United States Department of the Interior

FISH AND WILDLIFE SERVICE

Washington Fish and Wildlife Office
510 Desmond Dr. SE, Suite 102
Lacey, Washington 98503

APR 13 2016

In Reply Refer To:
01EWFW00-2014-F-0132

Robert P. Jones, Jr., Chief
Anadromous and Inland Fisheries Program
Sustainable Fisheries Division
National Marine Fisheries Service
7600 Sand Point Way NE
Seattle, Washington 98115

Dear Mr. Jones:

Subject: National Marine Fisheries Service 4(d) rule determination for Washington Department of Fish and Wildlife Salmon and Steelhead Hatchery Programs in the Dungeness River Watershed

This letter transmits the U. S. Fish and Wildlife Service's (USFWS) Biological Opinion on the proposed National Marine Fisheries Service (NMFS) 4(d) rule determinations of the Washington Department of Fish and Wildlife (WDFW) Dungeness River watershed salmon and steelhead hatchery programs located in Clallam County, Washington, and its effects on bull trout (*Salvelinus confluentus*), designated critical habitat for the bull trout, marbled murrelet (*Brachyramphus marmoratus)* and northern spotted owl (*Strix occidentalis caurina*). The NMFS determined that operation of the hatchery facilities would "adversely affect" bull trout, bull trout critical habitat,and marbled murrelets, but was "not likely to adversely affect" northern spotted owls. Formal consultation on the proposed action was conducted in accordance with section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*) (Act). Your April 26, 2014 letter, for the Chinook (*Oncorhynchus tshawytscha*), coho (*O. kisutch*), and pink salmon (*O. gorbuscha*) programs and your January 28, 2015 letter for the early winter steelhead (*O. mykiss*) program, requesting formal consultation were received on April 21, 2014 and January 28, 2015, respectively.

Your January 28, 2015 letter requested formal consultation for WDFW early winter steelhead programs in the Nooksack, Stillaguamish, and Dungeness River watersheds. The USFWS completed its reviews of the Stillaguamish and Nooksack programs in separate consultations (reference numbers 01EWFW00-2016-I-0511 and 01EWFW00-2015-F-0366, respectively). Therefore, the enclosed Biological Opinion includes only the Dungeness River watershed early winter steelhead program and operations, as well as those associated with the Chinook, coho, and pink salmon programs identified in your April 26, 2014 letter. The enclosed Biological Opinion is based on information provided in the October 2014 Biological Assessment, Hatchery and Genetic Management Plans for each program, and emails, telephone conversations, field investigations, and other sources of information cited in the Biological Opinion. A complete record of this consultation is on file at the Washington Fish and Wildlife Office in Lacey, Washington.

If you have any questions regarding the enclosed Biological Opinion, our response to your concurrence request(s), or our shared responsibilities under the Act, please contact my staff Mark Celedonia (360-534-9327, mark_celedonia@fws.gov) or Martha Jensen (360-753-9000, martha_l_jensen@fws.gov).

Sincerely,

Carolyn Scafidi

for Eric V. Rickerson, State Supervisor
Washington Fish and Wildlife Office

Enclosure

cc:
NOAA, Lacey, WA (T. Tynan)
WDFW, Olympia, WA (E. Kinne)

Endangered Species Act - Section 7 Consultation

BIOLOGICAL OPINION

U.S. Fish and Wildlife Service Reference:
01EWFW00-2014-F-0132

NMFS 4(d) Rule Determinations for WDFW Salmon and Steelhead Hatchery Operations in the Dungeness River Watershed

Clallam County, Washington

Federal Action Agency:

National Marine Fisheries Service

Consultation Conducted By:

U.S. Fish and Wildlife Service
Washington Fish and Wildlife Office
Lacey, Washington

Carolyn Scafed for

Eric V. Rickerson, State Supervisor
Washington Fish and Wildlife Office

4/13/16
Date

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ACRONYMS AND ABBREVIATIONS

Act	Endangered Species Act of 1973, as amended (16 U.S.C. l531 *et seq.*)
BA	Biological Assessment
CFR	Code of Federal Regulations
cfs	cubic feet per second
CHU	Critical Habitat Unit
dBA	A-weighted decibel level
DDT	dichlorodiphenyltrichloroethane
ESU	Evolutionarily Significant Unit
FL	fork length
FMO	Foraging, Migration and Overwintering
FR	Federal Register
ft^2	square feet
FTA	Federal Transit Authority
HCP	Habitat Conservation Plan
HGMP	Hatchery and Genetics Management Plan
mi^2	square mile
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
Opinion	Biological Opinion
PBF	physical or biological features
PCBs	Polychlorinated Biphenyls
PCE	Primary Constituent Element
PCSRF	Pacific Coastal Salmon Recover Fund
RM	river mile
RPM	Reasonable and Prudent Measures
spotted owl	northern spotted owl
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
WDFW	Washington Department of Fish and Wildlife
WDOE	Washington State Department of Ecology
WRIA	Water Resource Inventory Area

INTRODUCTION

This document represents the U. S. Fish and Wildlife Service's (USFWS) Biological Opinion (Opinion) based on our review of the National Marine Fisheries Service (NMFS) proposed 4(d) rule determinations for four Washington Department of Fish and Wildlife (WDFW) Dungeness River salmon and steelhead hatchery programs in Clallam County, Washington. We evaluated the effects of the proposed action on the bull trout (*Salvelinus confluentus*), designated critical habitat for the bull trout, the northern spotted owl (*Strix occidentalis caurina*), and the marbled murrelet (*Brachyramphus marmoratus*) in accordance with section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*) (Act). Your April 26, 2014 letter for the Chinook salmon (*Oncorhynchus tshawytscha*), coho salmon (*O. kisutch*), and pink salmon (*O. gorbuscha*) programs and your January 28, 2015 letter for the early winter steelhead (*O. mykiss*) programs requested formal consultation and were received on April 21, 2014 and January 28, 2015, respectively.

The January 28, 2015 request for formal consultation on early winter steelhead also included early winter steelhead programs in the Nooksack and Stillaguamish River watersheds. The USFWS completed its reviews of these programs in separate consultations: Stillaguamish, USFWS Consultation No. 01EWFW00-2016-I-0511; Nooksack, USFWS Consultation No. 01EWFW00-2015-F-0366.

This Opinion is based on information provided in the October 2014 Biological Assessment, and emails, telephone conversations, field investigations, and other sources of information as detailed below. A complete record of this consultation is on file at the Washington Fish and Wildlife Office in Lacey, Washington.

The NMFS is proposing to authorize WDFW's Dungeness River watershed hatchery operations under Limit 6 of the Act's section 4(d) rule for listed salmon and steelhead (50 CFR 223.203(b)(6)). Limit 6 allows for exemption of take of listed salmon and steelhead associated with joint Tribal/State fishery management plans developed under the United States v. Washington or United States v. Oregon settlement process. To be exempt under Limit 6, the joint fishery management plans must meet specific criteria and be subject to NMFS review and authorization. In the Dungeness River watershed, this authorization would allow the continued operation of hatchery programs for rearing and releasing Chinook, coho, and pink salmon, and steelhead trout. The NMFS proposes to determine these programs are consistent with Limit 6. The proposed hatchery operations will affect bull trout, bull trout critical habitat, and the marbled murrelet. The effects of these hatchery operations on bull trout, bull trout critical habitat, and marbled murrelets are entirely encompassed by the effects of the NMFS determination.

CONSULTATION HISTORY

The following is a summary of important events associated with this consultation:

2004 and 2005. The Olympic National Forest provides Endangered Species Act coverage for installation and operation of the Upper Dungeness and Gray Wolf Acclimation Ponds under the Programmatic Biological Opinion for Olympic National Forest Program of Activities (USFWS Reference Number 1-3-03-F-0833).

April 22, 2013. Informal consultation was completed on construction and operation of a fish passage structure on the Canyon Creek diversion structure that supplies the Dungeness Hatchery with surface water (USFWS Reference Number 01EWFW00-2013-I-0138).

October 25, 2013. The USFWS received a draft Biological Assessment (BA), dated October 2013, from the WDFW. The draft BA included salmon programs (Chinook, coho, and pink), and did not include the early winter steelhead program.

October 29, 2013. The USFWS provided general comments on the October 2013 draft BA to the WDFW. Comments included general areas that needed improvement.

November 7, 2013. The USFWS provided specific comments on the October 2013 draft BA to the WDFW. Necessary clarifications, additional details needed, and additional information needs were identified.

January 2014. The USFWS received a revised draft BA, dated December 2013, from the WDFW. This draft included the early winter steelhead program, which was not part of the October 2013 draft BA. The WDFW indicated that it was WDFW's preference to include all salmon and steelhead programs in one consultation.

March 17, 2014. The USFWS provided specific comments on the December 2013 draft BA to the WDFW. Necessary clarifications, additional details needed, and additional information needs were identified.

April 21, 2014. The USFWS received a request from the NMFS to initiate formal consultation for bull trout and bull trout critical habitat on the WDFW's Dungeness River watershed salmon programs (Chinook, coho, and pink). The early winter steelhead program was not included in this request.

May 19, 2014. The USFWS received a revised draft BA, dated May 19, 2014, from the WDFW. The NMFS had not yet requested formal consultation on the early winter steelhead program (this request was received on January 28, 2015).

September 29, 2014. The USFWS provided specific comments on the May 19, 2014 draft BA to the WDFW. Necessary clarifications, additional details needed, and additional information needs were identified. The USFWS also requested a site visit to the WDFW's Dungeness River watershed hatchery facilities.

October 24, 2014. The USFWS received a revised draft BA, dated October 2014, from the WDFW.

November 2014 to January 2015. The USFWS notified WDFW in November that not all previously identified information and analyses needed to complete the consultation were included in the October 24, 2014 version of the draft BA. The USFWS and WDFW cooperate on gathering some of the necessary data.

December 15, 2014. The USFWS conducted a site visit to the WDFW's Dungeness River watershed hatchery facilities.

January 28, 2015. The USFWS received a request from the NMFS to initiate formal consultation for bull trout and bull trout critical habitat on the WDFW's Dungeness River watershed early winter steelhead program.

February 2015 to February 2016. The USFWS and WDFW continued to cooperate on filling numerous information and analytical gaps in the draft BA that were necessary to complete the consultation, including the following: Canyon Creek hydrology; relationship between Dungeness Hatchery surface water withdrawals, the Agnew Irrigation system, and partial dewatering of a one-mile reach of the mainstem Dungeness River bull trout migratory corridor; passage needs for bull trout in open-channel surface waters as related to partial dewatering caused by hatchery surface water withdrawals; discrepancies within the draft BA regarding hatchery intake screening; discrepancies within the draft BA concerning numbers and release locations of hatchery fish; weir picket spacing; expected bull trout size and ability to move through weir pickets; landscaping chemicals used at the hatcheries and possible contamination of surface waters; maintenance activities at the acclimation ponds and exposure of juvenile bull trout to injury; influence of hatchery production on naturally-reproducing salmonid populations (important forage resources for bull trout); details concerning weir hatchery operation on weekends; exposure of marbled murrelets to activities at the acclimation ponds; and potential for spawning ground competition and redd superimposition from hatchery-origin strays.

March 1, 2016. The WDFW provided USFWS with updated data concerning natural coho production in the Dungeness River watershed. The updated data conflicted with previous data provided by WDFW, and required USFWS to reanalyze the effects of hatchery coho production on naturally-rearing coho salmon, an important forage resource to bull trout.

