water where fish are present. Information here complements the analysis provided for non-herbicide treatment methods.

In 1996, NMFS developed a methodology for making ESA determinations for individual or grouped activities at the watershed scale, termed the "Habitat Approach". A Matrix of Pathways and Indicators (MPI) was recommended under the Habitat Approach to assist with analyzing effects to listed species. The MPI was used by GPNF and CRGNSA in previous years to analyze project effects on listed fish species. When using the MPI, project effects to the Pathways (significant pathways by which actions can have potential effects on anadromous salmonids and their habitats) and Indicators (numeric ratings or narrative descriptors for each Pathway) are used to determine whether proposed actions would damage habitat or retard the progress of habitat recovering towards properly functioning condition.

As noted above, the Sept. 2, 2005 designated critical habitat PCE's pertinent for analysis on the Olympic National Forest's freshwater habitats include spawning sites, rearing sites, and migration corridors. The Habitat Approach's MPI has numerous habitat-associated Indicators that closely "cross-walk" with the PCE's of the Sept 2, 2005 designated critical habitat. **Table 37** displays a "cross-walk" between the MPI Indicators and PCE's of the Sept. 2, 2005 designated critical habitat used to assess effects on designated critical habitat. As noted in this tabular analysis, the key features that define PCEs of the Sept. 2, 2005 designated critical habitat crosswalk effectively and fully with MPI indicators.

Table 37 - MPI for Primary Constituent Elements Crosswalk

| Primary Constituent Elements | Matrix of Pathways and Indicators |
|---|---|
| **Spawning Habitat**, as defined by water quality, water quantity, substrate | **Water Quality**: Temperature, Suspended Sediment, Substrate, Chemical Contaminants and Nutrients<br>**Flow/Hydrology**: Change in Peak/Base flows<br>**Habitat Elements**: Substrate/Embeddedness |
| **Rearing** as defined by adequate water quantity and floodplain connectivity | **Channel Conditions and Dynamics**: Floodplain connectivity<br>**Flow/Hydrology**: Change in Peak/Base flow |
| **Rearing** as defined by adequate water quality and forage | **Water Quality**: Temperature, Substrate<br>**Habitat Elements**: Large Woody Debris, Pool Frequency and Quality, Off-channel Habitat |
| **Rearing** as defined by adequate natural cover | **Habitat Elements**: Large Woody Debris, Pool Frequency and Quality, Large Pools, Off-channel Habitat |
| **Migration** as defined by habitat free of artificial obstructions, and adequate water quality, water quantity, and natural cover | **Habitat Access**: Physical Barriers<br>**Water Quality**: Temperature<br>**Flow/Hydrology**: Change in Peak/Base flow<br>**Habitat Elements**: Large Woody Debris, Pool Frequency and Quality, Large Pools |

The following is an analysis of the effects on Primary Constituent Elements of the Sept. 2, 2005 designated critical habitat, as determined via analysis of MPI indicators. Please refer to previous discussions in this document for effects on Riparian Condition and Water Quality, Lakes, Wetlands and Floodplains.

### *Riparian Condition and Water Quality*

The proposed action does not have the potential to influence stream flow and channel morphology due to the small portion of any watershed that would be treated. Treating invasive plants would improve riparian stability where invasive plants such as knotweeds have colonized along stream channels and out-competed native species. The mechanical removal of large infestations of invasive plants carries some risk that could exacerbate stream instability. Such activities are not likely because the preferred method would be use of herbicides. The restoration plan prescribes mulching, seeding and planting as needed to revegetate riparian and other treated areas.

Manual and mechanical treatments, as well as site preparation for planting within riparian areas could accelerate sediment delivery to streams through ground disturbance. However, most of the treatments areas are previously disturbed roadways and trails so ground disturbance is not a significant concern. Modification of surface ground cover can also change the timing of run-off. Treatment areas comprise a small portion of any watershed so no effects to stream flows are plausible from the result of manual/mechanical treatment and site preparation for planting.

A primary issue for this analysis is the potential for herbicides to enter streams and impact domestic water sources and/or aquatic organisms by impairing water quality. The routes for herbicide to contaminate water are; direct application, drift into streams from spraying, runoff from a large rain storm soon after application, and leaching through soil into shallow ground water or into a stream. No direct application of herbicide to water is intended in the proposed action. Some invasive plants may grow in wetlands or stream channels and hand treatment of these plants may result in some minor drift to surface waters. Aquatic formulations would be used in these situations; however it is expected that concentrations of herbicide that could reach streams from these treatments would be far below levels of concern as discussed above.

Even considering the steepest, smallest dry season drainage occurring on GPNF and CRGNSA, the scenarios used in the GLEAMS modeling likely overestimates the herbicide concentrations that would plausibly enter streams from the proposed action, mainly because the proposed action prohibits broadcast treatments within 50 feet of streams. Spot treatments using herbicides of higher concern to aquatic organisms along streams would also be buffered. Hand and spot treatments are inherently far less likely to deliver herbicide to water because the herbicide is applied to individual plants, so drift, runoff and leaching are greatly minimized. Small amounts of some herbicides can trans-locate from the plant to the soil or an adjacent plant, but the concentrations of herbicide that may be delivered to streams from this mechanism is likely to be less than GLEAMS predictions for broadcast treatment with no buffers.

### *Lakes, Wetlands and Floodplains*

Herbicides affect lakes and wetlands differently than streams. Dilution by flow or tributary inflow is generally less effective in lakes. Dilution is partially a function of lake size, but dilution could be rapid in small lakes with large water contributing areas. Decreases in herbicide concentration in lakes, ponds, and other lentic water bodies are largely a function of chemical and biological degradation processes rather than of dilution. Evaporation of water from a lake's surface can concentrate chemical constituents. As vegetation within water dies the oxygen level within the lake can decrease.

Some invasive plants may grow in wetlands or stream channels and hand/select application treatment of these plants may result in minor amounts of herbicide contacting surface water. This amount would be insignificant based on monitoring results from WSDOA and compared to concentrations modeled with GLEAMS. Potential amounts of glyphosate, imazapyr, and triclopyr coming in contact with water is expected to below under any threshold of concern. indirect application to surface water. For wetlands, no more than 7 contiguous acres or half of a wetland would be treated in any given year per 6th field. The design criteria for wetlands limit the area treated at one time for two reasons:

1. They lower the amount of herbicide near the water body at one time and gives time for the herbicide to degrade. Many of the herbicides degrade quickly in soils high in organic mater or in water.

2. When vegetation is killed in the water it uses up oxygen as it decays. If only half an area is treated at a time it lowers the acreage affected by vegetation decay and leaves refugia for aquatic organisms in other parts of the lakeside, pond or wetland.

Small, unmapped ponds found during implementation planning would have the same PDCs on herbicide use within 100 feet of the wetland.

In addition, where there are listed fish species or critical habitat, no more than 7 contiguous emergent vegetation acres would be treated each year within each 6th field watershed.

Roadside Treatments

Approximately 943 roadside treatment acres (47 percent of total infested acres and 44 percent of infested roadside acres) are associated with conditions that indicate high potential for herbicide delivery.

Approximately 75 percent of the streams on the Gifford Pinchot National Forest are intermittent. When conditions are dry, intermittent streams and roadside ditches are far less likely to contribute to delivery of herbicides to live streams, because herbicides would be taken up by plants and soils and become less available for runoff upon application. The mobility, persistence and toxicity of the herbicides was considered in the PDC. Restrictions on herbicide selection and application method are adequate to protect streams and water quality.

**Pathway: Water Quality**
**Indicator: Temperature**
**PCE Crosswalk: Spawning, Rearing, Migration habitat PCEs**

Stream temperature is controlled by many variables at each site. These include topographic shading, stream orientation, channel morphology, discharge, air temperature, and interactions with ground water, none of which would be influenced by invasive plant treatments. Treatment of invasive plants using integrated methods, specifically herbicides, along small streams may increase solar radiation at a localized level (i.e. on a small portion of a stream) if invasive plants are the only source of shade. Where invasive plants provide the only source of shade on small streams with an estimated width of less than 5 feet (i.e. knotweed is the tallest), removing 100% of the shade producing cover can change forest floor microclimates and water temperature at the localized level. However, the precise effects to water temperature from treating invasive plants will depend on the size of the stream, how close to the stream a treatment site is, how much is treated along the stream, and what vegetation is currently available to shade the stream. Removal of invasive plants from the banks of small, intermittent streams would not effect temperature because they are dry during the hottest time of the year, relative size of the infestation is small within context of the watershed, and more than likely there is overstory canopy present. Conditions would have to mimic post wildfire in order to impact stream temperatures.

A significant amount of vegetation would need to be removed to change water temperature in the stream, and shade would have to be provided only by the invasive plant removed – a situation that is not likely on GPNF and CRGNSA. Many of the treatment sites in previously disturbed areas requiring herbicide use had riparian harvest or other ground disturbing activities (i.e. flood) that removed most of trees that provided stream shade. This implies that the greatest changes to water temperature may have already taken place. One reason treatment of invasive plants is being proposed is to recover vegetation structure and, in time, provide more stream shade with the establishment of native coniferous and deciduous trees. The PDCs prohibits broadcast applications within 100 ft. of wet perennial and intermittent waterbodies, and along roads that have a high likelihood of delivering herbicides to streams in order to prevent any potential adverse affects to stream channels or water quality conditions. This PDC will protect overhanging vegetation and smaller trees that are currently providing shade closest to the stream and other waterbodies.

The treatment of invasive plants with broadcast applications outside of the 100 ft buffer should have little affect on stream temperature because the invasive plants treated would be no taller than the ones left within the buffered area. Spot-spray applications would not be sufficient enough to impact enough vegetation influencing water temperature. Any short term impacts occurring from loss of small shade provided by invasive plants at the treatment site would not elicit an effect and would far outweigh the long term benefits of the restored and increased growth of native riparian vegetation, specifically coniferous and deciduous trees.

The US Environmental Protection Agency under the Clean Water Act (CWA) of 1972 requires States to set water quality standards to support the beneficial uses of water. The Act also requires states to identify the status of all waters and prioritize water bodies whose water quality is limited or impaired. Clean Water Act Section 303(d) directed the State of Washington to list Water Quality Limited Waterbodies (303(d) listed streams) and develop Total Maximum Daily Loads (TMDL) to control the non-point source pollutant causing loss of beneficial uses. Wind River Watershed is covered by a TMDL for temperature.

For water quality limited streams on National Forest lands, the Forest Service provides information, analysis, and site-specific planning efforts to support state processes to protect and restore water quality. The Northwest Forest Plan, the Regional Pacific Northwest Region Invasive Plan EIS and the GPNF and CRGNSA Management Plans all include standards and guidelines and other management measures designed to protect and improve water quality. This project adheres to all of the above protection measures and adds site specific design criteria to further protect water quality, meeting the requirements of the Clean Water Act.

There are 21 stream segments on GPNF and 2 in the CRGNSA on the 303d list. All are listed for temperature, see table below.

Table 38 – Streams Listed under 303(d) Clean Water Act

| Name Of Waterbody | Listing Criteria |
|---|---|
| **Gifford Pinchot National Forest** | |
| 1918 CREEK | Temperature |
| Lake Creek | Temperature |
| Cispus River | Temperature |
| East Creek | Temperature |
| Little Nisqually River | Temperature |
| East Canyon Creek | Temperature |
| Quartz Creek | Temperature |
| Little White Salmon River | Temperature |
| Little Nisqually River, W.F. | Temperature |
| Lewis River | Temperature |
| Silver Creek | Temperature |
| Muddy River | Temperature |
| Greenhorn Creek | Temperature |
| Clear Creek | Temperature |
| Clearwater Creek | Temperature |
| Copper Creek | Temperature |
| Lynx Creek | Temperature |
| Iron Creek | Temperature |
| Pumice Creek | Temperature |
| Lewis River | Temperature |
| Lewis River, E.F. | Temperature |
| **Columbia Gorge National Scenic Area** | |
| Columbia River | Temperature |
| Major Creek | Temperature |

On the Columbia River Gorge National Scenic Area, Campen Creek is part of a TMDL for fecal coliform and many segments of the Columbia are part of the 2002 Columbia River TMDL for dioxin, and total dissolved gas.

The Gifford Pinchot National Forest Plan (USDA, 1990, amended by the 1994 Northwest Forest Plan ROD and by the R6 2005 ROD for invasive plants) provides direction to protect and manage resources. The Forest Plan Goal for soils is to "Protect, conserve, and enhance the long-term productivity of forest soils for the multiple uses of the Forest".

Forest Plan Goals for water resources are to "provide water quality needs for municipal and domestic supply, and to protect rivers, streams, shorelines, lakes, wetlands, flood plains, and other riparian areas during implementation of management activities".

Forest Management Objectives for soil, riparian areas and water resources:

- The primary goal for water quality is to provide high quality water by minimizing soil erosion and the introduction of chemicals and bacteria (IV-12).
- To reduce sediment output and control erosion by following BMPs listed in FEIS Appendix J and integrating mitigation as project design (IV-12).

- All riparian areas are to be managed to protect and maintain their unique values as they relate to wildlife, fish habitat and water quality. (IV-18)

This project would comply with all Washington State water quality standards and requirements for detailed in Water Quality Standards for the State of Washington, Chapter 173-201A WAC. 1997 & 2003 and Forest Chemicals Chapter 222-38 WAC.

Waters on the Gifford Pinchot National Forest and the Columbia Gorge Scenic Area are considered AA (extraordinary) under State of Washington 173-201A120 list. Beneficial uses for these waters include:

- Water Supply (Domestic, Industrial, Agricultural)
- Stock Watering
- Commerce and Navigation
- Wildlife habitat
- Recreation
- Salmonid migration, rearing, spawning, and harvesting.

**Pathway: Water Quality**
**Indicator: Sediment/Turbidity**
**PCE Crosswalk: Spawning habitat PCEs**

Treatment of invasive plants has a low probability for producing sediment because very little ground disturbance will take place when invasive plants are treated with spot-spray or hand applications. Manual, mechanical, and restoration treatments are extremely unlikely to contribute sediment. The integration of manual/mechanical/herbicide treatments would limit the potential for excessive trampling and not solely rely on manual labor. Manual labor such as hand pulling and the use of mechanical equipment to control invasive plants may result in localized soil disturbance, but increases of sediment to streams would likely be undetectable. Not all vegetation in a treated area would be pulled or removed, so some ground cover plants would remain. Not all sediment from pulling weeds along roads or use of mechanical equipment to cut weeds would reach a stream because many relief culverts intercept ditch flow and drain it on to the forest floor away from streams. Handpulling is very labor intensive and costly. Thus, few areas per year could be treated using this technique across a watershed. The amount of sediment created by manual, mechanical, and restoration treatments is anticipated to be insignificant because the methods of treatments do not include ground disturbing activities by heavy equipment. When compared to the total acres within a watershed, project-related soil disturbance from handpulling would be negligible.

**Pathway: Water Quality**
**Indicator: Chemical Contaminants/Nutrients**
**PCE Crosswalk: Spawning habitat PCEs**

The routes for herbicide to contaminate water are treatments of emergent vegetation and potential runoff from a large rain storm soon after application, especially from treated roadside ditches. Treatment of emergent vegetation is not intended to be a direct application of herbicide to water. However, treatment of emergent vegetation may result in some minor drift to surface waters. Previous monitoring efforts from the State of Washington have not detected any exceedence of State drinking water standards for spot treatment of emergent vegetation. It is expected that concentrations of herbicide that could reach streams from these treatments would be far below levels of concern as discussed above. See analysis in Herbicide Use section above for “chemical contaminants”.

**Pathway: Channel Condition & Dynamics**
**Indicator: Floodplain Connectivity**
**PCE Crosswalk: Rearing habitat PCE**

Some invasive plant treatments can have positive effects on floodplains and streambanks when infestations of invasive plants on valley bottom areas are removed. Valley-bottom infestations often encroach floodplains where road-related and recreational activities have led to the establishment of invasive plant populations. Removal of such infestations is expected to benefit aquatic and terrestrial communities in the long term by increasing floodplain area available for nutrient, sediment and large wood storage, and flood flow refugia. There is no risk of negatively impacting channel condition and dynamics as a result of treating invasive plants.

**Pathway: Habitat Access**
**Indicator: Physical Barriers**
**PCE Crosswalk: Migration habitat PCE**

Invasive plant treatments will not create physical barriers or otherwise degrade access to aquatic habitat. On the contrary, where blackberries have been established along streambanks, lack of treatment may result in the increase of their root system which could cross the stream channel resulting in an aggraded channel blocking fish access during low flow. Once stream hydraulics are restored, the streambed will slowly be able to mobilize substrate naturally.

**Pathway: Habitat Elements**
**Indicator: Substrate/Sediment**
**PCE Crosswalk: Spawning, Rearing habitat PCEs**

Invasive plant treatments is not expected to affect substrate composition. All PDCs that minimize sediment would be implemented, such as no heavy equipment within riparian areas. These practices would reduce, but not eliminate sediment. Some sediment may enter stream channels as a result of extensive manual labor and could result in exposed soils. The amount of sediment that enters a stream is expected to be small, infrequent, short duration, and at a localized level. Localized increases in fine sediment in gravels or along channel margins may be seen at the immediate treatment site. However, substrate quality would not decrease over time because treatment of invasive plants would not result in a chronic sediment source.

**Pathway: Habitat Elements**
**Indicator: Large Woody Debris, and Pool Area, Quality and Frequency**
**PCE Crosswalk: Spawning habitat PCE**

Treatment of invasive plants would not impact pool area, quality and frequency. Treatment of invasive plants in riparian reserves would not impact current wood debris in streams. The PDC that establishes a 100 ft buffer for broadcast applications provides protection to the recruitment of conifer seedlings within riparian areas which will sustain channel and habitat features in the future. With the treatment of invasive plants, riparian stands in time would develop larger recruitment trees and would increase the size of inchannel debris. This would be of most importance on the Forest because loss of large woody debris was identified as a critical habitat issue for White River, and loss of pool habitat for the Nooksack and Stillaguamish Rivers (Bishop and Morgan, 1996). The use of spot-spray applications of aquatic glyphosate and aquatic imazapyr may result in some minor non-target vegetation impact because of drift. However, the amount necessary to drift into the entire riparian area and kill trees is not possible with spot-spray applications.

Invasive plant treatments could temporarily reduce streamside vegetation (albeit non-native and low quality) that provides cover for fish. It is unlikely that removal of invasive plants in known treatment areas that are currently providing cover along streams containing federally listed fish would lead to significant losses of cover. Removal would be negligible (plants surrounding target plant) and overhead story would still provide cover via shade and future input of allocthonous material.

**Pathway: Flow/Hydrology**
**Indicator: Change in Peak/Base Flows**
**PCE Crosswalk: Spawning, Rearing, Migration habitat PCEs**

Hydrologic changes from invasive plant treatments would never be large enough to cause effects at a subwatershed scale. There is no risk of increasing water yield at the subwatershed scale as a result of treating invasive plants. The only negative effect on designated critical habitat would result from the short term, localized increases in turbidity and sedimentation due to people implementing non-herbicide treatment methods along the waters edge. As previously discussed, the levels of fine sediment and turbidity increases at the project scale are expected to be insignificant and discountable, a one time event, and short-term. Any fines as a result of non-herbicide treatment methods are expected to be washed out by the end of the high flow period. However, the majority of fine sediment deposition is expected to be deposited in low-velocity areas including the pool tail crest regions. These are areas where there may be some redds in the lower reaches of watersheds.

However, the small increase in fine sediment does not have a negative effect on any PCE of critical habitat. All spawning gravel in the action area, including the pool tail crest regions, is expected to be usable for the next spawners.

The potential for increased erosion into aquatic areas as a result of removing the protective cover and rooting along streambanks or waterbodies is reduced by establishing a 50’ buffer for broadcast sprays of aquatic labeled herbicides. The 50’ buffer along waterbodies was established to avoid the potential for some erosion that could occur, at least in the short term, from the use of aquatic labeled glyphosate and aquatic labeled imazapyr (known to be non-selective) as a result of killing both weeds and native vegetation. Broadcast spray of aquatic labeled triclopyr is not allowed.