March 8, 2016. The USFWS identified a significant discrepancy between information reported in the draft BA concerning capture of bull trout in the Dungeness Hatchery off-channel adult collection pond. Specifically, the BA stated "No bull trout encounters have been recorded at the off-channel trap." However, historical records indicated that up to 19 adult and 45 juvenile bull trout were captured annually between 1996 and 2006. Additional information concerning pond operation and reanalysis of effects to bull trout were required.

March 29, 2016. The USFWS received a request from NMFS to initiate formal consultation on marbled murrelets and informal consultation on northern spotted owls for the WDFW's Dungeness River watershed salmon and steelhead programs.

CONCURRENCES

Northern Spotted Owl

The Dungeness Hatchery and the Upper Dungeness and Gray Wolf Acclimation Ponds are each within 0.9 mile of a historically occupied northern spotted owl (spotted owl) nest site and adjacent to suitable habitat. The Olympic National Forest is a Demography Study Site and a portion of the spotted owl sites on the Olympic National Forest (including the project areas) are monitored annually to determine population trends and reproductive success. Based on the survey results, the historic sites are not currently occupied and there are no active spotted owl nest sites near the acclimation ponds or the hatchery. In addition, the low-level noise generated from activities conducted at the Dungeness Hatchery or generators being operated at the acclimation ponds are far enough away from currently occupied sites that effects to nesting spotted owls are considered discountable.

Because the forests adjacent to these facilities are suitable habitat, there is a potential that individual spotted owls may move through the area (dispersing or foraging) at night or roost in the stands during the day. Most hatchery operations are conducted between the hours of 8 am to 5 pm. Like most owls, spotted owls are nocturnal and rest/sleep during the daytime. Mechanical sounds associated with the operation of motor vehicles, lawn mowers, generators, or occasional use of heavy equipment at these hatchery facilities may extend into the adjacent forests and be detectable to spotted owls. These sounds may result in minor behavioral responses, such as scanning or head-turning behaviors, or increased vigilance for short periods. Such minor behavioral responses are considered to have insignificant effects to spotted owls. Short-term disturbance or temporary displacement of non-nesting spotted owls that may be dispersing or roosting in close proximity to a hatchery facility may occur. If a spotted owl is perched in a tree near a hatchery site, it may flush in response to increases in activity (e.g., people walking close to or through adjacent forested areas, operation of heavy equipment or loud noises). Roosting spotted owls seek perches in the trees where they can remain concealed during the daytime and are reluctant to flush. If an individual were to flush in response to an activity or noise that occurs far away from an active nest site, this would be considered an insignificant effect because the affected spotted owl would simply be moving away from the source of disturbance (i.e. the disturbance will not affect nesting spotted owls or flightless young). Based on the available information, we concur with your “may affect, not likely to adversely affect determination” for the spotted owl.

BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

A federal action means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by federal agencies in the United States or upon the high seas (50 CFR 402.02).

Introduction

The proposed actions are determinations by the NMFS (NMFS 2015a; NMFS 2015b) whether hatchery programs operated by the WDFW in the Dungeness River watershed adequately address the criteria established for Limit 6 of the Act's section 4(d) rule for listed salmon and steelhead (50 CFR 223.203(b)(6)), specifically the Puget Sound Chinook salmon Evolutionarily Significant Unit (ESU) and the Puget Sound steelhead Distinct Population Segment. The effects of the hatchery operations on bull trout are entirely encompassed by the effects of the NMFS determinations. The NMFS determinations will be made for one on-going hatchery program that releases listed Chinook salmon (*Oncorhynchus tshawytscha*) and three on-going programs that release non-listed coho (*Oncorhynchus kisutch*) and pink salmon (*Oncorhynchus goburscha*), and steelhead trout (*Oncorhynchus mykiss*) into the Dungeness River watershed and nearby tributaries to the Strait of Juan de Fuca. The determinations would authorize the continued operation of the hatchery programs as described in the Hatchery and Genetics Management Plan (HGMP) for each program (WDFW 2013a; WDFW 2013b; WDFW 2013c; WDFW 2014). All activities necessary for brood stock collection, incubation, rearing, release, facility maintenance, and research, monitoring and evaluation of Dungeness River salmon and steelhead at sites and facilities affiliated with these programs would be authorized through the NMFS determinations. These are summarized below and described in detail in the Biological Assessment (WDFW 2014a) and the HGMPs.

Programs and Facilities

The four hatchery programs included in the proposed actions include:

- *Chinook salmon*. This is a conservation-oriented program intended to help rebuild and recover the listed naturally-reproducing Chinook salmon population in the Dungeness River. This is an integrated program, which means it is intended to maintain genetic uniformity between hatchery-origin and naturally-reproducing fish. This program will operate until the desired annual escapement goal of 925 natural-origin returns is reached in three of four consecutive years and habitat improvements are accomplished that assure long-term productivity of this stock.

- *Coho salmon*. This is a production-oriented program intended solely to provide fish for harvest. This program has existed since the early 1900's. This program is currently identified as a segregated program, which means that hatchery- and natural-origin fish are intended to remain genetically isolated from one another. This program will operate in perpetuity.

- *Pink salmon*. This is a conservation-oriented program intended to help rebuild and recover the naturally-reproducing population in the Dungeness River. This is an integrated program intended to maintain genetic uniformity between hatchery-origin and naturally-reproducing fish. This program will operate until the fall pink salmon stock rebuilds to 5,000 or more spawners in three out of four consecutive brood return years. Long-term escapement trends, genetic composition, and origin of fish on the spawning grounds, and success of habitat restoration efforts will also be considered in determining when the program may be terminated.

- *Steelhead trout*. This is a production-oriented program intended solely to provide fish for harvest. Fish for this program are derived from Bogachiel Hatchery Chambers Creek (Puget Sound) stock. Currently, this is a segregated program intended to keep hatchery-origin and naturally-reproducing fish genetically isolated from one another. This program will operate in perpetuity.

Five facilities support these programs and are proposed for operation and maintenance as part of the action (Figure 1):

- Dungeness Hatchery, a fully functional hatchery facility located at river mile (RM) 10.5 on the Dungeness River: This facility includes an off-channel adult collection pond, an in-line settling pond, an off-channel pollution abatement pond and artificial wetland/bioswale, surface water withdrawals from the Dungeness River and Canyon Creek, and effluent discharge into the Dungeness River.

- Hurd Creek Hatchery, a fully functional hatchery facility located at RM 0.2 on Hurd Creek, a Dungeness River tributary that enters the river at RM 2.7: This facility includes five wells for groundwater withdrawal, surface water withdrawal from Hurd Creek, a two-bay pollution abatement pond, and effluent discharge to Hurd Creek.

- Dungeness River weir, a temporary, seasonally-installed structure located at RM 2.5: The weir is a full channel-spanning wooden structure that is approximately 150 feet across with spacing of the pipes at 15/16th of an inch. This structure includes a fish trap to capture upstream-migrating adult fish. Maximum spacing on the trap is 2.13 inches of open space between pipes.

- Gray Wolf Acclimation Pond, a constructed earthen pond used solely for rearing fish located at RM 1.0 on the Grey Wolf River, a Dungeness River tributary that enters the river at RM 15.8: This facility withdraws surface water from a small side channel to the Gray Wolf River, and returns water to the Gray Wolf River. The pond is operated from April through June.

- Upper Dungeness Acclimation Site, a temporary, seasonally-installed tank used solely for rearing fish located at RM 15.8 on the Dungeness River: This facility withdraws surface water from the Dungeness River, and returns water a short distance downriver. This site is operated from April through June.

Hatchery Broodstock Collection

Opportunistic gill netting, seining, gaffing, snagging, noodling, dip netting, and hook-and-line collection is conducted in the lower 3.5 miles of the Dungeness River from May through September to collect pink salmon broodstock. Chinook broodstock may be collected using similar means in areas between the Dungeness Hatchery surface water intake to the mouth, although activities occasionally occur up to RM 15.8. Gill netting is conducted during the day using a net with 7.5-inch to 8.5-inch mesh size. Snagging, gaffing, noodling, and dip netting are only performed when there is a positive visual identification of the species of the target individual.

The Dungeness River weir is operated May through September to collect Chinook salmon broodstock. The weir is typically in operation Monday through Friday. Several weir panels are removed on weekends to allow unobstructed fish passage. The weir occasionally needs to be operated seven days per week during low fish return periods. The weir has operated on weekends approximately five to ten times in the previous five years. During any one year, the weir may be operated up to three non-consecutive weekends. Bull trout encountered at the trap or during gillnetting are returned to the river upstream of their capture point.

The Dungeness hatchery off-channel adult collection pond is operated May through March to collect Chinook and coho salmon and steelhead trout broodstock, and to remove hatchery-origin steelhead from the river. There are no weirs or diversion structures in the main channel – fish enter the off-channel collection pond volitionally. Hatchery staff seine the pond one or more times per week during the coho and steelhead returns. During Chinook returns, up to two weeks may elapse between seinings; occasionally more. Staff typically inspect the pond visually once per day for the presence of fish. Any bull trout identified during these inspections would be seined and returned to the river as soon as practicable. An electric fence around the perimeter of the pond minimizes predator intrusion.

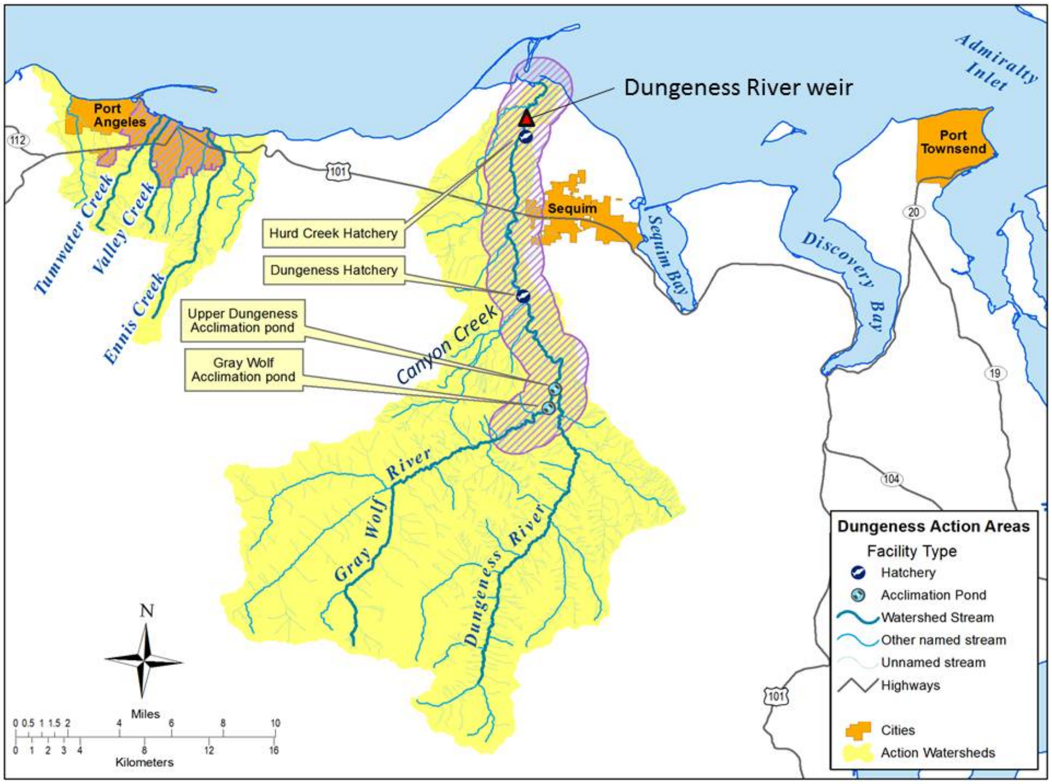

Figure 1. Map of the WDFW's Dungeness hatchery facilities, operations, and actions. The purple cross-hatched areas encompass the primary actions (broodstock collection and rearing and release of juvenile salmonids); however, the action area is not restricted to these areas. See text (page 11) for a complete definition of the Action Area.