### *Aquatic Conservation Strategy*

The Aquatic Conservation Strategy under the Northwest Forest Plan established a system of Key Watersheds to protect areas of high water quality and habitat for wild fish populations. Key Watersheds are intended to serve as refugia for at risk stocks of native and anadromous fish.

Treatment of invasive plants is consistent with recommendations in watershed analysis done for key watersheds on the Gifford Pinchot National Forest. None of the invasive plant treatments in the scope of this document would retard achievement of ACS objectives because the PDC minimize potential for harm at the site scale and less than one percent of the Aquatic Influence Zone of any $5^{th}$ field watershed would be affected (about 0.15 percent of the acreage within Aquatic Influence Zones in $5^{th}$ field watersheds is currently estimated to be infested, ranging from less than 0.1 percent up to about 0.4 percent).

Standards for invasive plant treatment in Riparian Reserves require that the Forest Service minimize delivery of herbicides of concern to water bodies. Project Design Criteria are intended to minimize or eliminate herbicide entry to water, and no beneficial uses are expected to be adversely affected.

## Cumulative Effects

Cumulative effects include the effects from future State, tribal, local or private actions that are reasonably certain to occur within the action area subject to consultations (50 CFR 402.02). The "reasonably certain to occur" clause is a key factor in assessing and applying cumulative effects and indicates, for example, actions that are permitted, imminent, have an obligation of venture, or have initiated contracts (U.S. Fish and Wildlife Service and National Marine Fisheries Service, 1998). Past and present impacts of non-Federal actions are part of the environmental baseline.

Cumulative effects analysis considers the additive, synergistic, or off-setting effects of other past, present, and foreseeable future actions in combination with the proposed project. Actions on neighboring lands can contribute to the spread or containment of invasive plants on National Forests (and vice versa). Treatment areas on the Columbia River Gorge National Scenic Area are within 1,000 feet of non-federal land, typically private land.

About 60 percent of the $6^{th}$ field watersheds that comprise the analysis area are National Forest system lands. In general, treatment is only proposed for National Forest system lands. About five percent of acreage within mapped treatment areas is in other ownerships.

All roads and trails may be vectors of invasive plant spread between the National Forest and adjacent ownerships. The following roads are some of the more heavily traveled.

Gifford Pinchot National Forest: U.S. Highway 12, State Route 504, Forest Roads 25 (north & south ends); 30, 86; 8620, 90; in addition to Beaver Campground; and Kalama Horse Camp.

Columbia River Gorge National Scenic Area: State Route 14, State Route 141, State Route 142, Belle Center Road, Strunk Road, Smith-Cripe Road, Bergen Road, Girl Scout Road, and Old

Highway 8 (Klickitat County Road 1230), None of these roads are National Forest system roads; they are state and county roads.

Only the portion of these roads on National Forest system lands would be treated in the action alternatives, however, the effectiveness of these treatments would be increased if adjacent lands were also treated. Ongoing coordination with landowners, land managers, and state and county weed coordinators would ensure that treatments occur as needed throughout $6^{th}$ field watersheds containing National Forest system lands.

Herbicides and other chemicals are widely used for agricultural and industrial forest management, landscaping, and invasive plant management. Herbicide use occurs on tribal lands, state and county lands, private forestry lands, rangeland, utility corridors, and road rights of way. No central source exists for compiling invasive plant management information off National Forests within Washington State. No requirement for landowners or counties to report invasive plant treatment information exists, thus an accurate accounting of the cumulative acreage of invasive plant treatment for all land ownerships is unavailable. Herbicide use in proximity to treatments considered in this project cannot be precisely predicted, especially given the long time span and uncertain implementation schedule for the project. Many people express personal concern about their exposure to agricultural and industrial chemicals and the cumulative effects to human and environmental health from herbicide, pesticide and other chemical use in our society.

The proposed use of herbicides on and off National Forest system lands could result in additive doses of herbicides to workers, the general public, non-target plant species, and/or wildlife. However, additive doses would not likely result in cumulative adverse effects because the herbicides proposed for use are rapidly eliminated from people, wildlife, and fish and do not accumulate in fatty tissue. Risk assessments considered chronic exposure to herbicides, which is universally associated with less risk of harm to organisms than acute exposures due to the lack of potential bioaccumulation and other characteristics of the herbicides (acute and chronic exposure scenarios are described in Appendices P and Q in the R6 2005 FEIS and its associated Biological Assessment for Aquatic Organisms). Uncertainty is also addressed in the R6 2005 FEIS, and is one of the reasons that reducing reliance on herbicide use is a goal for the National Forests in the region.

The risk of adverse effects from herbicide and other treatments on the National Forest would be minimized by utilizing PDC and buffers (described previously in this document, in the GPNF and CRGNSA DEIS, and the R6 2005 FEIS) which minimize the risk herbicide exposures that could exceed thresholds of concern for people, wildlife and fish (ibid.). These thresholds are very conservative and account for uncertainty (see section on layers of caution above). Herbicide persistence is managed through PDC to avoid chemical loading in the soil over time at any one site. Buffers minimize risk of herbicide concentrations of concern in water.

Assuming PDC are appropriately applied, the spatial extent of effects of herbicide use would mainly be limited to the site of application, and governed by the extent of the target species to be treated. Herbicide would only be applied where needed; non-target vegetation and bare ground would not be treated. Drift from broadcast treatments is unlikely to harm non-target vegetation 100 or more feet away from treated areas. Spot and hand treatments are far less likely to move off site because the applicator can narrowly focus the spray.

The PDC sufficiently minimize risks to compensate for uncertainty about the impacts of herbicide use on neighboring lands.

Early detection-rapid response is part of the proposed action, and is considered in the direct, indirect and cumulative effects analysis. Effects of treatments under early detection-rapid response would not exceed those predicted because if new infestations required methods outside the scope of the project, or if PDC cannot be appropriately applied, further analysis would be necessary prior to treatment.

The proposed action is unlikely to have significant effects to fish and their habitat, is unlikely to approach a threshold of concern and therefore, would not contribute to significant cumulative effects. No adverse cumulative effects are expected from implementation of the proposed action.

Local County Noxious Weed Boards continue to focus on priority weeds that pose a risk to high valued areas, such as riparian corridors and recreational lakes. Knotweed is a common priority species amongst all Counties. It is expected that joint partnerships among GPNF and CRGNSA, and local Counties would work cooperatively in the treatment of weeds. Forest Service standards described in this BA will be incorporated into official participating agreements, challenge cost-shares, and in contract clauses. All contracts require an inspector to ensure that Forest Service standards are being met.

It is unlikely that there would be negative cumulative effects from the proposed action as a result of actions from local Counties. Washington State DOA and DOE work closely with the Counties under a permitting process and randomly monitor sites that are treated for emergent weeds. Beginning in 2006, the WSDOA will no longer be monitoring for glyphosate residue as a result of spot applications for the treatment of emergent vegetation along streams because there have been no detections since 2003 (G. Haubrich, pers.communication). However, glyphosate stem injections will continue to be monitored because of the herbicide concentration used.
The proposed action is unlikely to have significant effects to fish and their habitat, is unlikely to approach a threshold of concern and therefore, would not contribute to significant cumulative effects. No adverse cumulative effects are expected from implementation of the proposed action.

## Effects Determinations

The effect determinations below are based on effects that have a reasonable probability of occurring due to invasive plant treatments within the action area, and conducted according to the Standards in the R6 FEIS and Project design criteria in the Proposed Action.

The potential for sublethal effects to fish from herbicide exposure was considered and addressed in the R6 2005 FEIS. Because there is insufficient data on the herbicides included in the Proposed Action to conclude that there may or may not be sublethal effects, the 1/20th of the NOEC values were used in the SERA risk assessments to account for the potential of sub-lethal effects from those herbicides that could potentially reach streams with federally listed fish. The lack of information on sub-lethal effects did not affect our ability to make determinations of effects to listed species because of the degree of risk for herbicides coming in contact with water at levels of concern.

Effects from the proposed action are expected to vary because of proximity to water, species occurrence, life stage present, and herbicide properties. Some treatments with no mechanism for herbicide delivery fall under a “no effect” determination. However, spot treatments along shorelines of streams or other waterbodies have the potential to deliver aquatic glyphosate and aquatic imazapyr to water. These type of treatments are not likely to adversely affect federally listed fish and their habitat because treatments will not result in the delivery of substantial amounts of herbicide and/or sediment into aquatic habitats. Toxic levels of herbicides are unlikely to enter streams or lakes due to the ability to alter application methods and distance from water, timing, active ingredients and formulations, and other project design criteria. Effects to immediate streamside cover cannot be avoided and there may be small droplets of aquatic glyphosate and aquatic imazapyr coming in contact with water. For example, treatment of knotweed species, ribbon grass (a cultivar of reed canarygrass), and purple loosestrife growing along the water's edge or streambank may result in insignificant amounts of aquatic glyphosate and aquatic imazapyr in water 24 hours after treatment. Any treatment method, could introduce minor amounts of sediment and/or herbicide into adjoining waters as result of spot/hand applications, manual/mechanical plant removal, stream bank trampling, and planting. Effects from treating known infestations are expected to be insignificant and therefore, discountable. Effects from treating future unknown infestations under EDRR are expected to be similar. However, because EDRR sites are "unknown" infestations, there is the possibility of treating emergent invasive vegetation during spawning and/or when redds are present. Although activities would be planned and scheduled to avoid disturbance of spawning fish or damage to redds, there is a small likelihood of accidentally stepping on a redd or displacing spawning fish. In addition, there is a slight potential for herbicide exposure to fish during emergent vegetation treatments if fish are present. Therefore, the programmatic nature of the proposed action may result in situations that are likely to adversely affect federally listed fish. The types of activities that are most likely to adversely affect listed fish and their habitat include:

- Herbicide applications of emergent invasive vegetation in small streams

Control of invasive plants will protect and restore native vegetation that provides essential habitat features for federally listed aquatic species. Invasive plants have the potential to completely alter and disrupt native ecosystems on GPNF and CRGNSA if not controlled in time, to the detriment of listed species that depend upon those ecosystems. Therefore, treatment of invasive plants will provide for long-term ecosystem maintenance or restoration.

Below is a discussion of the risk or likelihood of adverse affects for the federally listed fish.

Potential effects to federally listed fish within the action area are minimal. The number of actual ground treatments that may occur within distribution of federally listed fish will vary on the severity of invasive plant infestations and priority. The most severe situations on GPNF and CRGNSA have been analyzed and was used for analyzing similar situations for the treatment of future unknown infestations (EDRR). Infestations along rivers and streambanks are patchy in nature and spot or hand/select methods would not contribute to cumulative negative effects.

The removal of invasive vegetation along streambanks, and the potential for temporary occurrences of herbicide in the water indirectly impacting localized individual aquatic plants would need to be of significant size to have more than a discountable effect. Based on WSDOA monitoring results of 11 ac and 12 ac of riparian treatments, the potential to reach levels of concern is low. The potential for adverse effects as a result of significant amounts of sedimentation of gravels containing eggs or used for spawning is low and unlikely to occur.

Projects that posed an initial concern included herbicide treatment of knotweed species, purple loosestrife, or rhizomatous grasses in or adjacent to streams containing federally listed fish.

After analyzing potential exposure concentrations under worst-case scenarios, it is unlikely that there would be adverse affects to fish and their habitat given the restrictions on herbicide type, application method, and application location. There may be some droplets coming in contact with water as a result of spot-spray and hand/select methods, however the expected exposure concentration of these droplets is not expected to be biologically relevant.

Indirect effects to federally listed fish via the food web are not likely to be substantial because federally listed fish are opportunistic feeders, with food habits primarily a function of size and life-history strategy. Adult and juvenile federally listed fish prey on terrestrial and aquatic insects and macro-zooplankton. Insect and macro-zooplankton could be impacted at the immediate localized area but not enough to kill a juvenile or adult fish. Results from WSDOAs 2003-2005 monitoring of emergent weed treatments have all been below State drinking water standards and below the U.S. EPA (2004) toxicity values for aquatic organisms. In addition, all potential worst case situations for treatments under EDRR is expected to be below levels of concern because potential exposure is limited to only two aquatic formulations (glyphosate and imazapyr) from spot applications. Analysis of these aquatic formulations lead to the conclusion that PDCs and buffers, as well as the implementation and planning process, will minimize herbicide exposure to fish. In addition, it is highly unlikely that implementation of the invasive plant program on GPNF and CRGNSA will result in herbicide concentrations calculated from the SERA risk assessment and emergent vegetation.

Future invasive plant treatment projects under EDRR could impact federally listed fish if treatment of emergent invasive vegetation takes place during spawning and/or redds are accidentally stepped on. This situation introduces the possibility of disturbing fish during spawning and impacting redds, especially on smaller streams, resulting in an adverse affect. The likelihood is minimized because activities would be planned and scheduled to avoid disturbance of spawning fish or damage to redds. The threshold of treatment area relative to stream size is not currently known, therefore, there is the possibility of having a greater impact on smaller streams with larger infestations (i.e., contiguous 10 acres). Therefore, the effect determination for Lower Columbia Steelhead, Lower Columbia Chinook, Columbia River Chum, and Columbia River Bull trout is "**may affect, likely to adversely affect**". The effect determination Upper Columbia River Steelhead, Snake River Spring/Summer Chinook, Snake River Fall Chinook, Upper Columbia River Spring-run Chinook, Snake River Sockeye, and Coastal Puget Sound Bull is "**may affect, not likely to adversely affect**".

This determination is based on the following:

- For future treatments under EDRR, some treatments of streamside vegetation could involve workers walking in the water to access islands, side channels, or the opposite side of the stream. There is the potential for a worker to accidentally damage a redd while working within the bankfull channel of wadable streams. The potential exists when there is a need to treat emergent vegetation, or to wade across a stream to either access the opposite streambank or access an island/gravel bar.

The potential for adverse effects from invasive plant treatments are expected to be uncommon and transitory because:

- Project design criteria H16 is designed to avoid disturbance to spawning fish and damage to redds.
- Project design criteria significantly reduce the potential for herbicides coming in contact with water where there are federally listed fish present, if any were to come in contact with water the amounts would be far below levels of concern and potentially not at detectable levels.
- Effects from invasive plant treatments will be very localized, yet still allow for restoration of important native riparian habitat.
- Some herbicides could be introduced into the water indirectly from spot-spray and may impact aquatic plants at the immediate site. However, it is unlikely that a significant amount of aquatic plants would be adversely affected to the degree of impacting an entire food chain in the aquatic ecosystem and indirectly harming a fish.
- The majority of treatments on GPNF and CRGNSA are along roads and not necessarily adjacent to streams containing federally listed fish.
- Water flow in streams quickly dilutes herbicide, reducing the potential for herbicide exposure, and dissipates any sedimentation as a result of invasive plant treatments and revegetation.
- Transitory water quality impact, if any, would be limited to the point of contact with water and not an entire stream reach

### *Critical Habitat*

The NWFP was designed to incorporate all elements of the aquatic and riparian ecosystem necessary to maintain the natural disturbance regime. These elements include maintenance of hydrologic function, high water quality, adequate amounts of coarse woody debris, complex stream channels that provide a diversity of aquatic habitats types, and riparian areas with suitable microclimate and vegetation. Aquatic Standards and guidelines within the NWFP created a connected system of aquatic and riparian habitats throughout Region Six.

Under existing Forest Service standards and guidelines, projects implemented under the Proposed Action cannot have a negative impact, in the long term, on riparian-dependent resources or ecological processes in the Riparian Reserves at the watershed scale. Each project must maintain or restore the physical and biological processes required by riparian dependent-resources at the watershed scale or broader to comply with the ACS. S&Gs prohibit and regulate activities in Riparian Reserves that retard or prevent attainment of the ACS objectives. The ACS objectives address all of the physical and biological features that are essential to the conservation of anadromous fish (e.g. essential habitat features).

The potential, site-specific effects from the implementation of the Proposed Action on critical habitat was evaluated when addressing effects to Riparian Condition and Water Quality, Lakes, Wetland, and Floodplains.

The implementation of PDCs in the Proposed Action will reduce adverse affects to listed species' habitats during herbicide and non-herbicide treatment methods to a minimum, as discussed below and in Chapter IV of this BA.

*Water Quality Indicators*. Changes in water temperature resulting from herbicide use to control invasive plants would be negligible to non-existent. Invasive plants provide little to no shade to streams, and the risk for adverse affects to native vegetation is low with backpack or hand operated sprayers. Removal of solid vegetation stands by herbicide treatment may result in short-term, insignificant increases in surface erosion that will diminish as vegetation re-establishes treated areas. No large-scale changes in land cover conversions or stand structure (e.g. timber to grass) will result from chemical invasive plant control as proposed in this BA. Herbicide treatment of invasive plants is expected to result in a low risk of water contamination because of standards in the R6 FEIS, with additional PDCs in the Proposed Action. Site-specific soil characteristics, proximity to surface water and local water table depth were used to determine herbicide formulation, size of buffers, and application method and timing. Only those herbicides registered for aquatic use are allowed near streams or surface water with limitation on application and timing.

*Habitat Access Indicators*. Implementation of the Proposed Action would not create physical barriers to listed aquatic species.

*Habitat Element Indicators.* Implementation of the Proposed Action would not significantly affect substrate, large woody debris, pool quality, off-channel habitat, and refugia at the watershed scale. Large trees that provide shade and large wood would not be impacted by the use of herbicides as proposed under the Proposed Action.

*Channel Condition Indicators*. Implementation of the Proposed Action would result in reduction of invasive plants within riparian areas and along streambanks. Although impacts to streambank stability are unlikely, it is expected to be very localized, of low intensity and duration, and not significantly affecting fish habitat. Reduction of invasive plants along streambanks and riparian areas will benefit native plant species and result in improved streambank stability and riparian condition in the long-term.

*Flow/Hydrology Indicators*. Implementation of the Proposed Action is expected to result in no measurable effect to peak/base flow or water yield of watersheds.

*Watershed Condition Indicators*. No new roads or watershed scale disturbances are expected to result from the use of herbicides to treat invasive plants.

Invasive and noxious plants are a threat to overall watershed ecological condition. Long-term beneficial effects from the reduction of invasive plants in riparian areas, wetlands, and streams and subsequent increases in desirable vegetation will result in improved watershed conditions. The effect determination for designated critical habitat of Lower Columbia River Steelhead, Middle Columbia River Steelhead, Lower Columbia River Chinook, and Columbia River Chum is "**may affect, but not likely to adversely affect**." The effect determination for Upper Columbia River Steelhead, Snake River Spring/Summer Chinook, Snake River Fall Chinook, Upper Columbia River Spring-run Chinook, Snake River Sockeye, Columbia River Bull Trout, and Coastal Puget Sound Bull trout is "**no effec**t". These determinations are based on potential effects to the primary constituent elements, including the following:

- Although, invasive plant treatment projects may be conducted in close proximity to designated critical habitat, the potential to impact any of the PCEs at significant levels is very low.
- Invasive plant treatment projects is not expected to create sediment that may adversely affect embeddedness and availability of suitable substrate in localized areas.
- Only aquatic formulations of glyphosate and imazapyr are likely to come in contact water inhabited by listed fish but amounts or concentrations would more than likely be negligible or below a level of concern, and will not impact available food resources.
- Non-aquatic formulations of herbicides are not likely to enter streams with designated critical habitat because of buffers and restrictions of herbicide use on roads that have high potential for herbicide delivery.

Invasive plant treatments are not expected to create significant amounts of sediment leading to direct or indirect adverse effects to habitat. Any increase in sediment would be very localized given that herbicides would be used as opposed to heavy machinery. Manual and mechanical removal is not expected to create measurable amounts of sediment. Invasive plant treatments conducted in critical habitat would help to restore or maintain the native riparian vegetation that is essential to maintaining the primary constituent elements of the critical habitat in the long-term.