Release of Hatchery Juveniles

The majority of hatchery-reared fish are released from the Dungeness and Hurd Creek facilities and the two acclimation ponds (Table 1). Small numbers of hatchery-reared fish are released into nearby Strait of Juan de Fuca tributaries as part of local school educational projects. These tributaries include Tumwater, Ennis, and Valley Creeks (Figure 1), and Cooper Creek, which is located 1.2 miles east of the Dungeness River mouth. Table 1 shows release location, species and age class released, target number of fish released (plus or minus 10 percent), approximate fish size at release, and month of release. Monitoring, reporting, and control of specific fish pathogens are conducted in accordance with up-to-date, scientifically-based disease control policies approved by the co-managers. These policies are currently detailed in *The Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* (WDFW and WWTIT 2006), which requires fish to be certified as pathogen-free prior to release.

Table 1. Hatchery-reared fish releases from WDFW Dungeness facilities, including release location, species, age class, and number of fish released, and month of release.

Release location Species/age class	**Fish size** fpp[a]	mm FL[b]	**Number[c]**	**Date**
Dungeness Hatchery				
Chinook, subyearling	50	100	50,000	May-June
Coho, yearlings	17	140	500,000	May-June
Steelhead, yearling	5	210	10,000	May-June
Hurd Creek Hatchery				
Chinook, yearling	9	200	50,000	March-April
Pink, fry	450	< 50	100,000	April-May
Upper Dungeness Acclimation Site				
Chinook, subyearling	50	100	50,000	May-June
Gray Wolf Acclimation Pond				
Chinook, subyearling	50	100	50,000	May-June
Strait of Juan de Fuca Tributaries (school educational releases)[d]				
Coho, fry	200	60	2,000	May-June

[a] number of fish per pound
[b] fork length of fish, in millimeters
[c] Numbers represent production goals. Actual number of released fish typically varies by plus or minus 10 percent of the production goal.
[d] Number of released fish shown is the total for all creeks (Cooper, Ennis, Tumwater, and Valley) combined.

Water Withdrawal and Discharge

Water usage at all WDFW Dungeness facilities is non-consumptive. All water used at the facilities is discharged to nearby surface waters within 0.9 mile of withdrawal. All water usage is single-pass; that is, each unit of water passes through only one rearing pond or raceway, and does so only one time, prior to being discharged. There is no water recycling or re-use at any of the facilities.

The Dungeness Hatchery uses surface water exclusively, withdrawn through three water intakes: two on the Dungeness River, and one on Canyon Creek, a tributary to the Dungeness River. The Dungeness Hatchery may withdraw up to 40 cubic feet per second (cfs) of surface water from the Dungeness River and up to 8.5 cfs from Canyon Creek in accordance with current water rights. However, hatchery water usage is typically less, usually no more than 15 cfs from the Dungeness River. The two Dungeness River intakes are both located on a constructed feeder channel that also supplies irrigation water to downstream water rights holders. Both intakes are screened near the point of diversion from the main feeder channel. The WDFW is currently seeking options to decommission these two Dungeness River intakes, and construct a new intake nearby. Construction, operation, and maintenance of the new intake, if built, are not included in this consultation.

The Dungeness Hatchery also has decommissioned infrastructure in place which could function as an additional water intake from the Dungeness River. This infrastructure (termed the "siphon line") is not used for standard hatchery operations, and there are no plans to use it in the future other than in an emergency, most likely limited to the main intake channel becoming clogged with sediment after a flood or with ice during the winter. These are uncommon and rare events. This intake has been used once since the early 1990s. This intake is not screened.

The Canyon Creek intake is part of a small dam on Canyon Creek. Until recently, fish passage above the dam into upper Canyon Creek was completely blocked at this facility. The structure was modified in March 2016 and currently provides passage in accordance with NMFS guidelines (NMFS 2011a). The USFWS completed consultation with the U.S. Army Corps of Engineers under section 7 of the Act for construction of the fish passage structure (USFWS Consultation No. 01EWFW00-2013-I-0138). Through this consultation, minimum flow criteria for the reach of Canyon Creek downstream from the hatchery water intake were developed to ensure unimpeded migration for salmon, steelhead and bull trout.

All water used at the Dungeness Hatchery facility is discharged to the Dungeness River a short distance downstream from the hatchery. The discharge point is 0.9 mile downstream from the intakes on the Dungeness River, and 0.5 mile downstream from the mouth of Canyon Creek.

The Hurd Creek Hatchery uses up to 4.5 cfs of groundwater withdrawn from five on-site wells, and 1.4 cfs of surface water from Hurd Creek. Water is discharged into Hurd Creek adjacent to the hatchery. The Gray Wolf Acclimation Pond uses 1.0 cfs of surface water withdrawn from a side channel of the Gray Wolf River. The Upper Dungeness Acclimation Pond uses 1.0 cfs of surface water withdrawn from the Dungeness River. Both acclimation ponds operate (i.e., have fish rearing in them) from April through June.

The two Dungeness River surface water intakes are screened to prevent entrainment of fish (NMFS 1995; NMFS 1996), but screening may not be fully in compliance with current NMFS (2011a) guidelines (Carlson, in litt. 2015). The WDFW anticipates replacing these intakes with a new one, which will be screened to current NMFS standards, by 2021 (Carlson, in litt. 2015). Intake screening at the Hurd Creek Hatchery and the Upper Dungeness and Gray Wolf Acclimation Ponds are screened in compliance with current guidelines (NMFS 2011a) to prevent entrainment and impingement of fish.

The four hatchery facilities have current surface water right permits issued by the Washington Department of Ecology (WDOE) authorizing water withdrawals up to the amounts identified as maximums. Surface water withdrawal rights are formalized through Washington State water right permits # S2-06221 (25 cfs) & S2-21709 (15 cfs) for the Dungeness River and # S2-00568 (8.5 cfs) for Canyon Creek. Hurd Creek Hatchery water rights are formalized through permit # G2-24026. Monitoring and measurement of water usage are reported in monthly National Pollutant Discharge Elimination System (NPDES) reports to WDOE.

The Dungeness Hatchery operates under NPDES permit number WAG 13-1037. Under this permit, the Dungeness Hatchery operates an off-line settling pond and artificial wetland to remove biosolids before the water is discharged into the Dungeness River. The Hurd Creek Hatchery is under the 20,000 pounds per year fish production criteria set by the WDOE as the maximum threshold under which facilities may operate without an NPDES permit and without treating effluent. Nonetheless, the WDFW operates a single-cell pollution abatement pond to treat water prior to its discharge into Hurd Creek. The fish rearing ponds on the Gray Wolf River and the Upper Dungeness River have annual fish production levels below those for which a NPDES permit is required.

Pathogen Control

All Dungeness facilities operate in accordance with up-to-date, scientifically-based disease control policies approved by the co-managers. These policies are currently detailed in *The Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* (WDFW and WWTIT 2006). This policy details current minimum best management practices for monitoring, managing, and minimizing pathogens in the hatchery, and for minimizing amplification of pathogens in the hatchery and release of elevated pathogen loads into receiving waterbodies.

Maintenance Activities

Routine maintenance is required for "watered" facilities such as ponds, troughs, incubators, pumps, water diversions, outfalls, plumbing, and the weir, as well as buildings and grounds. Removal of minor debris accumulations from surface water diversion structures and from discharge outfall structures is necessary to maintain their integrity and performance. Heavy equipment may be used to remove larger sediment accumulations in the main Dungeness River intake channel. Minor repairs and adjustments to the weir are also required on occasion. At the Gray Wolf Acclimation Pond, rocks and cobble are moved by hand approximately one time per year at the head of the side channel that supplies the pond with water. This is done to ensure that sufficient flow is directed into the side channel to provide an adequate supply of water to the pond.

Hatchery pond maintenance is a regular occurrence. This involves the vacuuming and removal of accumulated sediment on the bottoms of hatchery ponds and raceways. The Dungeness Hatchery and Hurd Creek Hatchery both have pollution abatement structures, which act as additional settling chambers for sediment-laden water. Solids are periodically removed from the abatement structures and disposed of on land on the hatchery grounds or at commercial sites.

Other hatchery maintenance includes building and grounds maintenance, which includes painting, minor building repairs, security repairs such as lighting and fence repair, and weeding and mowing. Typical chemicals that are used during ground maintenance include Roundup and Rodeo or a similar aquatic-approved herbicide. Herbicide application is small in scale, follows manufacturer's label guidelines, and occurs during dry weather conditions (i.e., not raining) to prevent runoff into surface waters. Roundup is used around buildings and landscape, which are greater than 300 feet from the river. Rodeo or a similar aquatic-approved herbicide is used around rearing ponds, the adult collection pond, and the surface water intakes. A backpack sprayer is used for all applications. Herbicides are applied once in the spring and then spot sprayed as needed the rest of the summer. On an annual basis, approximately 104 oz. of Roundup is used, and 20 oz. of Rodeo or other aquatic herbicide is used.

Conservation Measures

Conservation measures and best management practices to minimize effects to the aquatic ecosystem and naturally-reproducing fish populations are integrated within hatchery operations. These are described as appropriate throughout this document.

Action Area

The action area is defined as all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action (50 CFR 402.02). In delineating the action area, we evaluated the farthest reaching physical, chemical, and biotic effects of the action on the environment. The action area for this proposed federal action is based on the geographic extent of brood stock collection, water withdrawal, effluent discharge, fish release, facility maintenance, research, monitoring and evaluation, and disturbances associated with these activities, including bull trout capture and handling, dewatering of river and stream channels, sediment disturbance, and in-air sound, as depicted in Figure 1. This generally includes anadromous reaches of rivers and streams in the Dungeness River watershed, as well as Cooper, Ennis, Tumwater, and Valley Creeks. It also includes Dungeness Bay. The USFWS anticipates that these are the areas in which physical or chemical effects due to the proposed action, including interrelated and interdependent actions, may be measurable. We anticipate that young salmon and steelhead released from the hatcheries will distribute themselves in the marine environment in concert with local currents. Beyond this area and extending out into the Pacific Ocean, effects quickly become diluted and are no longer measurable even though individual salmon released as part of this program may venture widely.

Term of the Consultation

The NMFS 4(d) rule, Limit 6 take authorization is open-ended in duration and is valid in perpetuity, subject to the permitee's compliance with program operational requirements and take limits specified in the NMFS determination, and required annual reporting.

The effects of the hatchery operations evaluated by this Biological Opinion cannot reasonably be evaluated beyond 20 years. This is because climate change is expected to have substantial implications to baseline conditions, Dungeness core area bull trout, hatchery operations, and success of recovery programs. Because the nature and extent of climate change and the effects of climate change cannot be predicted with adequate certainty beyond 20 years, we cannot evaluate effects of the action on bull trout after this time. Therefore, this consultation will expire 20 years from issuance, at which point consultation on these actions must be reinitiated.

ANALYTICAL FRAMEWORK FOR THE JEOPARDY AND ADVERSE MODIFICATION DETERMINATIONS

Jeopardy Determination

The following analysis relies on the following four components: 1) the *Status of the Species*, which evaluates the rangewide condition of the listed species addressed, the factors responsible for that condition, and the species' survival and recovery needs; 2) the *Environmental Baseline*, which evaluates the condition of the species in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of the species; 3) the *Effects of the Action*, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the species; and 4) *Cumulative Effects*, which evaluates the effects of future, non-federal activities in the action area on the species.

In accordance with policy and regulation, the jeopardy determination is made by evaluating the effects of the proposed federal action in the context of the species' current status, taking into account any cumulative effects, to determine if implementation of the proposed action is likely to cause an appreciable reduction in the likelihood of both the survival and recovery of listed species in the wild.

The jeopardy analysis in this Opinion emphasizes the rangewide survival and recovery needs of the listed species and the role of the action area in providing for those needs. It is within this context that we evaluate the significance of the proposed Federal action, taken together with cumulative effects, for purposes of making the jeopardy determination.

Adverse Modification Determination

The designation of critical habitat for bull trout uses the term "primary constituent elements" (PCEs). The new critical habitat regulations (81 FR 7214) replace this term with "physical or biological features" (PBFs). This shift in terminology does not change the approach used in conducting our analysis, whether the original designation identified primary constituent elements or physical or biological features. References to PCEs in the following analysis should be viewed as synonymous with PBFs.

Our analysis of effects to critical habitat relies on the following four components: 1) the *Status of Critical Habitat*, which evaluates the range-wide condition of designated critical habitat for the bull trout in terms of PCEs, the factors responsible for that condition, and the intended recovery function of the critical habitat overall; 2) the *Environmental Baseline*, which evaluates the condition of the critical habitat in the action area, the factors responsible for that condition, and the recovery role of the critical habitat in the action area; 3) the *Effects of the Action*, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the PCEs and how that will influence the recovery role of affected critical habitat units; and 4) *Cumulative Effects*, which evaluates the effects of future, non-federal activities in the action area on the PCEs and how that will influence the recovery role of affected critical habitat units.

The proposed federal action is evaluated to determine if critical habitat rangewide would remain functional (or retain the current ability for the PCEs to be functionally established in areas of currently unsuitable but capable habitat) to serve its intended recovery role for the bull trout**,** taking into account any cumulative effects.

STATUS OF THE SPECIES: Bull Trout

Status of the Species Rangewide

For a detailed account of bull trout biology, life history, threats, demography, and conservation needs, refer to Appendix A, Rangewide Status of the Species: Bull Trout.

Status of the Species in the Core Area and Marine Foraging Habitat in the Strait of Juan de Fuca

Core areas represent the closest approximation of a biologically functioning unit for bull trout and consist of habitat that could supply all of the necessary elements for every life stage of bull trout (e.g., spawning, rearing, migration, overwintering, foraging). Core areas have one or more local populations of bull trout, and are also the basic units upon which to gauge recovery within a bull trout recovery unit.

The project is located in the Coastal Recovery Unit, Dungeness River core area, which supports two local populations of bull trout. Anadromous, fluvial, and likely resident bull trout from both of these local populations are present in the action area. Anadromous fish from both of these populations also forage and migrate within the Strait of Juan de Fuca.

Dungeness River Core Area

The Dungeness River core area completely overlaps the action area. Therefore, the status of the species in the core area is as described below in the section Environmental Baseline, Current Condition of the Species and Critical Habitat in the Action Area.

Strait of Juan de Fuca

The nearshore marine areas of the Strait of Juan de Fuca are designated foraging, migration and overwintering (FMO) habitat for bull trout. The area includes nearshore waters between the northwestern tip of the Olympic Peninsula (Cape Flattery) east to Point Wilson at Port Townsend, and several small independent tributaries flowing into this area. It is located in the northern region of the Olympic Peninsula Management Unit.

The Dungeness and Elwha watersheds are the only bull trout core areas connected to the Strait of Juan de Fuca FMO. Coastal and marine tributaries to the Strait of Juan de Fuca used by bull trout adults and subadults, but where habitat is likely unsuitable for spawning or early rearing, include Morse, Ennis, Siebert, and Valley Creeks. Bell Creek may also be used occasionally by bull trout (Freudenthal, in litt. 2001).

There are a number of small independent drainages to the strait, some of which originate in Olympic National Park. The frequency of bull trout use of these tributaries is poorly understood. Bull trout have been documented in the Strait of Juan de Fuca drainages of Bell, Siebert, Morse, Ennis, and Valley Creeks (Mongillo and Hallock 1993; WDFW 1998; Freudenthal, in litt. 2000; Freudenthal, in litt. 2001a; Freudenthal, in litt. 2001b; Cooper, in litt. 2003; Ogg et al. 2008). Based on current or historical habitat conditions, and the experience and professional judgment of members of the bull trout recovery team, most of these rivers and streams located between Bell and Ennis Creeks on the Strait of Juan de Fuca are unlikely to support spawning populations, but do provide important foraging and overwintering opportunities for bull trout (OPRT, in litt. 2003).

Numerous forage fish (e.g., herring, surf smelt) spawning sites are found throughout the Strait of Juan de Fuca (Shaffer et al. 2003; WDFW 2000). Thus, the Strait of Juan de Fuca provides essential and biologically important foraging and migration habitats for bull trout.

Adult Abundance

Adult abundance data are extremely limited. Abundance of adults originating from the Dungeness River may be approximately 49 to 68 fish, based on data from Ogg et al. (2008) and USFWS (2008, p. 35). These figures presume that 27 percent of adults in the Dungeness River are anadromous, as found by Ogg et al. (2008) during radio tracking studies. See the section below entitled "Current Condition of the Species in the Action Area" for more information on how adult abundance in the Dungeness River was determined.

Abundance of adults originating from the Elwha River may be approximately 100 fish, based on preliminary survey results (Peters, in litt. 2015). This number is expected to increase as bull trout in the Elwha River continue to recover following dam removal.

Connectivity

The Strait of Juan de Fuca connects Puget Sound and Hood Canal to the Pacific Ocean. Currently, a portion of the migratory bull trout on the Olympic Peninsula appears to migrate into the Strait of San Juan de Fuca. The Strait of Juan de Fuca provides the nearest accessible marine habitat for the anadromous life history form in the Dungeness and Elwha core areas.

Acoustic telemetry work in the Puget Sound (Goetz et al. 2007; Hayes et al. 2011; Goetz et al. 2012) and the Olympic Peninsula (Brenkman and Corbett 2005; Ogg et al. 2008) indicate that bull trout from more than one river intermingle in nearshore marine and estuarine waters. Radio telemetry studies have demonstrated that anadromous bull trout spend significant time outside their core area (Brenkman and Corbett 2005; Ogg et al. 2008; Hayes et al. 2011).

Morse, Ennis, and Siebert Creeks are part of the Strait of Juan de Fuca FMO habitat, and were identified in the 2004 draft recovery plan as providing an important contribution to foraging habitat for anadromous bull trout (USFWS 2004, p. 66-67). Morse, Ennis, and Siebert Creeks represent the few freshwater streams outside of the Elwha River and Dungeness River core areas known to be used by bull trout. This habitat is identified in the recovery plan as providing an important contribution to the forage base and connectivity of anadromous bull trout in the Strait of Juan de Fuca (USFWS 2004, p. 66-67). Morse, Ennis, and Siebert Creeks are considered essential for maintaining overall distribution and abundance of anadromous bull trout in the Dungeness and Elwha core areas.

Valley Creek's use by bull trout was discovered by Ogg et al. (2008) using radio telemetry. Valley Creek is part of the Strait of Juan de Fuca FMO habitat, and is identified in the 2004 draft recovery plan as providing an important contribution to foraging habitat for anadromous bull trout. The lower reach of this stream and its associated riparian area has been severely degraded as a result of residential and urban development, so there is some uncertainty regarding the level of use by anadromous bull trout and degree of importance for recovery. However, it is considered essential for recovery at this time because of the connectivity it provides among Straits of Juan de Fuca FMO habitat between the Dungeness and Elwha core areas.

Changes in Environmental Conditions and Population Status

Development impacts in tributaries to the Strait of Juan de Fuca have resulted in significant habitat loss for anadromous salmonids, including bull trout. Morse Creek was a significant producer of several species of salmon, which provide an important seasonal prey base for bull trout. The Morse Creek channel has been altered by development, channelization, and forest practices (Haring 1999, p. 129-135). Floodplain function has been severely altered by constrictions resulting from diking, development encroachment, and transportation corridors. Historical estuary conditions, thought to be largely responsible for Morse Creek’s productivity, have been basically eliminated by development; however, Morse Creek habitat within the Olympic National Park boundary is in excellent condition. Habitat outside of Olympic National Park has been significantly impacted by suburban development.

Siebert and Ennis Creeks drain directly to the Strait of Juan de Fuca. The lower reaches of these creeks are relatively intact, but habitat in the upper stream reaches is adversely affected by recent rural development, agricultural practices, and forest practices.

Streams that have their headwaters in the foothills, such as Bell and Siebert Creeks (and other streams draining into the Strait of Juan de Fuca) are subject to hydrologic/stormwater effects as a result of the permanent loss of forest cover due to conversion to residential development and from forestry activities. During severe rain storms or rain-on-snow events these forest cover changes have resulted in increased erosion in the small headwater streams as well as increased stream power to transport sediment and erode streambanks lower in the system (Haring 1999).

The nearshore environment provides important habitat for bull trout prey species, including spawning surf smelt, herring, and salmon smolts. Significant portions of nearshore habitat in the Strait of Juan de Fuca have been altered by bulkheads placed to protect various developments. The marine shoreline is armored from the mouth of Morse Creek west through Port Angeles to the end of Ediz Hook at the mouth of the Elwha River. This armoring effectively eliminates most, if not all, natural nearshore habitat function (Haring 1999).

Stormwater runoff from residential development and urbanization contributes to nonpoint source water pollution from the transport of toxic metals and organic contaminants, such as petroleum hydrocarbons. Other sources of toxic contaminants are discharges of municipal and industrial wastewater, pesticide runoff from residential lands, leaching contaminants from shoreline structures (i.e., treated wood), and channel dredging. The Port Angeles Rayonier pulp mill is part of a clean-up action for contaminants (including dioxins and polychlorinated biphenyls) associated with the former mill.

Anadromous bull trout seasonally enter marine waters and prey largely on surf smelt, Pacific herring, and Pacific sand lance (Goetz et al. 2004). These forage fish species depend on the nearshore marine environment and spawn in the intertidal or shallow subtidal waters at specific locations (WDFW 2000). These locations are very vulnerable to destruction or modification through human activities, especially urban and rural development.

Forage fish, bottom fish, and wild salmon have declined in the Puget Sound. Part of this decline has been attributed to human encroachment and development of the nearshore areas throughout the Strait of Juan de Fuca that has resulted in the loss of nearshore habitat. It is likely that anadromous bull trout have been impacted by the decline in forage base and loss of habitat in this marine environment.

Threats

Threats to bull trout in the Straits of Juan de Fuca FMO include:

- Ongoing habitat degradation from development and shoreline protection measures.
- Climate change is anticipated to modify the ocean chemistry.
- Bull trout are susceptible to incidental mortality associated with fisheries that target commercially desirable species.

STATUS OF THE SPECIES: Marbled Murrelet

The rangewide status of the marbled murrelet is provided in Appendix B.

STATUS OF CRITICAL HABITAT: Bull Trout

Status of Critical Habitat Rangewide

For a detailed account of the status of designated bull trout critical habitat, refer to Appendix C, Status of Designated Critical Habitat: Bull Trout.