## Conclusion

The R6 2005 FEIS and Fisheries Biological Assessment analyzed the risk of herbicide use to aquatic plants, algae, macroinvertebrates and fish, including listed species. The analysis relied on SERA Risk Assessments (1997a, 1997b, 1999a, 1999b, 2001a, 2001c, 2003a, 2003b, 2003c, 2003d, 2003e, 2003f) to determine effects to fish and other aquatic organisms if herbicide is delivered to streams and other water bodies. The Project design criteria (PDCs) listed in Chapter 1 were developed to avoid scenarios of concern to fish species of local interest considering the R6 2005 FEIS analysis and local conditions. These restrictions go beyond label requirements by limiting the amount and type of herbicide that may be used adjacent to waterbodies or along roads with high potential to deliver herbicide to streams and other water bodies. The only herbicides proposed for use where there is a likelihood of indirect delivery to water are aquatic formulations of glyphosate, imazapyr, and triclopyr. Refer to the buffer Tables for buffer widths and acceptable use of herbicides adjacent to waterbodies. For example, spot applications within 15 feet of streams is limited to the aquatic formulations of glyphosate and imazapyr. Triclopyr is limited to hand/select methods within 15 feet of a stream.

Herbicides can disappear from treated water by dilution, adsorption to bottom sediments, volatilization, absorption by plants and animals or by dissipation. Dissipation refers to the breaking down of an herbicide into simpler chemical compounds. Herbicides can dissipate by photolysis (broken down by light), hydrolysis, microbial degradation, or metabolism by plants and animals. Both dissipation and disappearance are important considerations to the fate of herbicides in the environment because even if dissipation is slow, disappearance due to processes such as adsorption to bottom sediments makes a herbicide biologically unavailable. For example, glyphosate is not applied directly to water for weed control, but when it does enter the water it is bound tightly to dissolved and suspended particles and to bottom sediments and becomes inactive, posing a very low risk to fish, the aquatic food web, and critical habitat.

The likelihood that fish or other aquatic organisms may be impacted under the worst-case situations analyzed for the proposed action is very low. Any use of herbicide in Aquatic Influence Zones or along roads with high potential to deliver herbicides is associated with some risk, however the degree of risk is very low given the project design criteria for the proposed action.

Conditions similar to the Cave Creek Meadows and Hot Springs site have the greatest likelihood of herbicides coming in contact with water as a result of drift because of the possibility of treating invasive plants that may be emergent from water or growing in saturated soils. However, the amount herbicide coming in contact with water is greatly reduced from those calculated above under the proposed action. When SERA risk assessment models a concern, actual site conditions do not meet the modeled concern.

Adverse effects to fish under the worst case situations are not likely to occur because any herbicide or sediment that came in contact with water, regardless of the amount, would be quickly washed downstream and diluted. Based on the R6 2005 FEIS, the potential to reach levels of concern for invertebrates and aquatic plants is expected to be low and herbicides coming in contact with water as a result of the proposed action would more than likely be insignificant. Therefore, impacts to the aquatic food web are not likely and therefore, indirect effects to fish are discountable.

Project design criteria minimize and avoid concentrations of herbicide exceeding a level of concern coming in contact with fish and other aquatic organisms because:

- Established buffers along perennial and intermittent streams greatly reduce the potential for drift of herbicide to surface waters;
- No broadcasting of herbicides are allowed along roads that have a high potential for herbicide delivery, thereby significantly reducing the potential amount of herbicides delivered to streams via road-side ditches;
- Broadcast spray of triclopyr is prohibited, thereby greatly reducing risk of triclopyr coming in contact with surface waters;
- With the eliminated potential for concern for increased risk to aquatic species, the potential for effects to the aquatic food web is greatly reduced.

The Proposed Action may lead to removal of emergent vegetation that may be providing cover for juveniles and result in some sediment from ground disturbance related to revegetation/manual treatments. The magnitude of effects from these activities is likely to be very low and is therefore, discountable.

The potential for herbicides to enter streams in concentrations that are near or exceed thresholds of concern for federally listed fish and impacting aquatic ecosystems is very low. Therefore, the degree of risk is low and discountable. Whether known sites or new sites are treated following the proposed action, it is unlikely that the Forest will reach the most ambitious conceivable treatment scenario identified in the proposed action. In addition, the PDCs are more than likely going to minimize or eliminate the risk of adverse affects.

# V. MAGNUSON-STEVES FISHERY CONSERVATION AND MANAGEMENT ACT

The Magnuson-Stevens Fishery Conservation and Management Act (MSA), as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), established procedures designed to identify, conserve, and enhance essential fish habitat (EFH) for those species regulated under a Federal fisheries management plan.

Essential Fish Habitat is defined in the Act as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." Essential Fish Habitat includes all freshwater streams accessible to anadromous fish (Chinook, coho, and pink salmon), marine waters, and inter-tidal habitats. The objective of this EFH assessment is to determine whether or not the Proposed Action "may adversely affect" designated EFH for relevant commercially, federally-managed fisheries species within the Proposed Action area.

The GPNF and CRGNSA may incorporate an EFH assessment into the BA for this EIS pursuant to 40 CFR section 1500. NEPA and ESA documents prepared by the Olympic National Forest should contain sufficient information to satisfy the requirements in 50 CFR 600.920(g) for EFH assessments and must clearly be identified as an EFH assessment.

## A. Identification of EFH

Pursuant to the MSA the Pacific Fisheries Management Council (PFMC) has designated EFH for federally managed fisheries within the waters of Washington, Oregon, and California. Designated EFH for groundfish and coastal pelagic species encompasses all waters from the mean high water line, and upriver extent of saltwater intrusion in river mouths, along the coasts of Washington, Oregon and California, seaward to the boundary of the U.S. exclusive economic zone (370.4 km) (PFMC, 2004, 1998).

Freshwater EFH for Pacific salmon includes all those streams, lakes, ponds, wetlands, and other water bodies currently, or historically accessible to salmon in Washington, Oregon, Idaho, and California, except areas upstream of certain impassable artificial barriers (as identified by the PFMC, 2003), and longstanding, naturally-impassable barriers (i.e., natural waterfalls in existence for several hundred years) (PFMC, 2003). In estuarine and marine areas, designated salmon EFH extends from the nearshore and tidal submerged environments within state territorial waters out to the full extent of the exclusive economic zone (370.4 km) offshore of Washington, Oregon, and California north of Point Conception to the Canadian border (PFMC, 2003).

Detailed descriptions and identifications of EFH are contained in the fishery management plans for groundfish (PFMC 2004), coastal pelagic species (PFMC 1998), and Pacific salmon (PFMC, 2003).

The geographic extent of EFH on GPNF and CRGNSA is specifically defined as all currently viable waters and most of the habitat historically accessible to Chinook, coho, and pink salmon within the watersheds identified in Chapter IV. Salmon EFH excludes areas upstream of longstanding naturally impassible barriers (i.e., natural waterfalls in existence for several hundred years). Salmon EFH includes aquatic areas above all artificial barriers.

## B. Effects of the Proposed Action

The MSA defines adverse effects as any impact, which reduces the quality and/or quantity of Essential Fish Habitat. Non-herbicide treatment methods would have very localized effects to soil at the project scale. Herbicide treatment methods may result in insignificant amounts of herbicides coming in contact with water as a result of drift and runoff from roadside ditches, if any. Effects from both non-herbicide and herbicide treatment methods would not impact those waters necessary for spawning, breeding, feeding, or growth to maturity because there is no treatment of submerged invasive plants and the predicted amount of herbicide coming in contact with water is below levels of concern. As discussed above in Chapter IV, EFH for Chinook and coho salmon would not be adversely affected because:

- the quantity of EFH will not be reduced
- the quality of EFH will be maintained and not degraded

PDCs will be applied and Northwest Forest Plan standards would be met. Conservation measures and management alternatives are listed in the Pacific Coast Salmonid Plan that help conserve and enhance salmon EFH. These measures should be applied unless more specific or different measures based on the best and most current scientific information are developed prior to, or during, the EFH consultation process and communicated to the appropriate agency. The PDCs in the Proposed Action are more detailed measures and should take the place of ones listed in the Pacific Coast Salmonid Plan. However, there may be conservation measures that are different and complement the PDCs.

As described in detail in Chapter IV. of this BA, the exclusion of heavy machinery from the Proposed Action will not result in impacts to sediment and cover. The use of non-herbicide methods as described in the Proposed Action is not expected to reduce the quality and/or quantity of EFH. The use of herbicide treatments as described in the Proposed Action and analyzed in Section F. of Chapter IV of this BA is not expected to reduce the quality and/or quantity of EFH. The assessment of potential adverse effects from elements of the Proposed Action on EFH is based on information in Section F. of Chapter IV of this BA. Since estuarine and ocean habitat are not expected to be affected by the Proposed Action, no effect to EFH for groundfish or coastal pelagic species are expected.

## C. Conclusion

The Proposed Action is not expected to adversely affect EFH for Pacific salmon species listed in the table below. The long-term effects of the Proposed Action is expected to be an improvement in essential fish habitat conditions in locations currently infested with invasive plants.

Table 39 - Potential Effects to Commercially Important Fish Species

| Species | Magnuson-Stevens EFH Determination |
|---|---|
| Lower Columbia River Coho | No Effect |
| Columbia River Chum | No Effect |
| Lower Columbia River Chinook | No Effect |
| Snake River Fall-run Chinook | No Effect |
| Snake River Spring/Summer Chinook | No Effect |
| Lower Columbia River Steelhead | No Effect |

# REFERENCES


AEPA/OPP (U.S. Environmental Protection Agency, Office of Pesticide Programs). 2004. Overview of the Ecological Risk Assessment process in the Office of Pesticide Programs, U.S. Environmental Protection Agency; Endangered and Threatened Species Effects Determinations. Office of Prevention, Pesticides, and Toxic Substances; Office of Pesticide Programs, Washington, D.C. 92 pp.

Allendorf, F.W. and N. Ryman. 2002. The role of genetics in population viabilityanalysis. Pages 50-85 in S.R. Beissinger and D.R. McCullough (eds).Population Viability Analysis. The University of Chicago Press, Chicago, IL.

Anthony, R.G. and F.B. Isaacs. 1989. Characteristics of bald eagle nest sites in Oregon. J. Wildl. Manage. 53(1):148-159.

Anthony, R.G. and F.B. Isaacs. 1989. Characteristics of bald eagle nest sites in Oregon. J. Wildl. Manage. 53(1):148-159.

Anthony, R.G., M.G. Garrett, and C.A. Schuler. 1993. Environmental contaminants in bald eagles in the Columbia River estuary. J. Wildl. Manage. 57(1):10-19.Allendorf, F.W. 1983. Isolation, gene flow, and genetic differentiation among populations. Pages 51-65 in C. Schonewald-Cox, S. Chambers, B. MacBryde, and L. Thomas (eds). Genetics and Conservation. Benjamin and Cummings, Menlo Park, CA.

Anthony, R.G., E.D. Forsman, A.B. Franklin, D.R. Anderson, K.P. Burnham, G.C. White, C.J. Schwarz, J. Nichols, J.E. Hines, G.S. Olson, S.H. Ackers, S. Andrews, B.L. Biswell, P.C. Carlson, L.V. Diller, K.M. Dugger, K.E. Fehring, T.L. Fleming, R.P. Gerhardt, S.A. Gremel, R.J. Gutiérrez, P.J. Happe, D.R. Herter, J.M. Higley, R.B. Horn, L.L. Irwin, P.J. Loschl, J.A. Reid, and S.G. Sovern. 2004. Status and trends in demography of northern spotted owls, 1985-2003. Final Report to the Interagency Regional Monitoring Program, Portland, Oregon. September 2004. 179pp.

Anthony, R.G., M.G. Garrett, and C.A. Schuler. 1993. Environmental contaminants in bald eagles in the Columbia River estuary. J. Wildl. Manage. 57(1):10-19.

ATSDR (Agency for Toxic Substances and Disease Registry). 2004. Guidance manual for the assessment of joint toxic action of chemical mixtures. Available from U.S. Department of Health and Human Services, Public Health Service, ATSDR, Division of Toxicology.

Barrowclough, G.F. and R.J. Gutierrez. 1990. Genetic variation and differentiation in the spotted owl. Auk 107:737-744.

Barrowclough, G.F., R.J. Gutiérrez, and J.G. Groth. 1999. Phylogeography of spotted owl (Strix occidentalis) populations based on mitochondrial DNA sequences; gene flow, genetic structure, and a novel biogeographic pattern. Evolution 53(3):919-931.

Bart J. and E. D. Forsman. 1992. Dependence of northern spotted owls Strix occidentalis caurina on old-growth forests in the western USA. Biological Conservation 62: 95-100.

Bart, J. 1995. Amount of suitable habitat and viability of northern spotted owls. Conservation Biology 9 (4): 943-946.

Bartos, D.L., and Campbell, R.B. 1998. Decline of quaking aspen in the Interior West. Rangelands 20((1)): p.17-24.

Batt, P.E. 1996. State of Idaho bull trout conservation plan. Office of the Governor,Boise, ID. 20pp.

Baxter, C.V., C.A. Frissell, and F.R. Hauer. 1999. Geomorphology, Logging Roads, and the Distribution of Bull Trout Spawning in a Forested River Basin: Implications for Management and Conservation. Transactions of the American Fisheries Society 128:854-867.

Baxter, J.S., and J.D. McPhail. 1999. The influence of redd site selection, groundwater upwelling, and over-winter incubation temperature on survival of bull trout (Salvelinus confluentus) from egg to alevin. Canadian Journal of Zoology/Revue Canadien de Zoologie 77:1233-1239.

Begon, M., and M. Mortimer. 1986. Population Ecology: A Unified Study of Animals and Plants. Blackwell Scientific Publications, Cambridge, MA. 220 pgs.

Beissinger, S. R., and N. Nur. 1997. Population trends of the marbled murrelet projected from demographic analysis. Appendix B *in* Recovery plan for the threatened marbled murrelet (*Brachyramphus marmoratus*) in Washington, Oregon and California. U. S. Fish and Wildlife Service, Portland, Oregon.

Beissinger, S.R. 1995. Population trends of the marbled murrelet projected from demographic analyses. *In* Ralph, C.J., G.L. Hunt jr., M.G. Raphael, J.F. Piatt, tech. eds. 1995. Ecology and conservation of the marbled murrelet. Gen. Tech. Rep. PSW-GTR-152. Albany, CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture.

Beschta, R.L., R.E. Bilby, G.W. Brown, L.B. Holtby, and T.D. Hofstra. 1987. Stream temperature and aquatic habitat: fisheries and forestry interactions. Pages 191-232 in E.D. Salo and T.W. Cundy (eds). Streamside Management Forestry and Fisheries Interactions. Institute of Forest Resources, University of Washington, Seattle, Washington, Contribution No. 57.

Bevis, K.R.; G.M. King, and E.E. Hanson. 1997. Spotted owls and 1994 fires on the Yakama Indian Reservation. Proceedings: Fire effects on rare and endangered species and habitats conference. Nov. 13-16, 1995. Coeur d' Alene, Idaho. pp. 117-122.

Bingham, B. B., and B. R. Noon. 1997. Mitigation of habitat "take": Application to habitat conservation planning. Conservation Biology 11 (1): 127-138.

Blakesley, J.A., Franklin, A.B., and R.J. Gutierrez. 1992. Spotted owl roost and nest site selection in northwestern California. 1992. Journal of Wildlife Management, 56(2): 388-392.

Blossey, B, L.C. Skinner, and J. Taylor. 2001. Impact and management of purple loosestrife (*Lythrum salicaria*) in North America. Biodiversity and Conservation 10: 1787-1807.

Boag, T.D. 1987. Food habits of bull char, Salvelinus confluentus, and rainbow trout, Salmo gairdneri, coexisting in a foothills stream in northern Alberta. Canadian Field-Naturalist 101: 56-62.

Bond, C.E. 1992. Notes on the nomenclature and distribution of the bull trout and the effects of human activity on the species. Pages 1-4 in P.J. Howell, and D.V. Buchanan (eds). Proceedings of the Gearhart Mountain Bull Trout Workshop, Oregon Chapter of the American Fisheries Society, Corvallis, Oregon.

Bond, M.L.; R.J. Guitiérrez, A.B. Franklin, W.S. LaHaye, C.A. May, and M.E. Seamans. 2002. Short-term effects of wildfires on spotted owl survival, site fidelity, mate fidelity, and reproductive success. Wildlife Soc. Bull. 30(4):1022-1028.

Bonneau, J.L., and D.L. Scarnecchia. 1996. Distribution of juvenile bull trout in a thermal gradient of a plunge pool in Granite Creek, Idaho. Transactions of the American Fisheries Society 125: 628-630.

Boulanger, J. G., K. Martin, G. Kaiser, and A. E. Derocher. 1996. Evaluating uncertainty in estimating population trends of marbled murrelets. Pages 53-63 *in* A. W. Diamond and A. W. Nettleship, editors: Biology and conservation of forest birds. Society of Canadian Ornithologists, Fredericton, New Brunswick, Canada.

Boutin, C. and Rogers, C. 2000. Pattern of Sensitivity of Plant Species to Various Herbicides - An Analysis with Two Databases. Ecotoxicology 9:255-71.

Bradley, R. W. 2002. Breeding ecology of radio-marked marbled murrelets (*Brachyramphus marmoratus*) in Desolation Sound, British Columbia. M.S. Thesis, Simon Fraser University, British Columbia. 86 pages.

Brenkman, S., Olympic National Park. 2003. Additions to recovery plan 13 January 2003.

Brewin, P.A., M.K. Brewin, and M. Monita. 1997. Distribution maps for bull trout in Alberta. Pages 206-216 in W.C. Mackay, M.K. Brewin, and M. Monita (eds). Friends of the Bull Trout Conference Proceedings. Bull Trout Task Force (Alberta), c/o Trout Unlimited Calgary, Alberta, Canada.

Brooks, M.L., D'Antonio, C.M., Richardson, D.M., Grace, J.B., Keeley, J.E. and others. 2004. Effects of invasive alien plants on fire regimes. BioScience 54(7) p.77-88.

Brown, L.G. 1992. On the zoogeography and life history of Washington native char Dolly Varden (Salvelinus malma) and bull trout (Salvelinus confluentus). Washington Department of Wildlife, Fisheries Management Division Report, Olympia, Washington.

Buchanan, D.M., and S.V. Gregory. 1997. Development of water temperature standards to protect and restore habitat for bull trout and other cold water species in Oregon. Pages 1-8 in W.C. Mackay, M.K. Brewin and M. Monita (eds). Friends of the Bull Trout Conference Proceedings. Bull Trout Task Force(Alberta), c/o Trout Unlimited Calgary, Alberta, Canada.

Buchanan, D.V., M.L Hanson, and R.M. Hooton. 1997. Status of Oregon's bull trout. Oregon Department of Fish and Wildlife, Portland, Oregon. 168 pp.

Buchmann, S., and Nabhan, G.P. 1996. The Forgotten Pollinators. Washington, D.C.: Island Press.

Buktenica, M.W. 1997. Bull trout restoration and brook trout eradication at Crater Lake National Park, Oregon. Proceedings of the Friends of the Bull Trout Conference, Calgary, Alberta.

Burger, A. E. 2001. Using radar to estimate populations and assess habitat associations of marbled murrelets. Journal of Wildlife Management 65:696-715.

Burger, A. E. 2002. Conservation assessment of marbled murrelets in British Columbia, a review of biology, populations, habitat associations and conservation. Pacific and Yukon Region, Canadian Wildlife Service. 168 pages.

Burger, A.E. 1995. Inland habitat associations of marbled murrelets in British Columbia. Pages 151-161 *in* C.J. Ralph, G.L. Hunt, M. Raphael, and J.F. Piatt (Tech. eds.). Ecology and conservation of the marbled murrelet. Gen. Tech. Rept. PSW-GTR-152. Albany, CA: Pacific Southwest Research Station, Forest Service, U.S. Dept. of Agriculture. 420 pp.

Burkey, T.V. 1989. Extinction in nature reserves: the effect of fragmentation and the importance of migration between reserve fragments. Oikos 55:75-81.

Burkey, T.V. 1995. Extinction rates in archipelagoes: Implications for populations in fragmented habitats. Conservation Biology 9: 527-541.

Caffrey, C. 2003. Determining impacts of West Nile Virus on crows and other birds. American Birds (103rd Count) 57:14-21.

Caffrey, C. and C.C. Peterson. 2003. West Nile Virus may not be a conservation issue in northeastern United States. American Birds (103rd Count) 57:14-21.

Callaway, R.M., DeLuca, T.H., and Belliveau, W.M. 1999. Biological-control herbivores may increase competitive ability of the noxious weed *centaurea maculosa*. Ecology 80( 4):1196-201.

Carter, H.R. and S.G. Sealey. 1986. Year-round use of coastal lakes by marbled murrelets. Condor 88: 473-477.

Cavender, T.M. 1978. Taxonomy and distribution of the bull trout, Salvelinus confluentus (Suckley), from the American northwest. California Fish and Game 64:139-174.

Chamberlain, T. W., R. D. Harr, and F. H. Everest. 1991. Timber harvesting, silviculture and watershed processes. Pages 181-205 in W. R. Meehan (ed). Influences of forest and rangeland management on salmonid fishes and their habitats. American Fisheries Society Special Publication 19.

Chen, J., J.F. Franklin and T.A. Spies. 1993. Contrasting microclimates among clearcut, edge, and interior and old-growth Douglas-fir forest. Agricultural and Forest Meteorology 63:219-237.

Choudhury, H.; J. Cogliano; R. Hertzberg; D. Mukerjee; G. Rice; L. Teuschler; E. Doyle; and R. Schoeny. 2000. Supplementary guidance for conducting Health Risk Assessment of chemical mixtures. Risk Assessment Forum, U.S. Environmental Protection Agency, Washington, D.C. 143 pp. + appendices.

Courtney, S.P., J.A. Blakesley, R.E. Bigley, M.L. Cody, J.P. Dumbacher, R.C. Fleischer, A.B. Franklin, J.F. Franklin, R.J. Gutiérrez, J.M. Marzluff, L. Sztukowski. 2004. Scientific evaluation of the status of the northern spotted owl. Sustainable Ecosystems Institute. Portland, Oregon. September 2004.

Cox, R.D., and Anderson, V.J. 2004. Increasing native diversity of cheatgrass-dominated rangeland through assisted succesion. Journal of Range Management 57 (2) (March): p.203-10.

Craig, S.D., and R.C. Wissmar. 1993. Habitat conditions influencing a remnant bull trout spawning population, Gold Creek, Washington (draft report). Fisheries Research Institute, University of Washington. Seattle, Washington.

Cullen, S.A. 2002. Using radar to monitor populations and assess habitat associations of marbled murrelets within the Sunshine Coast Forest District. Surrey, BC, Ministry of Water, Land and Air Protection, 25 pp.

Dambacher, J.M., M.W. Buktenica, and G.L. Larson. 1992. Distribution, abundance, and habitat utilization of bull trout and brook trout in Sun Creek, Crater Lake National Park, Oregon. In: P.J. Howell and D.V. Buchanan, editors. Proceedings of theGearhart Mountain bull trout workshop. Oregon Chapter of the American Fisheries Society, Corvallis. p. 30-36.

Dark, S. J., R. J. Gutierrez, and G. I. Gould. 1998. The barred owl (Strix varia) invasion in California. Auk 115:50-56.

Dechesne, S. B. C., and J. L. Smith. 1997. Wildlife inventory Queen Charlotte Islands/Haida Gwaii 1994-1996. Husby Group of Companies. 49 pages.

Delaney, D. K., T. G. Grubb, L.L. Pater. 1997. Effects of Helicopter Noise on Nesting Mexican Spotted Owls, U.S. Air Force CES/CEV, Holloman Air Force Base, Project Order No. CE P.O. 95-4. 49pp.

De Santo, T. L., and M. F. Willson. 2001. Predator abundance and predation of artificial nests in natural and anthropogenic coniferous forest edges in southeast Alaska. Journal of Field Ornithology 72(1):136-149.

Detwyler, T.R. 1971. Man's Impact on Environment. New York, USA: McGraw Hill.

Deubel, V., L. Fiette, P. Gounon, M.T. Drouet, H. Khun, M. Huerre, C. Banet, M. Malkinson, and P. Despres. 2001. Variations in biological features of West Nile viruses. Annals of the New York Academy of Sciences 951:195-206.

DiTomaso, J. 2001. Yellow starthistle management possible with planning and integrated approach. Techline (May):6-8.

Donald, D.B., and D.J. Alger. 1993. Geographic distribution, species displacement, and niche overlap for lake trout and bull trout in mountain lakes. Canadian Journal of Zoology/Revue Canadien de Zoologie 71:238-247.

Dremann, C.C., and M.Shaw. 2002. Releasing the Native seedbank: an innovative approach to restoring a coastal California ecosystem. Ecological Restoration 20(2):103-7.

Dunham, J.B., and B.E. Rieman. 1999. Metapopulation structure of bull trout: Influences of physical, biotic, and geometrical landscape characteristics. Ecological Applications 9:642-655.

Dunbar, D. L., B. P. Booth, E. D. Forsman, A. E. Hetherington, and D. J. Wilson. 1991. Status of the spotted owl, Strix occidentalis, and barred owl, Strix varia, in southwestern British

Dunsmoor, L., and C. Bienz, Klamath Tribe. 1997. Comments on the proposed rule to list bull trout in the Klamath River and Columbia River to Robert Ruesink, Fish and Wildlife Service, Boise, Idaho. 6 p.

Estok, D., Freeman, B., and Boyle, D. 1989. Effects of the herbicides 2,4-D, glyphosate, hexazinone, and triclopyr on the growth of three species of ectomycorhizal fungi. Bulletin of Environmental Contamination and Toxicology 42:835-9.

Fielder, P.C. and R.G. Starkey. 1987. Bald eagle winter abundance and distribution in eastern Washington. Northwest Sci. 61:226-232.

Fitzgerald, S.D., J.S. Patterson, M. Kiupel, H.A. Simmons, S.D. Grimes, C.F. Sarver, R.M. Fulton, B.A. Fulton, B.A. Steficek, T.M. Cooley, J.P. Massey, and J.G. Sikarskie. 2003. Clinical and pathological features of West Nile Virus infection in native North American owls (family Strigidae). Avian Diseases 47:602-610.

Flatter, B. 1998. Life history and population status of migratory bull trout (Salvelinus confluentus) in Arrowrock Reservoir, Idaho. Prepared for U.S. Bureau of Reclamation by Idaho Department of Fish and Game, Nampa, Idaho.

Fletcher, J.S., Pfleeger, T.G., Ratsch, H.C., and Hayes, R. 1996. Potential Impact of Low Levels of Chlorsulfuron and other Herbicides on growth and yield of nontarget plants. Environmental Technology and Chemistry 15(7):1189-96.

Forsman, E.D., Anthony, R. G., Reid, J. A., Loschl, P. J., Sovern, S. G., Taylor, M., Biswell, B. L., Ellingson, A., Meslow, E. C., Miller, G. S., Swindle, K. A., Thrailkill, J. A., Wagner, F. F., and D. E. Seaman. 2002. Natal and breeding dispersal of northern spotted owls. Wildlife Monographs, No. 149. 35 pp.

Forsman, E.D., Meslow, E.C., Wight, H.M. 1984. Distribution and biology of the spotted owl in Oregon. Wildlife Monographs, 87:1-64.

Franklin, A. B., K .P. Burnham, G. C. White, R. J. Anthony, E. D. Forsman, C. Schwarz, J. D. Nichols, and J. Hines. 1999. Range-wide status and trends in northern spotted owl populations. U.S. Geological Survey, Colorado and Oregon Cooperative Fish and Wildlife Research Units, Fort Collins, CO and Corvallis, OR. 71 pp.

Franklin, A.B., Anderson, D.R., Gutierrez, R.J., and K.P. Burnham. 2000. Climate, habitat quality, and fitness in northern spotted owl populations in northwestern California. Ecological Monographs, 70(4): 539-590.

Fraley, J.J., and B.B. Shepard. 1989. Life history, ecology and population status of migratory bull trout (Salvelinus confluentus ) in the Flathead Lake and river system, Montana. Northwest Science 63:133-143.

Franklin, I.A. 1980. Evolutionary changes in small populations. Pages 135-150 in: SouléM. and B.A. Wilcox (eds). Conservation Biology: an evolutionary-ecological perspective. Sinauer Associates, Sunderland, MA.

Franklin, I.R. and R. Frankham. 1998. How large must populations be to retain evolutionary potential? Animal Conservation 1:69-70.

Friedman, S. 2004. personal communication on habitat for Plagiobothyrus hirtus (to Richard Helliwell).

Frissell, C.A. 1997. A spatial approach to species viability: Conservation of fishes in the Columbia River Basin. Biological Station Open File Report Number 101-97. Flathead Lake Biological Station, University of Montana, Polson, MT.

Furniss, M.J., T.D. Roelofs, and C.S. Yee. 1991. Road construction anFletcher, J.S., Pfleeger, T.G., and Ratsch, H.C. 1993. Potential Environmental Risks associated with the new Sulfonylurea Herbicides. Environmental Sciences & Technology 27(10):2250-2.

Gamett, B. 1999. The history and status of fishes in the Little Lost River drainage, Idaho. Salmon-Challis National Forest, Idaho Department of Fish and Game, U.S. Bureau of Land Management, Sagewillow, Inc. May 1999 draft.

Ganey, J.L., W.M. Block, J.K. Dwyer, B.E. Strohmeyer, and J.S. Jenness. 1998. Dispersal movements and survival rates of juvenile Mexican spotted owls in northern Arizona. Wilson Bulletin 110:206-217.

Garmendia, A.E., Van Kruiningen, H.J., French, R.A., Anderson, J.F., Andreadis, T.G., Kumar, A. and A.B. West. 2000. Recovery and identification of West Nile virus from a hawk in winter. Journal of Clinical Microbiology 38:3110-3111.

Gilpin, M., University of California. 1997. Bull trout connectivity on the Clark Fork River, letter to Shelly Spalding, Montana Department of Fish, Wildlife and Parks, Helena, Montana. 5 pp.

Goetz, F. 1989. Biology of the bull trout, Salvelinus confluentus, literature review. U.S. Department of Agriculture, U.S. Forest Service, Willamette National Forest, Eugene, Oregon.

Goheen, E.M., E.M. Hansen, A. Kanaskie, M.G. Williams, N. Oserbauer, and W. Sutton. 2002. Sudden oak death caused by Phytophthora ramorum in Oregon. Plant Disease 86:441.

Golightly, R. T., P. N. Hebert, and D. L. Orthmeyer. 2002. Evaluation of human-caused disturbance on the breeding success of marbled murrelets (*Brachyramphus marmoratus*) in Redwood National and State Parks, California. Bureau of Land Management, National Park Service, U.S. Fish and Wildlife Service, U.S. Geological Survey, California Department of Fish and Game, and California Department of Parks and Recreation. Arcata, CA. 61 pages.

Gremel, S. 2000. Spotted owl monitoring in Olympic National Park: 2000 annual report. U.S. Department of the Interior, National Park Service, Olympic National Park, Port Angeles, Washington.

Gremel, S. 2003. Spotted owl monitoring in Olympic National Park: 2003 annual report. U.S. Department of the Interior, National Park Service, Olympic National Park, Port Angeles, Washington.

Gutierrez, R. J., A. B. Franklin, and W. S. LaHaye. 1995. Spotted owl (Strix occidentalis). in: A. Poole and F. Gill, editors. The birds of North America, No. 179. The Academy of Natural Sciences and The American Ornithologists' Union, Washington, D.C.

Gutiérrez, R.J. 1994. Changes in the distribution and abundance of spotted owls during the past century. Studies in Avian Biology 15:293-300.

Haig, S.M., T.D. Mullins, E.D. Forsman, P. Trail, and L. Wennerberg. In Press. Genetic identification of Spotted Owls, Barred Owls, and their hybrids: evolutionary and legal implications. Conservation Biology.

Haig, S.M., Wagner, R.S., Forsman, E.D., and T.D. Mullins. 2001. Geographic variation and genetic structure in spotted owls. Conservation Genetics 2(1): 25-40.

Hamer, T. E., D.L. Hays, S.M. Senger, and E.D. Forsman. 2001. Diets of northern barred owls and northern spotted owls in an area of sympatry. J. Raptor Res 35(3): 221-227.

Hamer, T.E. and S.K. Nelson. 1995. Nesting chronology of the marbled murrelet. *In* Ralph, C.J., G.L. Hunt jr., M.G. Raphael, J.F. Piatt, tech. eds. 1995. Ecology and conservation of the marbled murrelet. Gen. Tech. Rep. PSW-GTR-152. Albany, CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture.

Hamer, T.E., S.G. Seim, and K.R. Dixon. 1989. Northern spotted owl and northern barred owl habitat use and home range size in Washington: preliminary report. Washington Department of Wildlife, Olympia, Washington.

Hanski, I. and M.E. Gilpin. 1997. Metapopulation Biology: Ecology, Genetics and Evolution. Academic Press, London, UK. 512 pp.

Hanski, I. and M.E. Gilpin. 1997. Metapopulation Biology: Ecology, Genetics and Evolution. Academic Press, London, UK. 512 pp.

Hard, J. 1995. A quantitative genetic perspective on the conservation of intraspecific diversity. American fisheries Society Symposium 17:304-326.

Hard, J. 1995. A quantitative genetic perspective on the conservation of intraspecific diversity. American fisheries Society Symposium 17:304-326.

Harestad, A., J. Hobbs, and I. Blackburn. 2004. Précis of the Northern Spotted Owl in British Columbia. Pages. 12-14 in Zimmerman, K., K. Welstead, E. Williams, J. Turner, (editors). Northern Spotted Owl Workshop Proceedings. Forrex Series (online No. 14), Vancouver, British Columbia, Canada.

Healy, M.C. and A. Prince. 1995. Scales of variation in life history tactics of Pacific salmon and the conservation of phenotype and genotype. American Fisheries Society Symposium 17:176-184.

Healy, M.C. and A. Prince. 1995. Scales of variation in life history tactics of Pacific salmon and the conservation of phenotype and genotype. American Fisheries Society Symposium 17:176-184.

Hebert, P.N. and R.T. Golightly. 2003. Breeding biology, and human-caused disturbance to nesting of marbled murrelets (*Brachyramphus marmoratus*) in Northern California: progress report 2002. Unpublished draft report, Humboldt State University, Dept. of Wildlife, Arcata, CA.

Hedrick, P.W. and S. T. Kalinowski. 2000. Inbreeding depression in conservation biology. Annual Review of Ecology and Systematics 31:139-162.

Henjum, M.G., J.R. Karr, D.L. Bottom, D.A. Perry, J.C. Bednarz, S.G. Wright, S.A. Beckwitt, and E. Beckwitt. 1994. Interim protection for late-successional forests, fisheries, and watersheds. National forests east of the Cascade Crest, Oregon, and Washington. A report to the Congress and President of the United States Eastside Forests Scientific Society Panel. American Fisheries Society, American Ornithologists Union Incorporated, The Ecological Society of America, Society for Conservation Biology, The Wildlife Society. The Wildlife Society Technical Review 94-2.

Henke, A.L., T.Y. Chi, J. Smith, C. Brinegar. Unpublished Draft. Microsatellite Analysis of Northern and California Spotted Owls in California. Conservation Genetics Laboratory, Department of Biological Sciences, San Jose State University, San Jose, California.

Herter, D.R., and L.L. Hicks. 2000. Barred owl and spotted owl populations and habitat in the central Cascade Range of Washington. Journal of Raptor Research 34(4): 279-286.

Hill, J.L., and Gray, K.L. 2004. Conservation Strategy for Spalding's Catchfly (Silene spaldingii Wats.).

Hoelscher, B., and T.C. Bjornn. 1989. Habitat, density and potential production of trout and char in Pend Oreille Lake tributaries. Project F-71-R-10, Subproject III, Job No. 8. Idaho Department of Fish and Game, Boise, Idaho.

Howell, P.J., and D.V. Buchanan. 1992. Proceedings of the Gearhart Mountain Bull Trout Workshop. Oregon Chapter of the American Fisheries Society, Corvallis, Oregon.

Huff, M. 2003. Marbled murrelet effectiveness monitoring, Northwest Forest Plan, 2002 annual summary report (version 2). Marbled murrelet module, Northwest Forest Plan Interagency Regional Monitoring Program. Portland, OR. 27pp.

Idaho Department of Fish and Game. 1995. List of streams compiled by IDFG where bull trout have been extirpated, fax from Bill Horton, IDFG.

Isaacs, F. 2003. E-mail regarding the results of 2003 midwinter bald eagle survey. Oregon State Univ., Corvallis, OR.

Isaacs, F.B. and R.G. Anthony. 2003. Bald eagle nest locations and history of use in Oregon and the Washington portion of the Columbia River Recovery Zone, 1971 through 2003. Oregon Cooperative Fish and Wildlife Research Unit, Oregon State University, Corvallis. 24pp, + appendices.

Iverson, W.F. 1993. Is the barred owl displacing the spotted owl in western Washington? M.S. Thesis, Western Washington University, Bellingham, Washington.

Iverson, W.F. 2004. Reproductive success of Spotted Owls sympatric with Barred Owls in western Washington. Journal of Raptor Research 38(1):88-91.

Kagen, J. (jimmy.kagan@orst.edu). 2004/ Aug 19. determination of habitat on Forest Service land for Plagiobothrys hirtus, Thelypodium howelli ssp spectabilis, Lilium occidentale. [E-mail to Linda Mazzu (lmazzu@fs.fed.us)].

Kay, C.E. 1994. Aboriginal overkill: the role of native Americans in structuring Western ecosystems. Human Nature 5: p.359-98.

Kaye, T.N. 2001. Common Ground and Controversy in Native Plant Restoration: the SOMS Debate, Source Distance, Plant Selections, and a Restoration Oriented Definition of Native. Keynote Address at Native Plant Propogation and Restoration Strategies Conference. December 12-13, 2001. Eugene, OR. 12.

Keeley, J.E. 2004. Ecological impacts of wheat seeding after a Sierra Nevada wildfire. International Journal of Wildland FIre 13(1): p.73-8.

Kenneth A. Langeland. 2006. Safe use of Glyphosate-containing products in Aquatic and Upland Natural Areas. Publication SS-AGR-104. Agronomy Department, Center for

Aquatic and Invasive Plants; Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL 32610.

Jakober, M. 1995. Autumn and winter movement and habitat use of resident bull trout and west slope cutthroat trout in MonLacey, J.R., Marlow, C.B., and Lane, J.R. 1989. Influence of spotted knapweed (*Centaurea maculosa)* on surface runoff and sediment yield. Weed Technology 3:627-31.

Johnston, A. 2002. Northern spotted owl survey and monitor report. U.S. Department of Interior, National Park Service, Crater Lake National Park, Crater Lake, Oregon.

Kannan, K., J. C. Franson, W.W. Bowerman, K.J. Hansen, P.D. Jones, and J.P. Giesy. 2001. Perluorooctane sulfonate in fish-eating birds including bald eagles and albatrosses. Environ. Sci. and Technology 35(15):3065-3070.

Kelly, E.G. 2001. Range expansion of the Northern Barred Owl: an evaluation of the impact on Spotted Owls. M.S. Thesis, Oregon State Univ., Corvallis, OR U.S.A.

Kelly, E.G. and E.D. Forsman. 2004. Recent records of hybridization between barred owls (Strix varia) and northern spotted owls (S. occidentalis caurina). Auk 121:806-810.

Kelly, E.G., E.D. Forsman, and R.G. Anthony. 2003. Are barred owls displacing spotted owls? Condor 105:45-53.

Klamath Basin Bull Trout Working Group. 2000. Unpublished data on bull trout population. KBBTW, Klamath Falls, Oregon.

Komar, N., N.A. Panella, J.E. Burns, S.W. Dusza, T.M. Mascarenhas, and T.O. Talbot. 2001. Serologic evidence for West Nile virus infection in birds in the New York City vicinity during an outbreak in 1999. Emerging Infectious Diseases 7(4):621-5.

Kuntz II, R.C. and R.G. Christophersen. 1996. A survey of the northern spotted owl in North Cascades National Park Service Complex. NPS Technical Report NPS/CCSONOCA/NRTR-96/05. U.S. Department of the Interior, National Park Service, North Cascades National Park, Sedro Woolley, Washington.