Status of Critical Habitat in the Dungeness River Critical Habitat Subunit

The Dungeness River Critical Habitat Subunit completely overlaps the action area. Therefore, the status of critical habitat is as described below in the section Environmental Baseline, Current Condition of the Species and Critical Habitat in the Action Area.

Status of Critical Habitat in the Strait of Juan de Fuca

Critical habitat not only includes designated freshwater habitats, but also extends offshore to the depth of minus 33 feet relative to the mean low low-water line, which is the photic zone and is considered to be the habitat most consistently used by bull trout in marine waters. Although the action area includes critical habitat within the Strait of Juan de Fuca, effects to critical habitat from the proposed action (effects from fish-weir installation and use and water withdrawal) are extremely unlikely to occur outside of the Dungeness River. Therefore, the status of Critical Habitat in the Strait of Juan de Fuca will not be discussed.

ENVIRONMENTAL BASELINE: Bull Trout and designated Bull Trout Critical Habitat

Regulations implementing the Act (50 CFR 402.02) define the environmental baseline as the past and present impacts of all Federal, State, or private actions and other human activities in the action area. Also included in the environmental baseline are the anticipated impacts of all proposed federal projects in the action area that have undergone section 7 consultation, and the impacts of state and private actions which are contemporaneous with the consultation in progress.

General Features and Characteristics of the Action Area

The Dungeness River flows in a northerly direction, entering the Strait of Juan de Fuca near the City of Sequim. The river is about 32 miles long, and the watershed has 546 miles of streams and tributaries draining approximately 198 to 270 square miles (EDPU 2005, p. 2.8-1). The Dungeness River has two major tributaries: 1) the Gray Wolf River, which is 17.4 miles long, has a subwatershed area of 76 mi^2, and enters the Dungeness River at RM 15.8; and, 2) Canyon Creek, which is 8.2 miles long, has a subwatershed area of 11.9 mi^2, and enters the Dungeness River at RM 11 (EDPU 2005, p. 2.8-1). The watershed includes steep, mountainous terrain in the upper watershed, foothills in the middle, and a broad valley and alluvial fan adjacent to the Strait of Juan de Fuca. Geologically, the basin consists of volcanic bedrock and unstable glacial deposits that produce high sediment loads in surface flows (Haring 1999). The flow regime in the Dungeness River is characterized by high flows from snowmelt in late spring and early summer, and variable high flows in winter from rainfall (EDPU 2005, pp. 2.8-5 to 2.8-7). Lowest annual river discharges usually occur during September and October.

Lands below RM 10.8 are primarily in private ownership. Land use in this area is predominantly agriculture, rural residential and urban development within and near the city of Sequim. Lands between RM 10.8 and 13.2 are privately owned or owned by the State of Washington, and contain mostly active timberlands and second growth forest at various stages of succession.

Lands above RM 13.2 are exclusively in federal ownership: 34 percent of the entire watershed lies within the Olympic National Park and another 40 percent lies within the Olympic National Forest. The Gray Wolf River watershed above RM 2.6 is almost exclusively in the protected areas of the Buckhorn Wilderness and the Olympic National Park. The Dungeness watershed above RM 13.2, exclusive of the Gray Wolf River drainage, includes unprotected timberlands and protected areas (Buckhorn Wilderness and Olympic National Park).

The large area of the Gray Wolf River watershed that lies within the Olympic National Park and the Buckhorn Wilderness is near pristine. Human presence here has been light, limited primarily to non-motorized recreation (e.g., hiking, fishing, and camping). These areas have not been logged or otherwise exploited for commercial resource extraction. There has been conjecture that the U.S. Forest Service (USFS), decades ago, bucked large wood within the channel and that the cut pieces floated out on high water (Haring 1999, p. 118). However, this has not been substantiated, and others assert that location and abundance of large wood indicates lack of such activity.

Impacts to salmonid habitat

Large areas of the Dungeness watershed above RM 10.8, exclusive of the Gray Wolf River drainage, have been subject to large-scale commercial timber extraction since the 1950's (Haring 1999, pp. 89-95). Much of these areas lie within the Olympic National Forest. Timber extraction and deficient construction and management of logging roads have resulted in unstable slopes, mass wasting, erosion, and high inputs of fine sediments into the river. Timber extraction and road construction and maintenance practices have improved, in part through the 1990 Land and Resource Management Plan, as amended by the 1994 Northwest Forest Plan and its associated Aquatic Conservation Strategy. However, logging roads that were constructed prior to these plans taking effect continue to degrade water quality and aquatic habitats. The USFS has implemented some restoration projects (e.g., road decommissioning, and tree planting) and identified many others as part of their Dungeness Watershed Action Plan (USFS 2015).

The lower river (below RM 10.8) has been considerably altered from historical, pre-disturbance conditions, and generally provides limited marginal to poor habitat for salmon, trout, and char (Haring 1999, pp. 85-107; USBOR 2002). The main channel of the river is confined and highly simplified, generally lacking in large wood, pools, and physical and hydraulic complexity. Substrates are unstable, scouring at relatively low flows. Valuable and highly-productive side channel and off-channel habitat has been substantially reduced. One of the most significant factors contributing to these deficient habitat conditions are decades-old levees along both banks of the river. These levees have disconnected the river from the floodplain and substantially reduced the quantity and quality of salmonid habitat, increased flood flow velocities and depths, impaired large wood recruitment, and reduced subsurface flows and groundwater inputs. Other contributors to the current state of the lower river include the following: historical removal of large wood from the main channel and tributaries; widespread logging and deforestation of riparian, floodplain, and upland areas throughout the watershed; hydraulic constrictions imposed by five road and railroad bridges; installation and maintenance of riverbank protection (i.e., riprapped banks); historical gravel extraction; and water diversion for irrigation and municipal use. Logging and logging roads in the upper watershed (Olympic National Forest) have been identified as potentially increasing sediment inputs and contributing to channel instability and aggradation in the lower watershed. Much of the lower river floodplain has been converted to agriculture, rural residential development, and urban development, which limits future restoration opportunities. A variety of small-scale restoration efforts along the mainstem and in tributaries - including large wood additions, riparian revegetation, conservation easements, levee setbacks, and dike breaches - have either been implemented or are planned, which will help improve habitat conditions.

Surface water withdrawals from the Dungeness River substantially reduce instream flows from April through early November (Haring 1999, p. 99-104; EDPU 2005, Chapter 2.3). The resultant partial dewatering affects the river below RM 10.8, impeding adult salmonid migration and decreasing useable juvenile salmonid rearing habitat. Water rights for agricultural irrigation are severely over-appropriated, and, although these rights are apparently not fully utilized, they take a substantial proportion of the river flow from April through October (Haring 1999, pp. 99-104; EDPU 2005, Chapter 2.3). Efforts have been made to improve these conditions and ensure that they do not degrade further. These include municipal and agricultural conservation efforts that have substantially reduced water consumption (EDPU 2005, pp. 2.3-42 to 2.3-61), and identification of additional conservation measures (e.g., JST 2007, pp. 79-83). The Washington Department of Ecology's 2012 Dungeness Water Management Rule and Memorandum of Agreements with Clallam County and with Members of the Dungeness River Agricultural Water Association (WDOE 2015) will make additional improvements, although some aspects of these measures are currently being challenged in court.

Clallam County population increased 115 percent between 1960 and 2000, and is projected to continue growing (EDPU 2005, Chapter 2.2, pp. 2.2-2 to 2.2-4). With the increasing human population in and around the City of Sequim, the demand for water for irrigation, domestic, and business use has markedly increased (EDPU 2005). In addition, burgeoning human development in the watershed has added contaminated run-off from a variety of urban, agricultural, residential and other sources. All these activities adversely impact water quality. The Clallam Conservation District implemented major improvements in irrigation ditch systems to reduce or eliminate the addition of pollutants into the Dungeness River, tributaries and Dungeness Bay. Additionally, water temperatures in the Dungeness River and side channels have improved by the reduction of diversions by the agricultural community (Jamestown S'Klallam 2005).

With continued growth in the region, threats to salmonid populations and the loss and degradation of their habitat will persist. Areas along the mainstem and lowland tributaries are most likely to be affected by growth and development pressures. When riverine lands are converted to residential and urban areas, forest cover and ecosystem processes are altered or lost and the change is commonly permanent.

The Dungeness River estuary has changed substantially over the past century to the detriment of many salmonid species (Haring 1999, pp. 104-105). The delta has prograded and distributary channels have been lost, as has important low-gradient, low-salinity habitat. These changes to the configuration and character of the delta and estuary have presumably occurred from the combined effects of the following: diking; lower watershed levees that have increased sediment transport to the estuary; large wood removal throughout the watershed that has diminished sediment retention capacity; and logging and riparian vegetation removal throughout the watershed that has resulted in elevated sediment inputs from unstable slopes and banks, and inadequate logging road construction and management. Some limited restoration actions have helped to improve conditions in the estuary (e.g., NWIFC 2009), and additional projects have been identified (CC and JST 2004).

The severely altered state of the Dungeness River and its estuary are one of the primary factors that have contributed to the decline of salmonid populations in the watershed. Abundance of naturally-reproducing anadromous salmon and steelhead populations in the Dungeness River is generally low (Haring 1999, p. 18), notwithstanding the recent increase in pink salmon abundance. Nutrient pulses related to adult spawner abundance have been identified as a primary driver of individual growth and population productivity in salmonids (e.g., Moore et al. 2008; Rinella et al. 2012; Walters et al. 2013, p. 516; Nelson and Reynolds 2014), including bull trout (Zimmerman and Kinsel 2010, p. 30; Copeland and Meyer 2011, pp. 937-938). Thus, habitat degradation and diminished salmon abundance may operate synergistically to persistently suppress salmon populations.

Fisheries

There are currently no fisheries for bull trout in the Dungeness River watershed, Dungeness Bay, or nearby marine waters. However, bull trout are highly susceptible to incidental capture in fisheries targeting other species when those fisheries overlap in time and space with bull trout. Incidentally-captured bull trout are exposed to inadvertent injury and immediate and delayed mortality associated with hooking, suffocation (e.g., from gill nets), handling, stress and physical exhaustion, and predation (e.g., Arlinghaus et al. 2007, pp. 105-134). Poaching and intentional killing (i.e., from anglers that believe bull trout are a threat to their preferred target species) are also a concern in some areas.

Various commercial, Tribal, and recreational fisheries in the Dungeness and Gray Wolf Rivers, Dungeness Bay, and nearby marine waters are open annually. It is currently not legal to retain bull trout captured in any of these fisheries. Fishing regulations, including when and where the fishing seasons are open, may change from year to year. Most, if not all, of these fisheries are supported by the WDFW's Dungeness hatchery programs for coho salmon and steelhead trout, which are intended solely to provide fish for harvest. The bull trout 4(d) rule, implemented at the time of bull trout listing in 1999, exempts take associated with fisheries operated in accordance with applicable state, National Park Service, and Native American Tribal laws and regulations. The USFWS considers fisheries supported by the WDFW's Dungeness hatchery programs as meeting requirements for exemption under the 4(d) rule. Therefore, for the purposes of this consultation, effects from hatchery-supported fisheries are considered part of the baseline and not interrelated and interdependent effects of the hatchery operations.

Specific effects to and take of bull trout from fisheries in the Dungeness system were not evaluated or determined at the time of listing and 4(d) rule implementation. Here, we provide a cursory evaluation of where fisheries overlap in time and space with bull trout to identify exposure of bull trout to incidental capture in fisheries, and supplement this with additional information where available.

The WDFW provides a recreational fishery for coho salmon that is usually open from October through December in the Dungeness River, extending from the mouth to RM 11.3. Bull trout are present in this part of the river during this time, including upstream-migrating anadromous adults, downstream-migrating anadromous adults, pre- and post-spawning fluvial and anadromous adults, and subadults. In 2003, the WDFW conducted creel surveys that encompassed approximately 40 percent of the fishing season (mid-October through November) and 88 percent of the open section of the river (RM 0.9 to 10.8) (Cooper, in litt. 2015). Anglers reported incidentally catching 32 bull trout. Approximately two-thirds of the reported catch of bull trout occurred between RM 9.2 and 10.8, the reach of the surveyed area that overlapped primary bull trout overwintering habitat. Some bull trout may have been captured and reported more than once; however, the extent of this is not known. It is reasonable to assume that more than 32 bull trout were captured by anglers for several reasons: 1) only part of the fishing season was sampled; 2) only part of the open area was sampled; 3) not all anglers were surveyed; and 4) some surveyed anglers may have captured bull trout, but not reported their catch. Based on this information, it is likely that a considerable proportion of the Dungeness core area population is incidentally caught in the hatchery-supported coho recreational fishery.

Recreational steelhead fisheries are open as follows: 1) mouth to RM 11.3, open from early October to end of January; 2) RM 11.3 to 15.8, open from mid-October to end of January; 3) Gold Creek and above, open from Memorial Day to end of October; and, 4) Gray Wolf River, RM 1 and above, open from early June to end of October. The extent of fishing pressure and incidental capture of bull trout has not been surveyed and is not known. Generally, bull trout are in these areas at these times. The Gray Wolf fishery completely overlaps the time and location of significant bull trout spawning by this local population.

Dungeness Bay is open for recreational coho fishing during October, and for Tribal Treaty harvest from late-September through October. This partially overlaps the anadromous bull trout return migration to the Dungeness River, which is believed to occur from July through October. Other fisheries are also open, but generally appear at times and places that would minimize incidental capture of bull trout.

Based on this information, incidental capture of bull trout and associated mortality and injury from fisheries in the Dungeness River watershed and Dungeness Bay may be quite high. Ogg et al. (2008, pp. 30-31) implicated sport fishing, alongside natural predation, as likely factors responsible for the high mortality of radio-tagged anadromous bull trout observed in their study. Additional study is needed to determine the full extent of incidental capture of bull trout and associated mortality and injury in the Dungeness system.

Hatcheries

WDFW hatcheries in the Dungeness River have produced and released various species of salmonids for many decades. Out-of-basin coho stocks were commonly planted, reared at the hatchery, and released into the watershed until 1981 (WDFW 2015b). The Dungeness River Hatchery spring Chinook and fall-run pink salmon hatchery programs were initiated for integrated recovery purposes to conserve and restore the indigenous Chinook and fall-run pink salmon populations in the Dungeness River. The coho salmon program at Dungeness River

Hatchery operates for fisheries harvest augmentation purposes to partially mitigate for lost natural-origin coho salmon resulting from degradation and loss of habitat as a result of human developmental activities in the watershed. The Dungeness River Hatchery Chinook salmon program was initiated in its current form as a supplementation effort in 2004, after functioning as a captive broodstock-based program since 1992. The conservation program for fall-run pink salmon at the hatchery operated from 1997 to 2001. It started again in 2007 and has been in operation since then. The Dungeness River Hatchery coho salmon program has operated for the longest duration, releasing smolts into the lower river since about 1902.

A full river spanning weir began operating at the Dungeness River Hatchery at RM 10 in the 1930s. The weir blocked migration to upstream spawning areas for approximately 50 years before it was abandoned in the 1980s. Its operation likely adversely affected the abundance and spatial structure of natural-origin salmonids.

Other Restoration and Recovery Activities

The Pacific Coastal Salmon Recovery Fund (PCSRF) was established by Congress to help protect and recover salmon and steelhead populations and their habitats (NMFS 2011c). The states of Washington, Oregon, California, Idaho, and Alaska, and the Puget Sound, Pacific Coastal and Columbia River tribes, receive PCSRF appropriations from NMFS each year. The fund supplements existing state, tribal and local programs to foster development of Federal-state-tribal-local partnerships in salmon and steelhead recovery. The PCSRF has made substantial progress in achieving program goals, as indicated in annual Reports to Congress, workshops, and independent reviews. Salmon and steelhead habitat restoration and protection projects in the Puget Sound region, including within the Dungeness River watershed action area, have been funded and implemented through the PCSRF process.

Current Condition of Bull Trout in the Action Area

The action area completely overlaps the Dungeness River core area. The Dungeness River core area includes the Dungeness and Gray Wolf Rivers, associated tributaries, and estuary. The Dungeness River core area is one of two core areas in the Coastal Recovery Unit that are connected to the Strait of Juan de Fuca.

Bull trout occur throughout the Dungeness and Gray Wolf Rivers downstream of natural impassable barriers, which are present on both rivers (RM 18.7 on the Dungeness River; approximately RM 9.0 on the Gray Wolf River). They also occur in the Dungeness River estuary and Gold Creek, a Dungeness River tributary. Of 79 char known to have been sampled from anadromous reaches of the Dungeness River watershed, all but one were positively identified as bull trout via genetic analysis (Spruell and Maxwell 2002; Spruell 2006; DeHaan et al. 2011; DeHaan, in litt. 2014). Upstream of the anadromous barrier on the Dungeness River, all 50 char sampled were confirmed as Dolly Varden (Young 2001). It is likely that the Dolly Varden sampled below the falls was a fish that passed over the falls and was not able to return to its home range above the falls. Dungeness River bull trout are genetically unique from other nearby bull trout populations, including those in the Elwha and Skokomish Rivers and along the coast (DeHaan et al. 2011, pp. 468-469).

Anadromous and fluvial life-history forms occur in the Dungeness core area (USFWS 2004, pp. 60-61; Ogg et al. 2008). Anadromy was observed in 27 percent of 48 radio tagged bull trout (Ogg et al. 2008, p. 19). The resident form is also likely, but has not been confirmed. Mainstem rivers within the core area provide spawning, rearing, foraging, migration, and overwintering habitats. The estuary also provides important foraging habitat. During a study in 2006 and 2007 by the Jamestown S'Klallam Tribe that targeted capture of salmon smolts, a number of bull trout were incidentally captured in fyke nets located in estuary feeder channels and during beach seining. These fish ranged in size from 117 to 380 millimeters and were often captured in the midst of juvenile pink and chum salmon and post larval surf smelt.

Fish passage into Canyon Creek has been blocked by an impassable diversion dam near its mouth. Bull trout are not known to currently occupy Canyon Creek. Fish passage was restored in March 2016, and it is believed that Canyon Creek will provide important foraging and potentially spawning and rearing habitat for bull trout (USFWS 2010, p. 19).

The Dungeness core area population was considered at "high risk" for extirpation in 2008 (USFWS 2008b, p. 35). Key status indicators have not changed since 2008; therefore, this designation is still valid. The status of the bull trout core area population can be described by four key elements necessary for long-term viability: 1) number and distribution of local populations, 2) adult abundance, 3) productivity, and 4) connectivity (USFWS 2004, p. 135).

Number and Distribution of Local Populations

Two local populations - the Middle Dungeness and the Gray Wolf - are recognized within the Dungeness core area (USFWS 2004, p. 61). The Gray Wolf local population occurs in the Gray Wolf River from the anadromous barrier at RM 8.5 to the confluence with the Dungeness River (USFWS 2006, p. 61; Ogg et al. 2008, pp. 23-26). The Middle Dungeness local population occurs from the anadromous barrier at RM 18.7 downstream to the confluence with Canyon Creek at RM 10.8 (USFWS 2004, p. 62), although spawning has not been documented downstream of RM 15. It includes Gold and Canyon Creeks. Both of these local populations spawn primarily from September through November (Ogg et al. 2008, pp. 24-27). Ogg et al. (2008, pp. 23-26) observed a seemingly distinct third group, which spawned near the Gray Wolf River confluence in December. Further study and analysis is needed to determine whether this late spawning group constitutes a third local population. With only two local populations, bull trout in this core area are considered to be at increased risk of extirpation and adverse effects from random naturally occurring events.

Adult Abundance

In 2005, the USFWS concluded that the number of spawning bull trout in the Dungeness core area appeared to be very low (USFWS 2005, p. 622), although this conclusion was based on very limited data. The USFWS 2008 Five Year Review categorized the Dungeness core area as having 50 to 250 individuals (USFWS 2008, p. 35). In 2004, Ogg et al. (2008, p. 26) observed 17 bull trout redds in the Dungeness River between the anadromous barrier and the Gray Wolf River confluence during thirteen surveys. In the Gray Wolf River, 33 redds were observed during twelve surveys (Ogg et al. 2008, p. 26). These surveys were considered intensive and likely captured the majority of redds within the core area (USFWS 2005, p. 620), although the December spawning group was not represented (no surveys were performed in December). Surveys performed in December 2005 identified ten redds in the Dungeness and Gray Wolf Rivers within about one-half mile of the confluence (Ogg et al. 2008, pp. 26-27). There is no information on trends in abundance of Dungeness core area adult bull trout. The USFWS 2014 Revised Draft Recovery Plan identifies “small population size” as one threat to this population (USFWS 2014, p. 82). Due to their low numbers, the species in this core area may be at increased risk of genetic drift, inbreeding, and extinction.

Productivity

There are limited data on bull trout productivity in the Dungeness River watershed. The WDFW has operated a smolt trap near the mouth of the river since 2005. Bull trout catch in the trap provides the only available indicator of productivity in the watershed. However, these data have limitations and must be used with caution. There are no trap efficiency estimates for bull trout; therefore, catch cannot be expanded to estimate the actual number of bull trout passing the trap, nor can confidence intervals be calculated to determine statistical significance of trends. Bull trout in the Dungeness core area are considered at risk of extirpation until sufficient information is collected to properly assess the productivity of this core area.

Between 2005 and 2015, bull trout catch in the trap varied between 10 and 77 fish, except for 2014 when catch jumped to 148 fish (Topping, in litt. 2014; Topping, in litt. 2015b; WDFW 2015a). These data suggest that bull trout productivity is generally low and has not varied much since 2005, the apparent increase in 2014 notwithstanding. The 148 fish captured in 2014 was a considerable increase over previous years. It also corresponds with the substantial increase in pink salmon spawner abundance observed within the Dungeness River and throughout Puget Sound in recent years. Pink salmon spawner abundance in the Dungeness River was more than ten times greater in 2013 than in previous years, attaining levels not seen since the 1960’s (WDFW 2015b). Nutrient pulses related to adult spawner abundance have been identified as a primary driver of individual growth and population productivity in salmonids (e.g., Moore et al. 2008; Rinella et al. 2012; Walters et al. 2013, p. 516; Nelson and Reynolds 2014), including bull trout (Zimmerman and Kinsel 2010, p. 30; Copeland and Meyer 2011, pp. 937-938). Although not conclusive, these data suggest that productivity in the Dungeness River watershed is closely correlated with adult salmonid spawner abundance.