Lahaye, W.S., and R.J. Gutierrez. 1999. Nest sites and nesting habitat of the northern spotted owl in northwestern California. Condor 101: 324-330.

Lahaye, W.S., Guiterrez, R.J., and J.R. Dunk. 2001. Natal dispersion of the spotted owl in southern California: dispersal profile of an insular population. Condor 103: 691-700.

Lank, D. B., N. Parker, E. A. Krebs, and L. M. Tranquilla. 2003. Geographic distribution, habitat selection, and population dynamics with respect to nesting habitat characteristics, of marbled murrelets. Centre for Wildlife Ecology, Simon Fraser University, Burnaby, Canada. 66 pages.

Leary, R.F., F.W. Allendorf, and S.H. Forbes. 1997. Genetic confirmation of sympatric bull trout and Dolly Varden in western Washington. Transactions of the American Fisheries Society 126:715-720.

Leary, R.F., F.W. Allendorf, and S.H. Forbes. 1993. Conservation genetics of Bull trout in the Columbia and Klamath River drainages. Conservation Biology 7:856-865.

Leathe, S.A., and P. Graham. 1982. Flathead Lake fish food habits study. Environmental Protection Agency, through Steering Committee for the Flathead River Basin

Environmental Impact Study. Contract R008224-01-4 to Montana Department of Fish, Wildlife and Parks.

Lesica, P., and DeLuca, T.H. 1996. Longterm harmful effects of crested wheatgrass on Great Plains grassland ecosystems. Journal of Soil and Water Conservation` 51: p.408-9.

Leskiw, T., and R.J. Gutiérrez. 1998. Possible predation of a Spotted Owl by a Barred Owl. Western Birds 29:225–226.

Light, J., L. Herger, and M. Robinson. 1996. Upper Klamath basin bull trout conservation strategy, a conceptual framework for recovery. Part one. The Klamath Basin Bull Trout Working Group.

Lohr, S., S. Duke, T. Cummings, and W. Fredenberg. 2001. Listing of bull trout as threatened in the United States and initial steps in recovery planning. In: Berwin, M.K., A.J. Paul, and M. Monita. 2001. Bull Trout II Conference Proceedings. 199-205.

Luginbuhl, J. M., J. M. Marzluff, J. E. Bradley, M. G. Raphael, and D. E. Varland. 2001. Corvid survey techniques and the relationship between corvid relative abundance and nest predation. Journal of Field Ornithology 72(4):556-572.

Lym, R.G., Messersmith, C.G., and Zollinger, R. 1998. Leafy spurge - identification and control [Web Page]. Located at: http://ndsuext.nodak.edu/extpubs/plantsci/weeds/w765w.htm. Accessed 2001 Dec 5.

Lynch, M. and R. Lande. 1998. The critical effective size for a genetically secure population. Animal Conservation 1:70-72.

Madsen, S., D. Evans, T. Hamer, P. Henson, S. Miller, S.K. Nelson, D. Roby, and M. Stapanian. 1999. Marbled murrelet effectiveness monitoring plan for the Northwest Forest Plan. Gen. Tech. Rept. PNW-GTR-439. Portland, OR. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 51 pp.

Manley, I. A. 1999. Behavior and habitat selection of marbled murrelets nesting on the Sunshine Coast. Masters of Science Thesis. Department of Biological Sciences, Simon Fraser University, Burnaby, Canada. 163 pages.

Manley, I.A., A. Harfenist, and G. Kaiser. 2001. Marbled murrelet telemetry study on Queen Charlotte Islands/Haida Gwaii. Smithers, BC, Ministry of Environment, Lands and Parks, 24 pp.

Marra, P.P., S. Griffing, C. Caffrey, A.M. Kilpatrick, R. McLean, C. Brand, E. Saito, A.P. Dupuis, L. Kramer, and R. Novak. 2004. West Nile Virus and wildlife. BioScience 54(5):393-402.

Marshall, D.B. 1988. Status of the Marbled Murrelet in North America: with special emphasis on populations in California, Oregon, and Washington. Audubon Society of Portland.

Masters, R.A, and Sheley, R.L. 2001. Invited synthesis paper: principles and practices for managing rangeland invasive plants. Journal Range Management 54: p.502-17.

Masters, R.A., Nissen, S.J., Gaussoin, R.E., Beran , D.D., StougaardR.N. 1996. Imidazolinone herbicides improve restoration of Great Plains grasslands. Weed Technology 10: p.392-403.

Mazzu, L.C. 2004. Common Control Measures for Pacific Northwest Invasive Plantsp 58.

McIntosh, B.A., J.R. Sedell, J.E. Smith, R.C. Wissmar, S.E. Clarke, G.H. Reeves, and L.A. Brown. 1994. Management history of eastside ecosystems: Changes in fish habitat over 50 years, 1935 to 1992. U.S. Forest Service, Pacific Northwest Research Station, General Technical Report. PNW-GTR 321.

McLean, R.G., S.R. Ubico, S.E. Docherty, W.R. Hansen, L. Sileo, and T.S. McNamara. 2001. West Nile Virus and transmission and ecology in birds. Annals of the New York Academy of Sciences 951:54-57.

McPhail, J.D., and J.S. Baxter. 1996. A review of bull trout (Salvelinus confluentus) life-history and habitat use in relation to compensation and improvement opportunities. Department of Zoology, University of British Columbia. Fisheries Management Report No. 104. Vancouver, British Columbia, Canada.

McShane, C., T. Hamer, H. Carter, G. Swartzman, V. Friesen, D. Ainley, R. Tressler, K. Nelson, A. Burger, L. Spear, T. Mohagen, R. Martin, L. Henkel, K. Prindle, C. Strong, and J. Keany. 2004. Evaluation report for the 5-year status review of the marbled murrelet in Washington, Oregon, and California. Unpublished report. EDAW, Inc. Seattle, Washington. Prepared for the U.S. Fish and Wildlife Service, Region 1. Portland, Oregon.

Meehan, W.R. 1991. Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats. American Fisheries Society Special Publication 19.

Meekins, D. J., and T. E. Hamer. 1998. Use of radar to monitor marbled murrelets at inland sites in the North Cascades of Washington: Preliminary Report. USDA Forest Service. 16 pages.

Meffe, G.K., and C.R. Carroll. 1994. Principles of conservation biology. Sinauer Associate, Inc. Sunderland, Massachusetts.

Meyer, C. B., S. L. Miller, and C. J. Ralph. 2002. Multi-scale landscape and seascape patterns associated with marbled murrelet nesting areas on the U.S. west coast. Landscape Ecology 17:95-115.

Meyer, J.S., Irwin, L.L., and M.S. Boyce. 1998. Influence of habitat abundance and fragmentation on northern spotted owls in western Oregon. Wildlife Monographs 139: 1-51.

Mierzykowski, S.E. and K.C. Carr. 2002. Organochlorine compounds and mercury in bald eagle eggs, Penobscot River, Maine. U.S. Fish and Wildlife Service. Special Project Report FY02-MEFO-1-EC. Old Town, Maine.

Miller, G.S. 1989. Dispersal of juvenile northern spotted owls in western Oregon. M.S. Thesis. Oregon State University, Corvallis, Oregon. 139 pages.

Miller, J.H., Boyd, R.S., and Edwards, M.B. 1999. Floristic diversity, stand structure, and composition 11 years after herbicide site preparation. Can. J. For. Res. 29:1073-83.

Miller, P.S. and R.C. Lacy. 1999. VORTEX: a stochastic simulation of the extinction process. Version 8 user's manual. Conservation breeding specialists group (SSC/IUCN), Apple Valley, MN.

Mills, E.L., Leach, J.H., Carlton, J.T., Secor, C.L. 1994. Exotic species and the integrity of the Great Lakes. BioScience: 44: p.666-76.

Montana Bull Trout Scientific Group. 1995a. Upper Clark Fork River drainage bull trout status report (including Rock Creek). Prepared for Montana Bull Trout Restoration Team. Helena, Montana.

Montana Bull Trout Scientific Group. 1995b. Bitterroot River drainage bull trout status report. Prepared for Montana Bull Trout Restoration Team. Helena, Montana.

Montana Bull Trout Scientific Group. 1995c. Blackfoot River drainage bull trout status report. Prepared for Montana Bull Trout Restoration Team. Helena, Montana.

Montana Bull Trout Scientific Group. 1995d. Flathead River drainage bull trout status report (including Flathead Lake, the North and Middle forks of the Flathead River and the Stillwater and Whitefish River). Prepared for Montana Bull Trout Restoration Team. Helena, Montana.

Montana Bull Trout Scientific Group. 1995e. South Fork Flathead River drainage bull trout status report (upstream of Hungry Horse Dam). Prepared for Montana Bull Trout Restoration Team. Helena, Montana.

Montana Bull Trout Scientific Group. 1996a. Swan River drainage bull trout status report (including Swan Lake). Prepared for Montana Bull Trout Restoration Team. Helena, Montana.

Montana Bull Trout Scientific Group. 1996b. Lower Clark Fork River drainage bull trout status report (Cabinet Gorge Dam to Thompson Falls). Prepared for Montana Bull Trout Restoration Team. Helena, Montana.

Montana Bull Trout Scientific Group. 1996c. Middle Clark Fork River drainage bull trout status report (from Thompson Falls to Milltown, including the lower Flathead River to Kerr Dam). Prepared for Montana Bull Trout Restoration Team. Helena, Montana.

Montana Bull Trout Scientific Group. 1996d. Lower Kootenai River drainage bull trout status report (below Kootenai Falls). Prepared for Montana Bull Trout Restoration Team. Helena, Montana.

Montana Bull Trout Scientific Group. 1996e. Middle Kootenai River drainage bull trout status report (between Kootenai Falls and Libby Dam). Prepared for Montana Bull Trout Restoration Team. Helena, Montana.

Montana Bull Trout Scientific Group. 1996f. Upper Kootenai River drainage bull trout status report (including Lake Koocanusa, upstream of Libby Dam). Prepared for Montana Bull Trout Restoration Team. Helena, Montana.

Montana Bull Trout Scientific Group. 1998. The relationship between land management activities and habitat requirements of bull trout. Prepared for Montana Bull Trout Restoration Team. Helena, Montana.

Naeem, S., F.S., Chapin III, R., Costanza, P.R, Ehrlich, F., Golley and others. 1999. Biodiversity and Ecosystem Functioning: Maintaining Natural Life Support Processes. Issues in Ecology 4:11.

Nehlsen, W., J. Williams, and J. Lichatowich. 1991. Pacific salmon at the crossroads: stocks at risk from California, Oregon, Idaho, and Washington. Fisheries 16(02):4-21.

Nelson, S. K., and A. K. Wilson. 2002. Marbled murrelet habitat characteristics on state lands in western Oregon. Corvallis, OR: Oregon Cooperative Fish and Wildlife Research Unit, OSU, Department of Fisheries and Wildlife. 151 pages.

Newmaster, S.G., Bell, F.W., and Vitt, D.H. 1999. The effects of glyphosate and triclopyr on common bryophytes in northwestern Ontario. Can. J. For. Res. 29:1101-11.

Newton, J.A., and S. Pribyl. 1994. Bull trout population summary: Lower Deschutes River subbasin. Oregon Department of Fish and Wildlife, The Dalles, Oregon. Oregon administrative rules, proposed amendments to OAR 340-41-685 and OAR 340-41-026. January 11, 1996.

North, M.P., Franklin, J.F., Carey, A.B., Forsman, E.D., and T. Hamer. 1999. Forest stand structure of the northern spotted owl's foraging habitat. Forest Science, 45(4): 520-527.

North, M.P., G. Steger, R. Denton, G. Eberlein, T. Munton, and K. Johnson. 2000. Association of weather and nest-site structure with reproductive success in California spotted owls. Journal of Wildlife Management 64(3):797-807.

Olson, B.E., Wallander, R.T., and Lacey, J.R. 1997. Effects of sheep grazing on a spotted knapweed-infested idaho fescue community. Journal of Range Management 50(4):386-91.

Olson, G.S., E. Glenn, R.G. Anthony, E.D. Forsman, J.A. Reid, P.J. Loschl, and W.J. Ripple. In Press. Modeling demographic performance of northern spotted owls relative to forest habitat in Oregon. Journal of Wildlife Management.

Olympic Peninsula Recovery Team. 2001. Meeting notes from 10/11/01 at U.S. Fish and Wildlife Service, Lacey, Washington.. Matrix of core area existing conditions.

Olympic Peninsula Recovery Team. 2003a. Meeting notes from 01/14/03 at U.S. Fish and Wildlife Service, Lacey, Washington. Recovered and current abundance for core areas. Designation of local populations and potential local populations. Elwha Dam removal salvage.

Oregon Chapter of American Fisheries Society. 1993. Petition to the Fish and Wildlife Service to list bull trout in the upper Klamath basin under the Endangered Species Act. Corvallis. Oregon.

Oregon. 1996. Oregon administrative rules, proposed amendments to OAR 340-41-685 and OAR 340-41-026. January 11, 1996.

Oregon. 1997. Coastal Salmon Restoration Initiative. The Oregon Plan. State of Oregon.

Paton, P. W. C., C. J. Ralph, and R. A. Erickson. 1992. Use of an inland site in northwestern California by marbled murrelets. Proceedings of the Western Foundation of Vertebrate Zoology 5:109-116.

Paton, P., C. Zabel, B. Bingham, H. Sakai, and C. Ogan. 1990. Examination of home-range size and habitat use of the spotted owl in the Klamath Province. U.S. Forest Service Redwood Science Laboratory, Arcata, CA. Unpublished report.

Pearson, D.E., Mckelvey, K.S., Ruggiero, L.F. 2000. Non-target effects of an introduced Biological control agent on Deer Mouse Ecology. Oecologia 122:121-8.

Pearson, R.R., and K.B. Livezey. 2003. Distribution, numbers, and site characteristics of spotted owls and barred owls in the Cascade Mountains of Washington. J. Raptor Res., 37(4): 265-276.

Peery, M.Z., S. Beissinger, and S. Newman. 2003. Post-breeding movements and distribution of marbled murrelets in Central California. Unpublished report to Oiled Wildl. Care Network, U.C. Davis, CA, and Cal. Dept. Fish and Game, Sacramento, CA.

Piper, Susan. Forest Wildlife Biologist, Olympic National Forest, Olympia, WA. Personal communication on August 18, 2006.

Pratt, K.L. 1985. Pend Oreille trout and char life history study. Idaho Department of Fish and Game in cooperation with the Pend Oreille Idaho Club.

Pratt, K.L. 1992. A review of bull trout life history. Pages 5-9 *in* P.J. Howell, and D.V. Buchanan, eds. Proceedings of the Gearhart Mountain Bull Trout Workshop. Oregon Chapter of the American Fisheries Society, Corvallis, Oregon.

Pratt, K.L., and J.E. Huston. 1993. Status of bull trout (*Salvelinus confluentus*) in Lake Pend Oreille and the lower Clark Fork River. Draft report. Prepared for the Washington Water Power Company, Spokane, Washington.

Quigley, T.M. and S.J. Arbelbide, tech. editors. 1997. An assessment of ecosystem components in the interior Columbia basin and portions of the Klamath and Great basins: volume III. General Technical Report PNW-GTR-4-5. U.S. Department of Agriculture, Forest Service, and U.S. Department of Interior, Bureau of Land Management.

Ralph, C.J., and S.L. Miller. 1995. Offshore population estimates of marbled murrelets in California. *In* Ralph, C.J., G.L. Hunt jr., M.G. Raphael, J.F. Piatt, tech. eds. 1995. Ecology and conservation of the marbled murrelet. Gen. Tech. Rep. PSW-GTR-152. Albany, CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture.

Ralph, C.J., G.L. Hunt jr., M.G. Raphael, J.F. Piatt, tech. eds. 1995. Ecology and conservation of the marbled murrelet. Gen. Tech. Rep. PSW-GTR-152. Albany, CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture.

Raphael, M. G., D. Evans-Mack, and B. A. Cooper. 2002. Landscape-scale relationships between abundance of marbled murrelets and distribution of nesting habitat. Condor 104(2):331-342.

Ratliff, D.E., and P.J. Howell. 1992. The status of bull trout populations in Oregon. Pages 10-17 *in*: P.J. Howell and D.V. Buchanan (eds). Proceedings of the Gearhart Mountain bull trout workshop. Oregon Chapter of the American Fisheries Society, Corvallis.

Rees, J. and P. Lee. 1990. Management of bald eagles, *Haliaeetus leucocephalus*, and their habitats on National Forests of the Pacific Northwest. USDA Forest Service, Portland, OR. 61 pp. + appendices.

Rich, C.F., Jr. 1996. Influence of abiotic and biotic factors on occurrence of resident bull trout in fragmented habitats, western Montana. M.S. Thesis, Montana State University, Bozeman, Montana.

Rieman, B.E., and F.W. Allendorf. 2001. Effective population size and genetic conservation criteria for bull trout. North American Journal of Fisheries Management 21:756-764.

Rieman, B.E., and J.B. Dunham. 2000. Metapopulations and salmonids: a synthesis of life history patterns and empirical observations. Ecology of Freshwater Fish 9:1-2.

Rieman, B.E., and J.D. McIntyre. 1993. Demographic and habitat requirements for conservation of bull trout. General Technical Report INT-302. U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Ogden, Utah.

Rieman, B.E., and J.D. McIntyre. 1995. Occurrence of bull trout in naturally fragmented habitat patches of varied size. Transactions of the American Fisheries Society 124(3):285-296.

Rieman, B.E., and J.D. McIntyre. 1996. Spatial and temporal variability in bull trout redd counts. North American Journal of Fisheries Management 16:132-141.

Rieman, B.E., D.C. Lee, and R.F. Thurow. 1997a. Distribution, status, and likely future trends of bull trout within the Columbia River and Klamath River basins. North American Journal of Fisheries Management. 17:1111-1125.

Rizzo, D.M., M. Garbeloto, J.M. Davidson, G.W. Slaughter, and S.T. Koike. 2002. Phytophthora ramorum as the cause of extensive mortality of Quercus spp. and Lithocarpus densiflorus in California. Plant Disease 86:205-214.

Rodway, M. S., H. M. Regehr, and J. P. L. Savard. 1993. Activity patterns of marbled murrelets in old-growth forest in the Queen-Charlotte-Islands, British Columbia. Condor 95:831-848.

Romo, J.T. 2005. Emergence and Establishment of *Agropyron desertorum* (Fisch.) (Crested Wheatgrass) Seedlings in a Sandhills Prairie of Central Saskatchewan . Natural Areas Journal 25((1)): p.26-35.

Saunders, D.A., R.J. Hobbs, and C.R. Margules. 1991. Biological consequences of ecosystem fragmentation: A review. Conservation Biology 5:18-32.

Schill, D.J. 1992. River and stream investigations. Job Performance Report, Project F-73-R-13. Idaho Department of Fish and Game, Boise, Idaho.

Schmidt, K. 2003. Northern spotted owl monitoring and inventory, Redwood National and State Parks, 2002 annual report. Redwood National and State Parks, Orick, California.

Sedell, J.R., and F.H. Everest. 1991. Historic changes in pool habitat for Columbia River Basin salmon under study for TES listing. Draft U.S. Department of Agriculture Report, Pacific Northwest Research Station, Corvallis, Oregon.

SERA (Syracuse Environmental Research Associates I. 2003. Glyphosate- Human Health and Ecological Risk Assessment Final Report.

SERA (Syracuse Environmental Research Associates, Inc.). 1999. Clopyralid (Transline)- Final Report. SERA TR 99-21-11/12-01c. February 27, 1999.

SERA (Syracuse Environmental Research Associates, Inc.). 1999. Imazapyr - Human Health and Ecological Risk Assessment Priliminary Draft - Program Description. SERA TR 98-21-14-01b. May 6, 1999.

SERA (Syracuse Environmental Research Associates, Inc.). 2001. Impazapic [Plateau and Plateau DG] - Human Health and Ecological Risk Assessment Final Report. SERA TR 00-21-28-01e. January 28, 2001.