Connectivity

There are no dams or other large water management structures within the Dungeness or Gray Wolf Rivers affecting connectivity within the mainstems. Connectivity between the lower Dungeness River and its floodplain has been eliminated by diking to prevent flooding. Migration during late summer and early fall can be blocked by reduced flows in the lower watershed from water diversions for irrigation and municipal water supplies. Water rights in the Dungeness River basin are severely overappropriated, and, although these rights are apparently not fully utilized, they take a substantial proportion of the river flow during the natural annual low flow period from August to early November (Haring 1999, pp. 99-104; EDPU 2005, Chapter 2.3). This period overlaps the upstream and downstream migration timing of bull trout in the

Dungeness River (Ogg et al. 2008). Decreased flows may inhibit passage of adult salmonids in the Dungeness River (Haring 1999, pp. 99-104), although the extent to which anthropogenically diminished flows inhibits the migration of adult bull trout has not been evaluated. Nonetheless, instream flows have been identified as a primary threat to bull trout in the Dungeness River (USFWS 2015b, p. A-17).

A number of barriers to fish movement and migration in the Dungeness River core area are due to improperly sized or installed culverts throughout the core area. Migration at certain times of the year may be obstructed by the WDFW fish hatchery collection weir on the lower Dungeness River. The hatchery water intake on Canyon Creek was a complete barrier to fish passage until March 2016 when the infrastructure was retrofitted with a fish ladder to provide fish passage.

Despite these impairments to connectivity, migratory bull trout persist in both local populations. The full extent to which connectivity impairments in the Dungeness River watershed directly affect bull trout reproduction, abundance, and distribution via migration delays and habitat fragmentation is not known. It appears likely that direct effects have at least some negative impact. In addition, impaired connectivity in the Dungeness watershed indirectly affect bull trout by impacting naturally-spawning salmonids (Haring 1999, pp. 85-107), a primary driver of freshwater ecosystem productivity and important forage resource for bull trout. For these reasons, bull trout in this core area are at increased risk of extirpation from impairments to connectivity.

Changes in Environmental Conditions and Population Status

Since the bull trout listing, federal actions occurring in the Dungeness core area have had short- and long-term effects to bull trout and bull trout habitat, and have both positively and negatively affected bull trout. These actions have included statewide federal restoration programs with riparian restoration, restoration of fish passage at barriers, and habitat-improvement projects. In addition, federally funded transportation projects involving repair and protection of roads and bridges have been completed. Finally, section 10(a)(1)(B) permits have been issued for Habitat Conservation Plans that address bull trout in this core area. For example, in 2000, State forest practice regulations were significantly revised following the Forest and Fish agreement. These regulations increased riparian protection, unstable slope protection, recruitment of large wood, and improved road standards significantly. Because there is biological uncertainty associated with some of the prescriptions, the Forest and Fish agreement relies on an adaptive management program for assurance that the new rules will meet the conservation needs of bull trout. The updated regulations are expected to significantly reduce the level of future timber harvest impacts to bull trout streams on private lands; however, most legacy threats from past forest practices will likely continue to be a threat for decades.

The number of non-federal actions occurring in the Dungeness River core area since the bull trout listing is unknown. Activities conducted on a regular basis, such as emergency flood control, development, and infrastructure maintenance, affect riparian and instream habitat and probably negatively affect bull trout.

Climate change is expected to affect both river flow and water temperatures to the detriment of bull trout and other salmonids. Increases in late fall and winter flow in the Dungeness River, and decreases in the spring, summer, and early fall flow are expected (Halofsky et al. 2011, p. 25; Whited et al. 2012). By 2020, a 20 percent decrease in late summer low flow is expected from pre-2006 levels. By 2080, this will reach 40 percent. This will exacerbate threats already posed by current anthropogenic water withdrawals and low flow in the lower watershed. In addition, water temperatures are expected to increase due to the projected increases in air temperature, especially in the lower elevations of this core area (Halofsky et al. 2011, p. 44). This will be exacerbated by the lower late summer flows which will increase the influence of air temperature on water temperature.

Threats

There are four primary threats to bull trout in the Dungeness core area (USFWS 2015b, p. A-17):

Instream Impacts: Flood Control. Flood and erosion control associated with agricultural and residential development continues to result in poor structural complexity and high water temperatures within the lower river, a migration corridor key to the persistence of the anadromous life history form. Floodplain restoration, large wood recovery, and riparian conservation are critical needs.

Water Quality: Altered Flows. Agricultural and residential water use continues to result in poor instream flow and dewatering within the lower Dungeness River, impairing FMO habitat.

Small Population Size: Genetic and Demographic Stochasticity. Available spawner abundance data indicates the low number of adults results in increased genetic and demographic stochasticity in both the Dungeness River and Grey Wolf River local populations.

Forage Fish Availability: Prey base. Depressed populations of salmon and steelhead limits the available freshwater prey base within this system even though abundance of some species (i.e., pink salmon) has significantly improved.

Additional threats to Dungeness watershed bull trout include:

- Climate change. Climate change is expected to negatively affect spawning and rearing bull trout via elevated water temperatures during migration, spawning, and rearing periods; redd scour due to increased peak flows; and decreased habitat quantity as a result of lower summer flows. Climate change will exacerbate the already problematic low flow issues caused by over-appropriated water rights.

- Fisheries. Bull trout are highly susceptible to incidental capture and mortality associated with fisheries directed at hatchery-origin coho and steelhead in the anadromous reaches of the Dungeness River watershed and Dungeness Bay. In 2003, the WDFW conducted creel surveys in the Dungeness River from mid-October through November, covering the lower watershed from the Dungeness Hatchery downriver to within one mile of the mouth. Anglers reported capturing 32 bull trout (Cooper, in litt. 2015). This likely underestimates the actual number of bull trout captured because the entire fishing season was not surveyed, surveys were not conducted on every day of the survey period, not all anglers were interviewed on each day of the survey, and the entire area open to fishing was not surveyed. The Gray Wolf recreational steelhead fishery overlaps completely the time and place of significant bull trout spawning by this local population. Illegal lethal take associated with poaching and negative perceptions by some steelhead anglers toward bull trout are also concerns.

Dungeness core area bull trout may also be susceptible to capture in Dungeness Bay recreational and Tribal fisheries targeting hatchery-origin coho and steelhead. The coho fisheries are generally open from mid-September through late-November; steelhead from early December through February. There are no direct empirical data on timing of bull trout movement into the Dungeness River. Adult Dungeness bull trout outmigrate from the river into marine waters primarily from May through August (Ogg et al. 2008, p. 2), which is several months later than other studied western Washington populations (Brenkman and Corbett 2005, pp. 1078-1079; Goetz et al. 2007, p. 18; Hayes et al. 2011, p. 394; Goetz et al., *in litt*. 2012). Assuming Dungeness River bull trout exhibit similar marine residency times as these other populations, their return through Dungeness Bay to the river mouth would occur from July through October, exposing the later returners to capture in the coho fisheries. Substantial impacts from capture in non-sport fisheries have been documented in the Hoh River (Brenkman and Corbett 2005, pp. 1077-1080).

- High anadromous mortality. Ogg et al. (2008) observed 14 tagged bull trout emigrating from the Dungeness River into the marine environment. Only one of these returned to the Dungeness River. Of those that did not return, the authors noted that half were confirmed mortalities likely due to natural predation and/or sport fishing (Ogg et al. 2008, pp. 30-31). The rest migrated to saltwater and were never detected afterward, or were tracked to nearby watersheds (Valley Creek and Morse Creek) and confirmed deceased from unknown causes.

- Past logging and logging-related activities, such as roads, have degraded habitat conditions (e.g., fisheries, water quality, and connectivity) in the upper watershed, which has a naturally unstable geology with steep slopes that are susceptible to mass wasting.

- Past and current agricultural practices and the over appropriation of water rights negatively affect instream flow, increase water temperatures, and increase sediment deposition in the streambed. Other impacts include blocked migration, decreased juvenile rearing areas, straying into other streams, transportation of pollutants in irrigation flows, reduced amounts of large woody debris, and loss of estuarine rearing and foraging habitat.

- Water quality has been degraded by municipal, agricultural, and industrial effluent discharges and development.

- Residential and urban developments along the shore that include intertidal filling, bank armoring, and shoreline modifications have caused the loss of extensive eelgrass meadows in the nearshore.

Factors Responsible for the Condition of the Species

The habitat conditions and threats detailed above are responsible for the condition of bull trout in the Dungeness River core area.

Current Condition of Bull Trout Critical Habitat in the Action Area

Anadromous-accessible portions of the Dungeness River, Gray Wolf River, and Canyon Creek are either designated Critical Habitat or are considered Essential Excluded Habitat (75 FR 63898-63979, October 18, 2010). The majority of designated Critical Habitat lies in the Olympic National Forest and the Olympic National Park. Nearly all of the Essential Excluded Habitat excluded from critical habitat designation are waters adjacent to nonfederal lands covered by legally operative incidental take permits for habitat conservation plans (HCPs) issued under section 10(a)(1)(B) of the Act, including the Washington State Department of Natural Resources HCP and the Washington Forest Practices HCP. Critical habitat also does not include anthropogenic structures such as outfall channels from facilities.

Critical habitat not only includes designated freshwater habitats, but also extends offshore to the depth of minus 33 feet relative to the mean low low-water line, which is the photic zone and is considered to be the habitat most consistently used by bull trout in marine waters. Although the action area includes critical habitat within the Straits of Juan de Fuca, effects to critical habitat from the proposed action (effects from fish-weir installation and use and water withdrawal) are extremely unlikely to occur outside of the Dungeness River. Therefore, we will focus our description of the critical habitat to that within the Dungeness River.

Within the critical habitat, the primary constituent elements (PCEs) of critical habitat for bull trout are those habitat components that are essential for the primary biological needs of foraging, reproducing, rearing of young, dispersal, genetic exchange, or sheltering. The PCEs and their baselines are as follows:

PCE 1: Springs, seeps, groundwater sources, and subsurface water connectivity (hyporheic flows) to contribute to water quality and quantity and provide thermal refugia.

The PCE is likely moderately impaired during the late summer and early fall low flow periods in the lower watershed. Several studies have evaluated the relationship between surface water and groundwater in the Dungeness (EDPU 2005, Chapter 2.8, pp. 2.8-11 to 2.8-12, and references therein; JST 2007, p. 30-33, and references therein). There are approximately 4,000 wells in the lower Dungeness watershed extracting groundwater, primarily serving residential users. This represents a large increase over the 200 wells present in 1970. Most of these wells are “exempt” and are not metered; therefore, estimates of groundwater withdrawal are not available. The

WDFW Hurd Creek Hatchery uses water from wells. Groundwater extraction may reduce discharges into the river and tributaries. We anticipate that this PCE in the lower watershed may be negatively affected seasonally by the groundwater withdrawals.

PCE 2: Migration habitats with minimal physical, biological, or water quality impediments between spawning, rearing, overwintering, and freshwater and marine foraging habitats, including but not limited to permanent, partial, intermittent, or seasonal barriers.

The PCE is moderately to severely impaired in the lower watershed during seasonal low flow conditions in late summer and early fall, which partially overlaps both upstream and downstream migration of adult and subadult bull trout. Surface and groundwater withdrawals reduce flow in the river and likely inhibit bull trout migration through the lower watershed during extreme low flow conditions. The extent and effect of any impediment to migration depends on the severity, duration, and timing of low flow conditions.

PCE 3: An abundant food base, including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.

This PCE is severely impaired due to the low abundance and depressed status of salmon and steelhead populations in the watershed. The low abundance of naturally-spawning salmonids in the Dungeness River system represents a substantial limitation in the bull trout forage base and general ecosystem productivity. Ongoing habitat restoration and salmon recovery efforts, including the WDFW's pink and Chinook salmon supplementation programs, are expected to improve the forage base for bull trout. Historic and persistent effects from the hatchery coho program may limit the abundance and long term viability of the naturally reproducing coho salmon population, a seasonally important forage resource to juvenile bull trout.