SERA (Syracuse Environmental Research Associates, Inc.). 2001. Sethoxydim [Poast] - Human Health and Ecological Risk Assessment Final Report. SERA TR 01-43-01-01c. October 31, 2001.

SERA (Syracuse Environmental Research Associates, Inc.). 2003. Chlorsulfuron - Human Health and Ecological Risk Assessment Preliminary Draft - Introduction and Program Description. SERA TR 02-43-18-01a. April 10, 2003.

SERA (Syracuse Environmental Research Associates, Inc.). 2003. Metsulfuron methyl - Human Heath and Ecoloical Risk Assessment Preliminary Draft - Introduction and Program Description. SERA TR 02-43-17-01a. April 14, 2003.

SERA (Syracuse Environmental Research Associates, Inc.). 2003. Picloram - Revised Human Health and Ecological Risk Assessment Final Report. SERA TR 03-43-26-01b. June 30, 2003.

SERA (Syracuse Environmental Research Associates, Inc.). 2003. Sulfometuron methyl - Human Health and Ecological Risk Assessment Preliminary Draft - Introduction and Program Description. SERA TR 02-43-17-02a. October 16, 2003.

SERA (Syracuse Environmental Research Associates, Inc.). 2003. Triclopyr - Revised Human Health and Ecological Risk Assessments Final Report. SERA TR 02-43-13-03b. March 15, 2003.

Sexauer, H.M., and P.W. James. 1997. Microhabitat use by juvenile trout in four streams located in the eastern Cascades, Washington. Pages 361-370 *in* W.C. Mackay, M.K. Brewin and M. Monita (eds). Friends of the Bull Trout Conference Proceedings. Bull Trout Task Force (Alberta), c/o Trout Unlimited Calgary, Alberta, Canada.

Sheley, R.L., Svejcar, T.J., Maxwell, B.D. 1996. A Theoretical Framework for Developing Successional Weed Management Strategies on Rangeland. Weed Technology 10(4):766-73.

Shepherd, M., S., Buchmann, M., Vaughan, and S., Black. 2003. Pollinator Conservation Handbook. Glazer, M., Editor. Portland, Oregon: The Xerces Society.

Simpson, J.C., and R.L. Wallace. 1982. Fishes of Idaho. University Press of Idaho. Moscow, Idaho.

Singer, S. W., D. L. Suddjian, and S. A. Singer. 1995. Fledging behavior, flight patterns, and forest characteristics at marbled murrelet tree nests in California. Northwestern Naturalist 76:54-62.

Sisco, C. L., and R. J. Gutierrez. 1984. Winter ecology of radio-tagged spotted owls on the Six Rivers National Forest, Eureka, CA: U.S. Department of Agriculture, Forest Service, Six Rivers National Forest. Eureka, CA.

Solis, D. M. 1983. Summer habitat ecology of northern spotted owls in Northwestern California. M. S. Thesis. Humboldt State University, Arcata, CA.

Soulé, M.E. 1987. Viable Populations for Conservation. Cambridge University Press, Cambridge, UK. 206pp.

Speich, S.M., and T.R. Wahl. 1995. Marbled murrelet populations of Washington-marine habitat preferences and variability of occurrence. *In* Ralph, C.J., G.L. Hunt jr., M.G. Raphael, J.F. Piatt, tech. eds. 1995. Ecology and conservation of the marbled murrelet. Gen. Tech. Rep. PSW-GTR-152. Albany, CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture.

Spruell, P., A.R. Hemmingsen, P.J. Howell, N. Kanda, and F.W. Allendorf. 2003. Conservation genetics of bull trout: Geographic distribution of variation at microsatellite loci. Conservation Genetics 4:17-29.

Spruell, P., and F. Allendorf. 1997. Nuclear DNA analysis of Oregon bull trout. Final report to the Oregon Department of Fish and Wildlife. Division of Biological Sciences, University of Montana.

Spruell, P., B.E. Rieman, K.L. Knudsen, F.M. Utter, and F.W. Allendorf. 1999. Genetic population structure within streams: microsatellite analysis of bull trout populations. Ecology of Freshwater Fish 8:114-121.

Stalmaster, M.B. 1987. The Bald Eagle. Universe Books. New York, New York.

Stalmaster, M.V. and J.R. Newman. 1978. Behavioral responses of wintering bald eagles to human activity. J. Wildl. Manage. 43:506-513.

Steventon, J.D., and N.L. Holmes. 2002. A radar-based inventory of marbled murrelets (*Brachyramphus marmoratus*), northern Mainland Coast of British Columbia. Prince Rupert Forest Region, British Columbia Ministry of Forests, 40 pp.Strong, C. S. 2003a. Marbled murrelet abundance and reproductive indices in Oregon during 2002. Oregon Department of Fish and Wildlife, Wildlife Diversity Program. 14 pages.

Strong, C. S. 2003a. Marbled murrelet abundance and reproductive indices in Oregon during 2002. Oregon Department of Fish and Wildlife, Wildlife Diversity Program. 14 pages.

Strong, C. S. 2003b. Status of marbled murrelets at sea in conservation zone 5: Mendocino, Sonoma, and Marin counties. Crescent Coastal Research, Astoria, Oregon. 22 pages.

Strong, C.S., and T.M. Carten. 2000. Marbled murrelets at sea in Oregon: status of abundance and reproduction during 1999. Draft final report to the Oregon Department of Fish and Wildlife. Portland, Oregon. 17pp.

Swanberg, T. R. 1997. Movements of and habitat use by fluvial bull trout in the Blackfoot River, Montana. Transactions of the American Fisheries Society 126:735-746.

Taylor, B.E., S. Pollard, and D. Louie. 1999. Mitochondrial DNA variation in bull trout (*Salvelinus confluentus*) from northwestern North America: implications for zoogeography and conservation. Molecular Ecology 8:1155-1170.

Thomas, G. 1992. Status of bull trout in Montana. Report prepared for Montana Department of Fish, Wildlife and Parks, Helena, Montana.

Thomas, J.W. and M.G. Raphael (eds.) 1993. Forest Ecosystem Management: An Ecological, Economic, and Social Assessment. Report of the Forest Ecosystem Management Assessment Team (FEMAT). July 1993. Portland, OR: USDA Forest Service and the USDI Bureau of Land Management.

Thomas, J.W., E.D. Forsman, J. B. Lint, E. C. Meslow, B. R. Noon, and J. Verner. 1990. A conservation strategy for the northern spotted owl. Report of the Interagency Scientific Committee to address the conservation of the northern spotted owl. Unpublished interagency document.

Thomas, J.W., M.G. Raphael, R.G. Anthony, E.D. Forsman, A.G. Gunderson, R.S. Holthausen, B.G. Marcot, G.H. Reeves, J.R. Sedell, and D.M. Solis. 1993. Viability assessments and management considerations for species associated with late-successional and old-growth forests of the Pacific Northwest. Portland, Oregon. U. S. Department of Agriculture, Forest Service. 523 pp.

Tilghman, N.G. and P.W.C. Paton. 1988. Examination of home range size and habitat use of the spotted owl in the Klamath Province, Progress Report covering the period from: spring 1987 – February 29, 1988. Unpublished report. USDA Forest Service, Pacific Southwest Forest and Range Experiment Station, Arcata, CA.

Tu, M. , Hurd, C., and Randall, J. M. 2001. Weed Control Methods Handbook: Tools and Techniques for Use in Natural Areas.

Tyser, R.W., Asebrook, J.M., Potter, R.W., and Kurth LL. 1998. Roadside vegetation in Glacier National Park, U.S.A: Effects of herbicide and seeding treatments. Restoration Ecology 6(2):197-206.

U.S. Department of Agriculture, Forest Service. 2004. National Strategy and Implementation Plan for Invasive Species.

U.S. Fish and Wildlife Service and National Marine Fisheries Service. 1998. Endangered Species Consultation Handbook: Procedures for conduction consultation and conference activities under Section 7 of the Endangered Species Act.

U.S. Fish and Wildlife Service. 1998. Endangered Species Consultation Handbook. US Fish and Wildlife Service/NOAA Fisheries.

USDA Forest Service. 2005. National Forest System Land Management Planning. Federal Register 70(3): 1023-1061.

Department of Agriculture and Department of Interior . 1995a. Interim strategies for managing fish-producing watersheds in eastern Oregon and Washington, Idaho, western Montana, and portions of Nevada (INFISH).

USDA (U.S. Department of Agriculture), and USDI (U.S. Department of the Interior). 1995b. Decision Notice/Decision Record Finding of No Significant Impact, Environmental Assessment for the Interim Strategies for Managing Anadromous Fish-producing Watersheds in Eastern Oregon, and Washington, Idaho, and portions of California (PACFISH).

USDA (U.S. Department of Agriculture), and USDI (U.S. Department of the Interior). 1996. Status of the Interior Columbia Basin, Summary of Scientific Findings.

USDA (U.S. Department of Agriculture), and USDI (U.S. Department of the Interior). 1997. Interior Columbia River Basin Ecosystem Management Project, Upper Columbia River Basin Draft Environmental Impact Statement. Vol I., Vol II, Vol III.

U.S. Department of Agriculture and U.S. Department of the Interior. 1994a. Record of decision for amendments to Forest Service and Bureau of Land Management planning documents within the range of the northern spotted owl. U.S. Forest Service, Bureau of Land Management, Portland, OR. 2 vols. and appendices.

U.S. Department of Agriculture and U.S. Department of the Interior. 1994b. Final supplemental environmental impact statement on management of habitat for late-successional and old-growth forests related species within the range of the northern spotted owl. U.S. Forest Service, Bureau of Land Management, Portland, OR.

U.S. Department of Agriculture, U.S. Department of the Interior, U.S. Department of Commerce, and the Environmental Protection Agency. 1993. Forest Ecosystem Management: An Ecological, Economic, and Social Assessment. Report of the Forest Ecosystem Management Assessment Team. Forest Service, Fish and Wildlife Service, National Marine Fisheries Service, National Park Service, Bureau of Land Management, Environmental Protection Agency. Portland, Oregon.

U.S. Department of the Interior and U.S. Department of Commerce. 1996. Policy: regarding the recognition of distinct vertebrate population segments under the endangered species act. Federal Register 61:4722-4725.

U.S. Fish and Wildlife Service 2004. Biological Opinion on FY 2005-2006 projects within the North Coast Province which may modify habitat for bald eagles, northern spotted owls, and marbled murrelets [FWS Reference: 1-7-05-F-0005].

U.S. Fish and Wildlife Service. 1981. Bald Eagle Management Guidelines Oregon-Washington. U.S. Fish and Wildlife Service, Portland, Oregon. 10pp.

U.S. Fish and Wildlife Service. 1986. Recovery plan for the Pacific Bald Eagle. U.S. Fish and Wildlife Service, Portland, Oregon. 160pp.

U.S. Fish and Wildlife Service. 1987. The northern spotted owl status review. U.S. Fish and Wildlife Service, Portland, OR.

U.S. Fish and Wildlife Service. 1989. The northern spotted owl; a status review supplement. U.S. Fish and Wildlife Service, Portland, OR.

U.S. Fish and Wildlife Service. 1990a. Final rule listing: listing of threatened status for northern spotted owl (Strix occidentalis caurina). Federal Register 55:26114-26194.

U.S. Fish and Wildlife Service. 1990b. 1990 status review: northern spotted owl; Strix occidentalis caurina. Report to the Fish and Wildlife Service, Portland, OR.

U.S. Fish and Wildlife Service. 1992. Endangered and threatened wildlife and plants; determination of threatened status for the Washington, Oregon, and California population of the marbled murrelet, final rule. Fish and Wildlife Service, Federal Register 50 CFR 17: 45328-45337.

U.S. Fish and Wildlife Service. 1992a. Final rule: designate critical habitat for northern spotted owl (Strix occidentalis caurina). Federal Register 57:1796-1838.

U.S. Fish and Wildlife Service. 1992b. Recovery plan for the northern spotted owl. Final draft. U.S. Fish and Wildlife Service. Portland, Oregon. 2 Volumes.

U.S. Fish and Wildlife Service. 1994. Final biological opinion for the preferred alternative of the supplemental environmental impact statement on management of habitat for late-successional and old-growth forest related species within the range of the northern spotted owl. U.S. Fish and Wildlife Service, Portland, Oregon.

U.S. Fish and Wildlife Service. 1995. Endangered and Threatened Wildlife and Plants; proposed special rule for the conservation of the northern spotted owl on non-federal lands; proposed special rule. Federal Register Vol. 60, No.33:9484-9495. February 17, 1995.

U.S. Fish and Wildlife Service. 1995. Final rule: reclassify endangered to threatened for bird *Haliaeetus leucocephalus).* Federal Register 60:35999-36010.

U.S. Fish and Wildlife Service. 1996. Endangered and threatened wildlife and plants; determination of critical habitat for the marbled murrelet; final rule. Fish and Wildlife Service, Federal Register, 50 CFR 17: 26256-26320.

U.S. Fish and Wildlife Service. 1997. Recovery plan for the threatened marbled murrelet (*Brachyramphus marmoratus*) in Washington, Oregon, and California. Fish and Wildlife Service, Portland, Oregon. 203 pp.

U.S. Fish and Wildlife Service. 1999. Proposed rule: delist bald eagle *Haliaeetus leucocephalus)* in the lower 48 states. Federal Register 64:36453-36464.

U.S. Fish and Wildlife Service. 2001. A range wide baseline summary and evaluation of data collected through section 7 consultation for the northern spotted owl and its critical habitat: 1994-2001. Region 1, Portland, Oregon.

U.S. Fish and Wildlife Service. 2003. Appendix 1: Estimates of distances at which incidental take of murrelets and spotted owls due to harassment are anticipated from sound-generating, forest-management activities in Olympic National Forest. unpublished report prepared by Kent Livezey, Western Washington Fish and Wildlife Office, Lacey, WA. 20 pp.

U.S. Fish and Wildlife Service. 2003. Biological Opinion and Letter of Concurrence for effects to bald eagles, marbled murrelets, northern spotted owls, bull trout, and designated critical habitat for marbled murrelets and northern spotted owls from Olympic National Forest Program of Activities for August 5, 2003, to December 31, 2008. U.S. Fish and Wildlife Service, Western Washington Fish and Wildlife Office, Lacey, WA. August 2003. 298pp.

U.S. Fish and Wildlife Service. 2004a. Marbled murrelet 5-year review process: overview. August 31, 2004. unpublished report. Portland, Oregon. 28 pp.

U.S. Fish and Wildlife Service. 2004b. Northwest Forest Plan consultation effects tracker. Fish and Wildlife Service Region 1 internal website, Portland, OR.

USDA Forest Service, and USDI Bureau of Land Management. 2004. Final supplemental environmental impact statement to remove or modify the survey and manage mitigation measure standards and guidelines, Volume 1—Summary, Chapters 1-4. Forest Service National Forests in Regions 5 and 6 and Bureau of Land Management Districts in Washington, Oregon, and California within the Range of the Northern Spotted Owl. January 2004.

USDA Forest Service, USDI Bureau of Land Management, U.S. Fish and Wildlife Service, and USDC National Marine Fisheries Service. 2002. Northwest National Fire Plan Consultation Process. ver. 2.1, June 11, 2002. Available online at: http://www.fs.fed.us/r6/fire/consultation.

USDA Forest Service. 2003. Biological Assessment for USDA Forest Service Fish Passage Restoration Activities Affecting ESA-listed Animal and Plant species found in eastern Oregon and the whole of Washington. Portland, OR. 165 pp.

USDA Forest Service. 2004. Biscuit Fire Recovery Project, Final Environmental Impact Statement. USDA Forest Service, Rogue River-Siskiyou National Forest, Medford, OR.

USDA Forest Service. 2005a. Biological Assessment for the USDA Forest Service, Pacific Northwest Region, Invasive Plant Program. USDA Forest Service, Pacific Northwest Region, Portland, OR. June 17, 2005. 452pp + appendices.

USDA Forest Service. 2005b. Pacific Northwest Region Invasive Plant Program Record of Decision. USDA Forest Service, Pacific Northwest Region, Portland, OR. October 2005, R6-NR-FHP-PR-02-05. 39 pp. + appendices.

USDA Forest Service. 2005c. Fisheries Biological Assessment for USDA Forest Service, Pacific Northwest Region, Invasive Plant Program, Environmental Impact Statement. USDA Forest Service, Pacific Northwest Region, Portland, OR. 221pp.

USDI. 2003. Biological Opinion and letter of concurrence for effects to bald eagles, marbled murrelets, northern spotted owls, bull trout, and designated critical habitat for marbled murrelets and northern spotted owls from Olympic National Forest program of activities for August 5, 2003, to December 31, 2008. USDI Fish and Wildlife Service, Lacey, Washington. August 2003; revised September 2004.

U.S. Fish and Wildlife Service. 1998a. Proposed rule: threatened status for fish *Salvelinus confluentus* (bull trout) for the Coastal-Puget Sound, Jarbridge River, and St. Mary-Belly River populations. Federal Register 63:31693-31710.

U.S. Fish and Wildlife Service. 1998b. Final rule: threatened status for fish *Salvelinus confluentus* (bull trout) for the Columbia River and Klamath River populations. Federal Register 63:31647-31674.

U.S. Fish and Wildlife Service. 1999a. Final rule: threatened status for fish *Salvelinus confluentus* (bull trout) for the coterminous United States. Federal Register 64:58910-58933.

U.S. Fish and Wildlife Service. 1999b. Final rule: threatened status for fish *Salvelinus confluentus* (bull trout) for Jarbridge River population. Federal Register 64:17110-17125.

U.S. Fish and Wildlife Service. 2002a. 25 Chapters. *In:* Bull trout (*Salvelinus confluentus)* draft recovery plan. U.S. Fish and Wildlife Service, Portland, Oregon.

U.S. Fish and Wildlife Service. 2002b. Proposed rule: critical habitat for fish *Salvelinus confluentus* (bull trout) for Klamath River and Columbia River DPSs. Federal Register 67:71235-71438.

U.S. Fish and Wildlife Service. 2004a. Proposed rule: critical habit for fish *Salvelinus confluentus* (bull trout) for Coastal-Puget Sound DPS. Federal Register 65:3866-3875.

U.S. Fish and Wildlife Service. 2004b. Proposed rule: critical habitat for fish *Salvelinus confluentus* (bull trout) for Coastal-Puget Sound DPS. Federal Register 65:17634-17636.

U.S. Fish and Wildlife Service. 2004c. Volume I and II. Draft recovery plan for the Coastal-Puget Sound distinct population segment of bull trout (*Salvelinus confluentus)*.

U.S. Fish and Wildlife Service 2004d. Notice of initiation of a 5-year review for bull trout (*Salvelinus confluentus*). Federal Register 69:19449-19450.

U.S. Fish and Wildlife Service. 2004e. Final rule: critical habitat for fish Salvelinus confluentus (bull trout) for Klamath River and Columbia River DPSs. Federal Register 69:59996-60075.

U.S. Fish and Wildlife Service and National Oceanic and Atmospheric Administration. 1996. Policy regarding the distinct vertebrate population. Federal Register 61:4721-4725.

Waples, R.S. 2002. Definition and estimation of effective population size in the conservation of endangered species. Pages 147-168 *in* S.R. Beissinger and D.R. McCullough (eds). Population Viability Analysis. The University of Chicago Press, Chicago, IL.

WSCC (Washington State Conservation Commission). 2003. Salmon and steelhead habitat limiting factors. Water Resources Inventory Area 16: Skokomish/Dosewallips watersheds.

WDFW (Washington Department of Fish and Wildlife). 1997. Grandy Creek trout hatchery biological assessment. FishPro Inc., and Beak Consultants.

Washington State University FCE. 2004. The Washington State Invasive Weed Species Bioagent Enhancement Program.

Ward, J.W. Jr., Gutierrez, R.J., and B.R. Noon. 1998. Habitat selection by northern spotted owls: the consequences of prey selection and distribution. Condor 100: 79-92.

Waterhouse, F. L., R. Bradley, J. Markila, F. Cooke, and L. Lougheed. 2002. Use of airphotos to identify, describe, and manage forest structure of marbled murrelet nesting habitat at a coastal British Columbia site. British Columbia Forest Service, Nanaimo, Canada. 19 pages.

Watson, G., and T. W. Hillman. 1997. Factors affecting the distribution and abundance of bull trout: An investigation at hierarWeidemeier, D.J. and S.P. Horton. 2000. Trends in spotted owl and barred owl detections in the Olympic Experimental State Forest from 1991 to 1999. Northwestern Naturalist 81(3):63.

Werdon, S. 1998. Personal conservation on August 5, 1998, between Selena Werdon, U.S. Fish and Wildlife Service, Reno, Nevada, and Sam Lohr, U.S. Fish and Wildlife Service, Boise, Idaho, concerning bull trout observed by survey teams during the *Salvelinus confluentus* Curiosity Society meeting August 4-6.

Werdon, S., U.S. Fish and Wildlife Service. 2001. Email message concerning bull trout observed in Dave Creek, Jarbidge River basin, during temperature monitoring survey conducted in 1999.

Whiteley, A. R., P. Spruell, and F.W. Allendorf. 2003. Population genetics of Boise Basin bull trout (*Salvelinus confluentus*). Final report to Rocky Mountain Research Station, Contract:RMRS # 00-JV-1122014-561.

Wiemeyer, S.N., C.M. Bunck, and C.J. Stafford. 1993. Environmental contaminants in bald eagle eggs – 1980-84 and further interpretations of relationships to productivity and shell thickness. Archives of Environ. Contam. and Toxicol. 24:214-227.

Wilde, Susan B. 2004. Avian vacuolar myelinopathy (AVM) linked to exotic aquatic plants and a novel cyanobacterial species. unpublished Abstract.

Wilson, L.M., M. Schwarzlaender, B. Blossey, and C.B. Randall. 2004. Biology and biological control of purple loosestrife. Forest Health Technology Enterprise Team, USDA Forest Service, publication FHTET-2004-12. Morgantown, WV. 78 pp.

Williams, R. N., R. P. Evans, and D. J. Shiozawa. 1997. Mitochondrial DNA diversity in bull trout from the Columbia River basin. Pages 283-297 *in* W.C. Mackay, M.K. Brewin, and M. Monita (eds). Friends of the Bull Trout Conference Proceedings. Bull Trout Task Force (Alberta), c/o Trout Unlimited Calgary, Alberta, Canada.

Wissmar, R. C., J. E. Smith, B. A. McIntosh, H. W. Li, G. H. Reeves, and J. R. Sedell. 1994. A history of resource use and disturbance in riverine basins of eastern Oregon and Washington (early 1800s-1990s). Northwest Science 68:1-35.

Wright, S. 1931. Evolution of Mendelian populations. Genetics 16:97-159.

Zabel C.J., S.E. Salmons, and M. Brown. 1996. Demography of northern spotted owls in southwestern Oregon. Studies in Avian Biology 17:77-82.

Zharikov, Y., D. B. Lank, F. Huettmann, R. W. Bradley, N. R. Parker, P. P.-W. Yen, L. McFarlane Tranquilla, and F. Cooke. *Submitted*. Nest site selection and breeding success in marbled murrelets in relation to distances to edges and forest patch size, at Desolation Sound and Clayoquot Sound, British Columbia, Canada. Auk

Ziller, J. S. 1992. Distribution and relative abundance of bull trout in the Sprague River subbasin, Oregon. Pages 18-29 *in* P.J. Howell, and D.V. Buchanan, eds. Proceedings of the Gearhart Mountain Bull Trout Workshop. Oregon Chapter of the American Fisheries Society, Corvallis, Oregon.

# VI. GLOSSARY

The nature of this document and the analysis conducted for it necessitates the use of terminology specific to the field of toxicology, as well as the typical terminology used in ESA consultation. Please refer to the DEIS for additional terms and definitions.

## A

**Abiotic -** Not involving living organisms.

**Absorption -** The process by which the chemical or other substance is able to pass through body membranes and enter an organism. In mammals and many other animals, the main routes by which toxic agents are absorbed are the gastrointestinal tract, lungs, and skin.

**ACS -** American Chemical Society.

**Active Ingredient (a.i.) -** In any pesticide product, the component (a chemical or biological substance) that kills or otherwise controls the target pests. Pesticides are regulated primarily on the basis of active ingredients. The remaining ingredients are called "inerts".

**Acute exposure -** A single exposure or multiple brief exposures occurring within a short time (e.g., 24 hours or less in humans). The classification of multiple brief exposures as "acute" is dependant on the life span of the organism.

**Acute toxicity -** Any harmful effect produced in an organism through an acute exposure to one or more chemicals.

**Adapted** - "How well plants are physiologically suited for high survival, good growth, and resistance to pests and diseases in a particular environment" (Northern Region Native Plant Handbook, 1995).

**Adaptive Management** - A continuing process of action-based planning, monitoring, researching, evaluating, and adjusting with the objective of improving implementation and achieving the goals of the standards and guidelines (USDA, USDI 1994a).

**Adjuvant(s) -** Chemicals that are added to pesticide products to enhance the toxicity of the active ingredient or to make the active ingredient easier to handle or mix.

**Administratively Withdrawn Areas** - Areas removed from the suitable timber base zthrough agency direction and land management plans.

**Adsorption** - The tendency of one chemical to adhere to another material such as soil.

**Adverse-Effect Level (AEL) -** Signs of toxicity that must be detected by invasive methods, external monitoring devices, or prolonged systematic observations. Symptoms that are not accompanied by readily observable signs of toxicity. Compare to "Frank-effect level".

**Advisory** - A non-regulatory document that communicates risk information to persons who may have to make risk management decisions.

**Aerobic** - Life or processes that require, or are not destroyed by, the presence of oxygen. (see also, *anaerobic*).

**Affected Environment** - Existing biological, physical, social, and economic conditions of an area subject to change, both directly and indirectly, as the result of a proposed human action.

**Agent** - Any substance, force, radiation, organism, or influence that affects the body. The effects may be beneficial or injurious.

**Alien Species** - "With respect to a particular ecosystem, any species, including its seeds, eggs, spores, or other biological material capable of propagating that species, that is not native to that ecosystem" (Executive Order 13122, 2/3/99).

**Alluvial** - Relating to clay, silt, sand, gravel, or similar detrital material deposited by flowing water. Alluvial deposits may occur after a heavy rain storm.

**Ambient** - Usual or surrounding conditions.

**Amphibian** - Any of a class of cold-blooded vertebrates (including frogs, toads, or salamanders) intermediate in many characteristics between fishes and reptiles and having gilled aquatic larvae and air-breathing adults.

**Anadromous** - Fish that spend their adult life in the sea but swim upriver to fresh water spawning grounds to reproduce.

**Anaerobic** - Life or process that occurs in, or is not destroyed by, the absence of oxygen.

**Anions** - Negatively charged ions in solution e.g., hydroxyl or $OH^-$ ion.

**Annual** - A plant that endures for not more than a year. A plant which completes its entire life cycle from germinating seedling to seed production and death within a year. (Dayton, 1950)

**Aquatic Influence Zone** – The inner half of the Riparian Reserve, as defined by the Northwest Forest Plan.

**Arthropods** - Invertebrates belonging to the largest animal phylum (more than 800,000 species) including crustaceans, insects, centipedes, and arachnids. Characterized by a segmented body, jointed appendages, and an exoskeleton composed of chitin (USDA, USDI 1994a).

**Assay** - A kind of test (noun); to test (verb).

**ATSDR** - Agency for Toxic Substances and Disease Registry; federal agency within the Public Health Service charged with carrying out the health-related analyses under CERCLA and SARA.

## B

**Background Level** - In pollution, the level of pollutants commonly present in ambient media (air, water, soil).

**Bacteria** - Microscopic living organisms that can aid in pollution control by metabolizing organic matter in soil, water, or other environmental media. Some bacteria can also cause human, animal and plant health problems.

**Base** - Substances that (usually) liberate OH anions when dissolved in water and weaken a strong acid.

**Benchmark** - A dose associated with a defined effect level or designated as a no effect level.

**Best management Practice** - A practice or combination of practices determined by a state or an agency to be the most effective and practical means (technological, economic, and institutional) of controlling point and nonpoint source pollutants at levels compatible with environmental quality.

**Bioconcentration** - The accumulation of a chemical in tissues of a fish or other aquatic organism to levels greater than in the surrounding water.

**Biological Control** - The use of nonnative agents including invertebrate parasites and predators (usually insects, mites, and nematodes), and plant pathogens to reduce populations of nonnative, invasive plants.

**Biomass** - The amount of living matter.

**Biota or Biome** - All living organisms of a region or system.

**BMPs** - Best Management Practices.

**Broadcast Application** - In pesticides, to spread a chemical over an entire area.

**Bryophytes -** Plants of the phylum *Bryophyta*, including mosses, liverworts, and hornworts; characterized by the lack of true roots, stems, and leaves (USDA, USDI 1994a).

**Buffer Zone** - A strip of untreated land that separates a waterway or other environmentally sensitive area from an area being treated with a pesticide.

# C

**Carcinogen** - A chemical capable of inducing cancer.

**Carrier** - A non-pesticidal substance added to a commercial pesticide formulation to make it easier to handle or apply.

**Central Nervous System (CNS)** - The portion of the nervous system consisting of brain and spinal cord.

**CERCLA** - Comprehensive Environmental Response, Compensation, and Liability Act. The initial legislation authorizing Superfund passed by Congress in December 1980. This law created a tax on the chemical and petroleum industries and provided broad Federal authority to respond directly to releases or threatened releases of hazardous substances that may endanger public health or the environment.

**Chemical Control** - The use naturally derived or synthetic chemicals called herbicides to eliminate or control the growth of invasive plants.

**Chlorophyll** - A class of molecules found in plant cells that convert the energy of sunlight to food in the process known as photosynthesis.

**Chronic Exposure** - Exposures that extend over the average lifetime or for a significant fraction of the lifetime of the species (for a rat, chronic exposure is typically about 2 years). Chronic exposure studies are used to evaluate the carcinogenic potential of chemicals and other long-term health effects.

**Chronic Toxicity** - The ability of a substance or mixture of substances to cause harmful effects over an extended period, usually upon repeated or continuous exposure sometimes lasting for the entire life of the exposed organism.

**Code of Federal Regulations (CFR)** - Document that codifies all rules of the executive departments and agencies of the federal government. It is divided into fifty volumes, known as titles. Title 40 of the CFR (referenced as 40 CFR) lists all environmental regulations, including regulations for EPA pesticide programs (40CFR Parts 150-189).

**Confidential Business Information (CBI)** - Information submitted to EPA by a pesticide registrant to fulfill requirements for pesticide registration that contains trade secrets or commercial or financial information that has been claimed as confidential by its source. EPA has special procedures for handling such information.

**Conifer** - An order of the Gymnospermae, comprising a wide range of trees and a few shrubs, mostly evergreens that bear cones and have needle-shaped or scalelike leaves; Conifer timber is commercially identified as softwood.

**Contaminants -** For chemicals, impurities present in a commercial grade chemical. For biological agents, other agents that may be present in a commercial product.

**Control** - In toxicology or epidemiology studies, a population that is not exposed to the potentially toxic agent under study.

**Control** - Means, as appropriate, eradicating, suppressing, reducing, or managing invasive species populations, preventing spread of invasive species from areas where they are present, and taking steps such as restoration of native species and habitats to reduce the effects of invasive species and to prevent further invasions (Executive Order 13122, 2/3/99).

## D

**Dams** - A term used to designate females of some animals such as rats.

**Degraded** - Broken down or destroyed.

**Dissociate** - The process of ionization of a salt upon being dissolved in water.

**Disturbance** - An effect of a planned human management activity, or unplanned native or exotic agent or event, that changes the state of a landscape element, landscape pattern, or regional composition" (USDA Forest Service. "An Assessment of Ecosystem Components in the Interior Columbia Basin and Portions of the Klamath and Great Basins", Vol. II, 1997).

**Diversity** - "The species richness of a community or area, though it provides a more useful measure of community characteristics when it is combined with an assessment of the relative abundance of species present" (Allaby, 1996).

**Documented** – In the context of the Forest Service sensitive species program, an organism that has been verified to occur in or reside on an administrative unit.

**Dose-Response Assessment** - A description of the relationship between the dose of a chemical and the incidence of occurrence or intensity of a specific biological response. 3. Evaluating the quantitative relationship between dose and toxicological responses.

**Dose-Response Relationship** - The quantitative relationship between the amount of exposure to a substance and the extent of toxic injury or disease produced.

**Drift** - That portion of a sprayed chemical that is moved by wind off a target site.

## E

**$EC_{50}$** - A concentration in air or in water that causes 50% inhibition of growth.

**Ecosystem** - The complex of a community of organisms and its environments (Executive Order 13122, 2/3/99).

**Ecotype** - "A locally adapted population of a widespread species. Such populations show minor changes of morphology and/or physiology, which are related to habitat and are genetically induced. Heavy metal-tolerant ecotypes of common grasses such as *Agrostis tenuis* are an example" (Allaby, 1996).

**Effects** - Effects, impacts, and consequences are synonymous. Effects may be direct, indirect, or cumulative and may fall in one of these categories: aesthetic, historic, cultural, economic, social, health, or ecological (such as effects on natural resources and on the components, structures, and functioning of affected ecosystems) (USDA USDI 1994a).

**Embryo** - An organism in the early stages of development before birth. In humans, the developing child is considered an embryo from conception to the end of the second month of pregnancy.

**Empirical** - Refers to an observed, but not necessarily fully understood, relationship in contrast to a hypothesized or theoretical relationship.

**Endangered** –Any species listed in the *Federal Register* as being in danger of extinction throughout all or a significant portion of its range.

**Endangered Species Act (ESA)** - A law passed in 1973 to conserve species of wildlife and plants determined by the Director of the Fish and Wildlife Service or the NOAA Fisheries to be endangered or threatened with extinction in all or a significant portion of its range. Among other measures, ESA requires all federal agencies to conserve these species and consult with the Fish and Wildlife Service or NOAA Fisheries on federal actions that may affect these species or their designated critical habitat.

**Endocrine** - Referring to several glands in higher animals that secrete hormones.

**Environmental Assessment** - A written environmental analysis which is prepared pursuant to the National Environmental Policy Act to determine whether a federal action would significantly affect the environment and thus require preparation of a more detailed environmental impact statement.

**Environmental Fate** - The destiny of a chemical or biological pollutant after release into the environment.

**Environmental Impact Statement (EIS)** - A statement of the environmental effects of a proposed action and alternatives to it. It is required for major federal actions under Section 102 of the National Environmental Policy Act (NEPA), and released to the public and other agencies for comment and review. It is a formal document that must follow the requirements of NEPA, the CEQ guidelines, and directives of the agency responsible for the project proposal.

**Exotic** - "Not native; introduced from elsewhere, but not completely naturalized" (Harris, 1994). See "Alien Species".

**Exposure Assessment** - The process of estimating the amount of contact with a chemical or biological agent that an individual or a population of organisms will receive from a pesticide application conducted under specific, stated circumstances.

**Extirpate** - To destroy completely; wipe out.

## F

**Federally Listed Species** - Formally listed as a threatened or endangered species under the ESA. Designations are made by the FWS or NMFS.

**Fire Management Plan** - A strategic plan that defines a program to manage wildland and prescribed fires and documents the Fire Management Program in the approved land use plan. The plan is supplemented by operational plans such as preparedness plans, preplanned dispatch plans, prescribed fire plans, and prevention plans. (Interagency Implementation Guide, 1998)

**Flora** - Plant life, especially all the plants found in a particular country, region, or time regarded as a group. Also, a systematic set of descriptions of all the plants of a particular place or time.

**Foaming -** Hot foam as a tool for controlling invasive plants has been tested by the Nature Conservancy and used by the BLM effectively on puncturevine and slender false brome. Hot foam is a non-chemical method. It is effective on seedlings and annuals and can be applied under weather conditions including wind and light rain.

**Food Chain** - A hierarchical sequence of organisms, each of which feeds on the next, lower member of the sequence.

**Forage** - Food for animals. In this document, term applies to both availability of plant material for wildlife and domestic livestock.

**Forest Ecosystem Management Assessment Team (FEMAT)** - An interagency, interdisciplinary team of scientists, economists, and sociologists led by Dr. Jack Ward Thomas and chartered to review proposals for management of federal forests within the range of the northern spotted owl. The team produced a report assessing ten options in detail, which were used as a basis for developing the Northwest Forest Plan.

**Formulation** - A commercial preparation of a chemical including any inerts and/or contaminants.

**Fungi** - Molds, mildews, yeasts, mushrooms, and puffballs, a group of organisms that lack chlorophyll and therefore are not photosynthetic. They are usually nonmobile, filamentous, and multicellular. (Source: Carbon Dioxide Information Analysis Center, 1990)

## G

**Groundwater** - The supply of fresh water found beneath the Earth's surface, usually in aquifers, which is often supplies wells and springs.

## H

**Habitat** - The place where a population (e.g., human, animal, plant, microorganism) lives and its surroundings, both living and non-living.

**Hazard Identification** - The process of identifying the array of potential effects that an agent may induce in an exposed of humans or other organisms.

**Hazard Quotient (HQ)** - The ratio of the estimated level of exposure to a substance from a specific pesticide application to the RfD for that substance, or to some other index of acceptable exposure or toxicity. A HQ less than or equal to one is presumed to indicate an acceptably low level of risk for that specific application.

**Herbaceous** - A plant that does not develop persistent woody tissue above the ground (annual, biennial, or perennial). Herbaceous vegetation includes grasses and grass-like vegetation, and broadleaved forbs.

**Herbicide** - A chemical preparation designed to kill plants, especially weeds, or to otherwise inhibit their growth.

**Herbivore** - An animal that feeds on plants.

**Histopathology** - Signs of tissue damage that can be observed only by microscopic examination.

**Hydrolysis** - Decomposition or alteration of a chemical substance by water.

## I

***In vitro*** - Isolated from the living organism and artificially maintained, as in a test tube.

***In vivo*** - Occurring in the living organism.

**Inerts** - Anything other than the active ingredient in a pesticide product; not having pesticide properties.

**Infested Area** - A contiguous area of land occupied by a single invasive plant species. An infested area of land is defined by drawing a line around the actual perimeter of the infestation as defined by the canopy cover of the plants, excluding areas not infested. Generally, the smallest area of infestation mapped will be 1/10th (0.10) of an acre or 0.04 hectares. (NRIS Standards).

**Integrated Weed Management (IWM)** - An interdisciplinary weed management approach for selecting methods for preventing, containing, and controlling noxious weeds in coordination with other resource management activities to achieve optimum management goals and objectives (FSM 2080.5).

**Interdisciplinary Team (IDT)** - A group of individuals with varying areas of specialty assembled to solve a problem or perform a task. The team is assembled out of recognition that no one scientific discipline is sufficiently broad enough to adequately analyze the problem and propose action.

**Introduction** - "The intentional or unintentional escape, release, dissemination, or placement of a species into an ecosystem as a result of human activity" (Executive Order 13122, 2/3/99).

**Invasive Plant Species** - An alien plant species whose introduction does or is likely to cause economic or environmental harm or harm to human health (Executive Order 13122, 2/3/99).

**Issue** - A point, matter, or question of public discussion or interest to be addressed or decided through the planning process.

## L

**Label** - All printed material attached to or part of the pesticide container (W).

**Land Management** - Intentional process of planning, organizing, programming, coordinating, directing, and controlling land use actions.

**Late-Successional Forests** - Forest stands consisting of trees, structural attributes, supporting biological communities, and processes associated with old-growth and/or mature forests (USDA, USDI 1994a). Forest seral stages that include mature and old-growth age classes (USDA, USDI 1994a). Age is not necessarily a defining characteristic but has been used as a proxy or indicator in some usages.

Minimum ages are typically 80 to 130 years, more or less, depending on the site quality, species, rate of stand development, and other factors.

**$LC_{50}$ (lethal concentration$_{50}$)** - A calculated concentration of a chemical in air or water to which exposure for a specific length of time is expected to cause death in 50 percent of a defined experimental animal population.

**$LD_{50}$ (lethal dose$_{50}$)** - The dose of a chemical calculated to cause death in 50 percent of a defined experimental animal population over a specified observation period. The observation period is typically 14 days.

**Leaching** - The process by which chemicals on or in soil or other porous media are dissolved and carried away by water, or are moved into a lower layer of soil.

**Lethargy** - Sluggish behavior. Less than typical activity.

**Level of Concern (LOC)** - The concentration in media or some other estimate of exposure above which there may be effects.

**Local** - “”Pertaining to, characteristic of, or restricted to a particular place or particular places” (Barnhart, 1970).

**Local Native** - “A population of native plant species which originated, i.e., grew from seeds or cuttings, from genetically local sources. The geographic and elevational boundaries that define a species’ genetically local source are determined by plant movement guidelines” (Mt. Baker-Snoqualmie NF Native Plant Handbook, 1994).

**Lowest-Observed-Adverse-Effect Level (LOAEL)** - The lowest dose of a chemical in a study, or group of studies, that produces statistically or biologically significant increases in frequency or severity of adverse effects between the exposed and control populations.

## M

**Macrophyte** - Terrestrial or aquatic plant that is large enough to be seen without the aid of a microscope.

**Margin of Safety (MOS)** - The ratio between an effect or no effect level in an animal and the estimated human dose.

**Material Safety Data Sheet (MSDS)** - A compilation of information required under the OSHA Communication Standard on the identity of hazardous chemicals, health and physical hazards, exposure limits, and precautions.

**Mature Forest** - A subset of Late-Successional forests. Mature forests are characterized by the onset of slowed height growth, crown expansion, heavier limbs, gaps, some mortality in larger trees, and appearance of more shade-tolerant species or additional crown layers. In Douglas-fir west of the Cascades, this stage typically begins between 80 and 130 years, depending on site conditions and stand history (adapted from USDA, USDI 1994b, pp. B-2 and B-3).

**Media** - Specific environments such as air, water, soil, animal or plant matter.

**Metabolism** - The sum of the chemical reactions occurring within a cell or a whole organism; includes the energy-releasing breakdown of molecules (catabolism) and the synthesis of new molecules (anabolism).

**Metabolite** - A compound formed as a result of the metabolism or biochemical change of another compound.

**Microorganisms** - A generic term for all organisms consisting only of a single cell, such as bacteria, viruses, protozoans and some fungi.

**Mitochondria** - A component in a cell that is involved in the conversion of food to stored chemical energy.

**Modeling** - Use of mathematical equations to simulate and predict real events and processes.

**Molecule** - The smallest division of a compound that still retains or exhibits all the properties of the substance.

**Monitoring** - A process of collecting information to evaluate if objectives and anticipated or assumed results of a management plan are being realized or if implementation is proceeding as planned (USDA, USDI 1994a).

**Most Sensitive Effect** - The adverse effect which is observed at the lowest dose level, given the available data. This is an important concept in risk assessment because, by definition, if the most sensitive effect is prevented, no other effects will develop. Thus, RfDs are normally based on doses at which the most sensitive effect is not likely to develop.

## N

**Narcosis** - Stupor or unconsciousness often produced by exposure to organic chemicals.

**National Marine Fisheries Service (NMFS)** - The federal agency that is the listing authority for marine mammals and anadromous fish under the ESA.

**Native Species** - With respect to a particular ecosystem, a species that, other than as a result of an introduction, historically occurred or currently occurs in that ecosystem (Executive Order 13122, 2/3/99).

**Nematodes** - Roundworms, some of which are pathogenic for plants and sometimes animals.

**Neurotoxin** - A material that affects the nerve cells and may produce muscular, emotional, behavioral abnormalities, impaired or abnormal motion and other physiologic changes.

**Nitrification** - The process whereby ammonia in soil or water is oxidized to nitrite and then to nitrate by bacterial or chemical reactions.

**NLAA** see Not Likely to Adversely Affect)

**NOAA Fisheries** – An informal alternative name for National Marine Fisheries Service.

**Non-Target** - Any plant or animal that is not the intended organism to be controlled by a pesticide treatment.

**No-Observed-Adverse-Effect Level or Concentration (NOAEL or NOAEC)** - An exposure level at which there are no statistically or biologically significant increases in the frequency or severity of adverse effects between the exposed population and its appropriate control; some effects may be produced at this level, but they are not considered as adverse, or as precursors to adverse effects. In an experiment with several NOAELs, the regulatory focus is primarily on the highest one, leading to the common usage of the term NOAEL as the highest exposure without adverse effects.

**No-Observed-Effect-Level/Concentration (NOEL or NOEC)** - Exposure level at which there are no statistically or biological significant differences in the frequency or severity of adverse effects between the exposed population and its appropriate control.

**Northwest Forest Plan** - Coordinated ecosystem management direction incorporated into land and resource management plans for lands administered by the BLM and the Forest Service within the range of the northern spotted owl. In April 1993, President Clinton directed his cabinet to craft a balanced, comprehensive, and long-term policy for management of over 24 million acres of public land within the range of the northern spotted owl. A Forest Ecosystem Management Assessment Team (FEMAT) was chartered to develop a series of options. These options were modified in response to public comment and additional analysis and then analyzed in a Final Supplemental Environmental Impact Statement (USDA, USDI 1994a). A Record of Decision was signed on April 13, 1994, by the Secretaries of the Department of Agriculture and the Department of Interior to adopt Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl (USDA, USDI 1994b). The Record of Decision, including the Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl is referred to as the "Northwest Forest Plan." The Northwest Forest Plan is not a "plan" in the agency planning regulations sense; the term instead refers collectively to the 1994 amendment to existing agency land and resource management plans or to the specific standards and guidelines for Late-Successional species incorporated into subsequent land and resource management plans.

**Not Likely to Adversely Affect (NLAA) -** Determinations are applied to those species that had very little habitat on National Forests in Region Six, were not in habitats susceptible to invasive plants, or were known to tolerate herbicide treatments without effects.

**Noxious Weed** - "Any living stage (including but not limited to, seeds and reproductive parts) of any parasitic or other plant of a kind, or subdivision of a kind, which is of foreign origin, is new to or not widely prevalent in the United States, and can directly or indirectly injure crops, other useful plants, livestock, or poultry or other interests of agriculture, including irrigation, or navigation or the fish and wildlife resources of the United States or the public health" (Public Law 93-629, January 3, 1975, Federal Noxious Weed Act of 1974).

## O

**Old-Growth Forest** - An ecosystem distinguished by old trees and related structural attributes. Old growth encompasses the later stages of stand development that typically differ from earlier stages in a variety of characteristics which may include tree size, accumulations of large dead woody material, number of canopy layers, species, composition, and ecosystem function. More specific parameters applicable to various species are available in the 1993 Interim Old Growth Definitions (USDA Forest Service Region 6). The Northwest Forest Plan SEIS and FEMAT describe old-growth forest as a forest stand usually at least 180 to 220 years old with moderate-to-high canopy closure; a multi-layered, multi-species canopy dominated by large overstory trees; high incidence of large trees, some with broken tops and other indications of old and decaying wood (decadence); numerous large snags; and heavy accumulations of wood, including large logs on the ground (USDA, USDI 1994a).

**Organic Matter** - Carbonaceous material contained in soil, plants or animal matter.

## P

**Partition** - In chemistry, the process by which a compound or mixture moves between two or more media.

**Partition Coefficient** - The ratio of concentrations of a chemical in two different media at equilibrium – e.g, octanol/water.

**Pathway** - In metabolism, a sequence of metabolic reactions.

**Percolation** - Downward flow or filtering of water through pores or spaces in rock or soil.

**Perennial** - A plant species having a life span of more than 2 years.

**Permeability** - For dermal exposures, permeability refers to the degree to which a chemical in contact with the skin is able to penetrate the skin.

**Persistence** - Refers to the length of time a compound, once introduced into the environment, stays there.

**Personal Protective Equipment (PPE)** - Clothing and equipment worn by pesticide mixers, loaders and applicators and re-entry workers, hazmat emergency responders, workers cleaning up Superfund sites, et. al., which is worn to reduce their exposure to potentially hazardous chemicals and other pollutants.

**Pest** - An insect, rodent, nematode, fungus, weed or other form of terrestrial or aquatic plant or animal life that is classified as undesirable because it is injurious to health or the environment.

**Pesticide** - Any substance used for controlling, preventing, destroying, repelling, or mitigating any pest. Includes fungicides, herbicides, fumigants, insecticides, nematicides, rodenticides, desiccants, defoliants, plant growth regulators, and so forth. (W, modified).

**pH** - The negative log of the hydrogen ion concentration. A high pH (>7) is alkaline or basic and a low pH (<7) is acidic.

**Pharmacokinetics** - The quantitative study of the absorption, distribution, metabolism, and excretion of chemicals by an organism.

**Physiographic Province** - A geographic area having a similar set of biophysical characteristics and processes due to effects of climate and geology that result in patterns of soils and broad-scale plant communities. Habitat patterns, wildlife distributions, and historical land use patterns may differ significantly from those of adjacent provinces (USDA, USDI, 1994a) (See Figure 1 in the standards and guidelines).

**Planning Area** - All of the lands within a federal agency's management boundary addressed in land management plans (USDA, USDI, 1994a).

**Plant** - Any of various photosynthetic, eukaryotic (meaning an organism with cells having a distinct nucleus), multicellular organisms of the kingdom Plantae characteristically producing embryos, containing chloroplasts, having cellulose cell walls, and lacking the power of locomotion. (For purposes of this EIS, the term "plant" does not include "mushrooms" and "fungi")

**Population** - "A group of individuals of the same species in an area" (Wilson and Hipkins, 1999).

**Porosity** - Degree to which soil, gravel, sediment, or rock is permeated with pores or cavities through which water or air can move.

**Predation** - The act or practice of capturing another creature (prey) as a food source.

**Prevention** - To detect and ameliorate conditions that cause or favor the introduction, establishment, or spread of invasive plants.

**Programmatic -** Of having, advocating, or following a plan, policy, or program, as in a *Programmatic EIS*.

## R

**Rare** - A species is considered to be rare when: there are a low number of extant known sites with low numbers of individuals present at each site and populations are not well-distributed within its natural range. "Low" numbers and "not well distributed" are relative terms that must be considered in the context of other criteria such as distribution of habitat, fecundity, and so forth. See complete list of criteria under "Relative Rarity" in the standards and guidelines.

**Receptor** - Ecological entity exposed to a stressor.

**Reclamation** - The process of mitigating physical or chemical environmental conditions perceived to be limiting to land management objectives and attempting to alter or lessen the effect of environmental damage through whatever means are available" (Brown, 1997).

**Record of Decision** - A document separate from, but associated with, an environmental impact statement that: (1) states the management decision; (2) states the reason for that decision, (3) identifies all alternatives including the environmentally preferable and selected alternatives; and (4) states whether all practicable measures to avoid environmental harm from the selected alternative have been adopted, and if not, why not (USDA, USDI 1994a).

**Reference Dose (RfD)** - The RfD is a numerical estimate of a daily exposure to the human population, including sensitive subgroups such as children, that is not likely to cause harmful effects during a lifetime. RfDs are generally used for health effects that are thought to have a threshold or minimum dose for producing effects.

**Registration -** Formal licensing with EPA of a new pesticide before it can be sold or distributed. Under the Federal Insecticide, Fungicide, and Rodenticide Act, EPA is responsible for registration (pre-market licensing) of pesticides on the basis of data demonstrating no unreasonable adverse effects on human health or the environment when applied according to approved label directions.

**Release** - A treatment done to free desirable trees from competition with less desirable vegetation.

**Resorption** - Removal by absorption. Often used in describing the unsuccessful development and subsequent removal of post-implantation embryos.

**Restoration** - "[Ecological restoration] is the process of assisting the recovery and management of ecological integrity. Ecological integrity includes a critical range of variability in biodiversity, ecological processes and structures, regional and historical context, and sustainable cultural practices" (Society of Ecological Restoration, 2000).

**Revegetation** - "The re-establishment of plants on a site (does not imply native or non-native; does not imply that the site can ever support any other types of plants or species and is not at all concerned with how the site 'functions' as an ecosystem)". (Northern Region Native Plant Handbook, 1995).

**RfD** - A daily dose which is not anticipated to cause any adverse effects in a human population over a lifetime of exposure. These values are derived by the U.S. EPA.

**Riparian Area** - A geographic area containing an aquatic ecosystem and adjacent upland areas that directly affect it (Northwest Forest Plan).

**Riparian Reserves** - Areas along live and intermittent streams, wetlands, ponds, lakes, and unstable and potentially unstable areas where riparian-dependent resources receive primary emphasis. Riparian Reserves are important to the terrestrial ecosystem as well, serving as dispersal habitat for certain terrestrial species (USDA, USDI 1994a).

**Risk** - The chance of an adverse or undesirable effect.

**Risk Assessment** - The qualitative and quantitative evaluation performed in an effort to estimate the risk posed to human health and/or the environment by the presence or potential presence and/or use of specific chemical or biological agents.

**Risk Management** - The process of evaluating potential alternative regulatory and non regulatory responses to risk and selecting among them. The selection process necessarily requires the consideration of legal, economic and social factors.

**Road Prism** - This is the horizontal template of a road that includes the road running surface, cutslope, fillslope, and ditch.

## S

**Sensitive Species** – Species identified by the Regional Forester for which population variability is a concern, as evidenced by significant current or predicted downward trend in population numbers or density; or significant current or predicted downward trends in habitat capability that would reduce a species existing distribution (FSM 2670)..

**Silviculture** - Management of forest land for diverse purposes through manipulation of the density, structure and species composition of the trees thereon.

**Site Preparation** - The removal of competing vegetation and debris to enhance a site for planting, and survival and growth of seedlings, or to enhance germination of natural seed (on site).

**Species** - "A group of organisms all of which have a high degree of physical and genetic similarity, generally interbreed only among themselves, and show persistent differences from members of allied groups of organisms" (Executive Order 13122, 2/3/99).

**Standards and Guidelines** - The rules and limits governing actions, as well as the principles specifying the environmental conditions or levels to be achieved and maintained (USDA, USDI 1994a).

**Substrate** - With reference to enzymes, the chemical that the enzyme acts upon.

**Succession** - "The development of biotic communities following disturbances that produce an earlier successional community" (USDA Forest Service. "An Assessment of Ecosystem Components in the Interior Columbia Basin and Portions of the Klamath and Great Basins", Vol. II, 1997).

**Surfactant** - A surface active agent; usually an organic compound whose molecules contain a hydrophilic group at one end and a lipophilic group at the other. Promotes solubility of a chemical, or lathering, or reduces surface tension of a solution.

**Synergistic Effect** - situation in which the combined effects of exposure to two chemicals simultaneously is much greater than the sum of the effect of exposure to each chemical given alone.

## T

**Toxicity** - The inherent ability of an agent to affect living organisms adversely. As defined by U.S. EPA, toxicity is "...the degree to which a substance or mixture of substances can harm humans or animals.

**Treaty** - A legally binding agreement between two or more sovereign governments. With respect to American Indian tribes, a treaty is a document negotiated and concluded by a representative of the President of the United States and ratified by 2/3 majority vote of the U.S. Senate. (McConnell, 2003)

**Treaty Rights** - Tribal rights or interests reserved in treaties, by Indian Tribes for the use and benefit of their members. The uses include such activities as described in the respective treaty document. Only Congress may abolish or modify treaties or treaty rights. (McConnell, 2003)

## W

**Weed** - "A plant growing where man does not want it to grow" (Daubenmire, 1978).

**Wetlands** - An area that is regularly saturated by surface or ground water and subsequently is characterized by a prevalence of vegetation that is adapted for life in saturated soil conditions. Examples include swamps, bogs, fens, marshes, and estuaries.

**Wilderness** - Areas designated by Congressional action under the 1964 Wilderness Act. Wilderness is defined as undeveloped federal land retaining its primeval character and influence without permanent improvements or human habitation. Wilderness areas are protected and managed to preserve their natural conditions, which generally appear to have been affected primarily by the forces of nature with the imprint of human activity substantially unnoticeable; have outstanding opportunities for solitude or for a primitive and confined type of recreation; include at least 5,000 acres or are of sufficient size to make practical their preservation, enjoyment, and use in an unimpaired condition; and may contain features of scientific, educational, scenic, or historical value as well as ecological and geologic interest (USDA, USDI,1994a).

# Glossary Bibliography

A large number of environmental glossaries are available on the Internet. The current glossary is based on previous glossaries in various Forest Service/SERA Risk Assessments as well as three glossaries available publicly on the internet: The University of Washington, Forest Soils Home Page (http://soilslab.cfr.washington.edu/S-7/ envglossary.html), the U.S. EPA (http://www.epa.gov/OCEPAterms), and the National Safety Council: (http://www.nsc.org/ehc/glossary.htm).

The entries taken from these three sites are only those terms that may be relevant to and helpful in the review of the Forest Service risk assessments. For a more extensive series of definitions, the above links should be consulted directly. Following is a list of bibliographic references in addition to those referenced above.

Allaby, M., ed., 1996. The Concise Oxford Dictionary of Botany, Oxford University Press, Oxford, Great Britain.

Barnhart, C.L. 1970. The American College Dictionary. Random House, New York.

Brown, R.W.; Amacher, M. C. 1997. "Selecting plant species for ecological restoration: a perspective for land managers: proceedings, 1997 Society for Ecological Restoration annual meeting; 1997 November 12-15; Ft. Lauderdale, FL Proc RMRS-P-8, Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Daubenmire, R., 1978. Plant Geography, Academic Press, INC., New York, NY.

Dayton, W.A. 1950. Glossary of botanical terms used in range research, Revised Edition. Miscellaneous Publication 110, 41 pp. Washington, DC: U.S. Department of Agriculture.

Federal Native Plant Conservation Committee, 1994. Office of the Federal Environmental Executive, Federal Register, pp. 40837-41.

Harris, J.G.; Harris M.W. 1994. Plant Identification Terminology. Spring Lake Publishing, Payson, UT.

King, R.C.; Stansfield, W.D. 1997. A Dictionary of Genetics. Oxford University Press, New York, NY.

Northern Region Native Plant Handbook, 1995. USDA Forest Service, Northern Region.

McConnell, L. 2003. Tribal Relations, USDA Forest Service, Pacific Northwest Region.

Potash, L.; Aubry, C.; Busse, B.; Hamilton, W.; Ketcheson, G.; Henderson, J.; Mace, R. 1994. Mt. Baker-Snoqualmie NF Native Plant Handbook. R6-MBS-003-94. USDA Department of Agriculture, Forest Service, Pacific Northwest Region.

Society for Ecological Restoration International Science & Policy Working Group. 2002. The *SER Primer on Ecological Restoration.* www.ser.org. This citation can be abbreviated in text as: (SER 2002).

Soil Conservation Society of America, 1982. Soil Conservation Glossary, Soil Conservation Society of America, Ankeny, IA.

USDA Forest Service, 1993. Forest Service Handbook 2409.26f, Seed Handbook, Region 2, USDA Forest Service, Lakewood, CO, 200: 2.

USDA Forest Service. 1997. An Assessment of Ecosystem Components in the Interior Columbia Basin and Portions of the Klamath and Great Basins, Vol. II.

U.S. Department of Agriculture. 1974. Federal Noxious Weed Act. In http://bluegoose.arw.r9.fws.gov/FICMNEWFiles/FederalNoxiousWeedAct.html.

Wilson and Hipkins. Genetics vocabulary. Handout for the "Short Course in Genetic Issues Using Native Plants in Revegetation", Lakewood, CO, Sept. 1999.

Wilson, E.O. 1988. The current state of biological diversity. p. 3-18 in E.O. Wilson and F.M. Peter, eds. Biodiversity. N.

# VII. APPENDICES

Appendix A - Project Consistency Evaluation Form for Early Detection Rapid Response

Appendix B - Herbicide Mixture Analysis

Appendix C - Formulations in Risk Assessments Completed for the USDA Forest Service R6 2005 FEIS Invasive Plant Program

Appendix D - Environmental Baseline Assessment

Appendix E – Subbasin Descriptions

Appendix F - Road Crossings In Treatment Areas Where There Are ESA Fish

Appendix G - Treatments Outside 100ft Buffer

Appendix H – Photos of CRGNSA Treatment Areas