PCE 4 - Complex river, stream, lake, reservoir, and marine shoreline aquatic environments, and processes that establish and maintain these aquatic environments, with features such as large wood, side channels, pools, undercut banks and substrates, to provide a variety of depths, gradients, velocities, and structure.

This PCE is severely impaired in the lower watershed, and improves but is still moderately impaired above RM 10.8. This PCE is largely intact in the Gray Wolf River. In the lower watershed, historical levee construction, large wood removal, and riparian deforestation have greatly simplified the aquatic environment and continue to constrain the processes that create and maintain complex environments. Sedimentation in the upper watershed from historical logging practices have also contributed to simplification of the aquatic environment.

PCE 5: Water temperatures ranging from 2 °C to 15 °C (36 °F to 59 °F), with adequate thermal refugia available for temperatures that exceed the upper end of this range.

Water temperatures appear suitable throughout the year in the upper watershed, including the Gray Wolf River. In the lower watershed, the combined effects of water withdrawals and riparian vegetation removal along the mainstem and tributaries contribute to elevated water temperatures above 15 °C in the summer (Haring 1999, p. 98).

PCE 6: In spawning and rearing areas, substrate 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.

No formal surveys of spawning and rearing habitat have been performed. However, inferences can be made from land use history (e.g., protected or logged), known impacts (e.g., sediment inputs from logging roads), biological surveys (i.e., Ogg et al. 2008), and supporting information (e.g., USFWS 2004). In the Gray Wolf River, this PCE appears to be generally intact given the protected status, light impacts, and large proportion of bull trout spawners observed within this subwatershed. In the upper Dungeness subwatershed (above RM 10.8), the PCE appears to be at least partially intact due to the known occurrence of spawning bull trout in this area. However, this PCE is likely impaired due to impacts associated with logging and logging roads in the surrounding timberlands. Canyon Creek is believed to contain high quality habitat that may support bull trout spawning and rearing once fish passage is restored (USFWS 2010, p. 19).

PCE 7: A natural hydrograph, including peak, high, low, and base flows within historical and seasonal ranges or, if flows are controlled, minimal flow departure from a natural hydrograph.

This PCE is severely impaired during summer and early fall in the lower Dungeness River FMO habitat (below RM 10.8) due to water withdrawals for agricultural irrigation and municipal uses. The Dungeness Hatchery may partially impair this PCE between RM 11.1 (water intake) and 10.2 (effluent discharge) due to hatchery water use. Median annual low flow in the Dungeness River before water withdrawal is 130 to 200 cfs. Gage records indicate that flow drops to 61 to 84 cfs one year out of every four. These episodes have lasted from a few days up to nearly one month, and usually occur in September, October, or November. During annual low flow (late August through late October), the Dungeness hatchery typically withdraws 10 to 15 cfs of surface water from the mainstem Dungeness River. The hatchery may withdraw up to 40 cfs, in accordance with current water rights.

PCE 8: Sufficient water quality and quantity such that normal reproduction, growth, and survival are not inhibited.

The Dungeness River watershed above RM 10.8, including Canyon Creek, is considered to have excellent water quality (WDOE 2011). Water quality degrades somewhat below this point, although it is still generally very good. There have been some fecal coliform and other contamination issues in the lower watershed in recent years, which have been the focus of corrective measures (EDPU 2005, Chapter 2.8, pp. 2.8-26 to 2.8-38; JST 2007). It is too soon to determine whether these efforts are having an effect.

As described above, water withdrawals for agricultural, municipal, and hatchery uses reduce the instream flows in the lower watershed.

PCE 9: Sufficiently low levels of occurrence of nonnative predatory (e.g., lake trout, walleye, northern pike, smallmouth bass); interbreeding (e.g., brook trout); or competing (e.g., brown trout) species that, if present, are adequately temporally and spatially isolated from bull trout.

There are no known nonnative predatory or interbreeding species present in the action area. Hatchery releases of salmon and steelhead with genetic origins outside of the Dungeness River watershed have occurred in the past. The current hatchery coho stock originated from wild Dungeness River spawners with some introductions from Elwha River stock. The current early winter steelhead stock originated from WRIA 12's Lakewood Hatchery, formerly known as the South Tacoma Hatchery. This stock has been used by WDFW throughout western Washington and is commonly referred to as "Chambers Creek" stock.

Factors Responsible for the Condition of Critical Habitat

The factors responsible for the condition of critical habitat are as described above.

Conservation Role of the Action Area

The action area completely overlaps the Dungeness River core area. Maintaining and recovering bull trout at the core area level is considered essential to re-establishing a viable range-wide population (USFWS 2004; USFWS 2015a). Threats that need to be addressed in the action area to ensure recovery are as described above.

Climate Change

Our analyses under the Endangered Species Act include consideration of ongoing and projected changes in climate. The terms "climate" and "climate change" are defined by the Intergovernmental Panel on Climate Change (IPCC). "Climate" refers to the mean and variability of different types of weather conditions over time, with 30 years being a typical period for such measurements, although shorter or longer periods also may be used (IPCC 2007, p. 78). The term "climate change" thus refers to a change in the mean or variability of one or more measures of climate (e.g., temperature or precipitation) that persists for an extended period, typically decades or longer, whether the change is due to natural variability, human activity, or both (IPCC 2007, p. 78). Various types of changes in climate can have direct or indirect effects on species. These effects may be positive, neutral, or negative and they may change over time, depending on the species and other relevant considerations, such as the effects of interactions of climate with other variables (e.g., habitat fragmentation) (IPCC 2007, pp. 8–14, 18–19). In our analyses, we use our expert judgment to weigh relevant information, including uncertainty, in our consideration of various aspects of climate change.

As described above, climate change is a threat to Dungeness River bull trout, particularly as it interacts with and exacerbates effects of anthropogenic water withdrawals.

ENVIRONMENTAL BASELINE: Marbled Murrelet

Marbled murrelets in Washington generally use large patches of old forest or uneven-aged forest with old-growth characteristics for nesting habitat (Hamer and Nelson 1995). Hamer and Nelson (1995) described both landscape and forest stand characteristics of 36 marbled murrelet nest stands in the Pacific Northwest (a stand being defined as a contiguous group of trees with no gaps larger than 330 ft).

Marbled murrelets locate their nests throughout forest stands and fragments, including various types of natural and man-made edges. Riparian forests can provide potential nest sites for marbled murrelets if the appropriate structures are present (i.e., large trees with suitable nest platforms located within a patch of suitable nesting habitat). On the Olympic Peninsula, the vast majority of suitable habitat is on federal lands (Olympic National Park and Forest; approximately 1 million acres, combined) and on lands managed by the Washington Department of Natural Resources, tribe and private landowners (approximately 260,000 acres, combined.

The Hurd Creek Hatchery is very low in the watershed and is within 400 feet of small, fragmented patches of marginal suitable habitat for marbled murrelets (Raphael et al. 2015). These patches are a small component of the landscape, which is dominated by rural residential uses, agricultural fields, and local access roads.

The Dungeness Hatchery is in a forested setting surrounded by patches of early-, mid-, late-successional forests, and mixed-seral forest, including some recently logged patches located to the east. Some of these forests likely provide suitable nesting habitat for marbled murrelets (Raphael et al. 2015) and numerous detections were documented during surveys conducted in 2002 in stands to the east of the hatchery. The hatchery is also adjacent to Fish Hatchery Road, which provides access to state timber lands and the Olympic National Forest to the south.

The Upper Dungeness and Gray Wolf Acclimation Ponds are in an area of the Olympic National Forest dominated by late-seral stage coniferous forest, although some areas were previously disturbed by historical logging. Satellite imagery shows that much of the area around each site is marginal- to high-quality marbled murrelet habitat. Mature Douglas fir (*Pseudotsuga menziesii*) are the dominant trees around the Upper Dungeness site. The Gray Wolf site is situated in a relict side channel of the river and is dominated by red alder (*Alnus rubra*) with some large conifers. Logging operations are not currently occurring in the Dungeness watershed on the forest, nor are they projected to occur in the near future. Both sites are along main Forest Service roads (2880 and 2870) that lead to the upper Dungeness watershed. Recreational traffic is low to moderate; lower in early April and increasing through the spring and summer as the weather improves. The Upper Dungeness site is approximately 120 feet from the Dungeness Forks Campground, which opens seasonally in late May.

Current Condition of Marbled Murrelet in the Action Area

Marbled murrelets were listed as threatened in 1992 due, in large part, to habitat loss and predation in the terrestrial environment, and oil spills and net fisheries entanglement in the marine environment. The final Recovery Plan for the marbled murrelet outlines the conservation strategy for the species (USFWS 1997b). In 2012, the USFWS convened the marbled murrelet Recovery Implementation Team which concluded that the primary cause of the continued population decline is sustained low recruitment (USFWS 2012b). Sustained low recruitment can be caused by nest failure, low numbers of nesting attempts, and/or low juvenile survival rates due to 1) terrestrial habitat loss, 2) nest predation, 3) changes in marine forage base which reduce prey resources, and 4) cumulative effects of multiple smaller impacts.

Threats in the terrestrial environment are all related to habitat loss and quality as it pertains to the availability of marbled murrelet nesting habitat (i.e., fragmentation, tree loss, etc.).
More marbled murrelet habitat has been lost historically in the U.S. than in Canada, and in the U.S., marbled murrelet population numbers are lower (less than one-third of the Canadian population), productivity is lower, old-growth forest loss is more severe, and there is less remaining suitable habitat (USFWS 2009a, p. 5).

The Dungeness watershed is located in murrelet Conservation Zone 1, and all of the marbled murrelets nesting in the watershed are considered to be part of the Conservation Zone 1 marbled murrelet population. Much of the Puget Trough's mature forest has been replaced by urban and suburban development. The suitable marbled murrelet habitat remaining in Conservation Zone 1 is typically a considerable distance from the marine environment, lending special importance to habitats close to Puget Sound (USFWS 1997).

Status of the Marbled Murrelet in the Action Area

Surveys for marbled murrelets were conducted on the Olympic Peninsula opportunistically in limited areas from 1987 to 1991. More extensive surveys were carried out between 1992 and 1999 using the intensive survey method described in the Pacific Seabird Group protocol. These surveys were primarily in response to proposed activities (primarily timber sales). Large portions of the Olympic National Forest have not been surveyed at all or not surveyed to current protocols for marbled murrelets (Evans Mack et al. 2003). In a radio-telemetry study of nesting marbled murrelets in the Olympic Peninsula, Bloxton and Raphael (2005, p. 5) documented a nest success rate of 0.20 (2 chicks fledging from 10 nest starts). In the Puget Sound and outer coast of Washington, Bloxton and Raphael (2009, p. 2) captured and banded 29 murrelets in 2004, 41 in 2005, 40 in 2006, 31 in 2007, and 21 in 2008. They placed radio-transmitters on 27 adult murrelets in 2004, 40 in 2005, 40 in 2006, 32 in 2007, and 18 in 2008 (pp. 5–6). Of the 20 nests monitored, only three were successful and one was presumed to be successful (p. 8). Of the nest trees that were identified, eight were in large Douglas-fir (*Pseudotsuga menziesii*) trees, five were in western hemlocks (*Tsuga heterophylla*), three were in western red cedar trees (*Thuja plicata*), and one was in a Sitka spruce (*Picea sitchensis*); the diameter at breast height of nest trees ranged from 79 to 248 cm (31.1 to 97.6 inches) (Bloxton and Raphael 2009, p. 8).

From 2001 to 2010, numbers of murrelets observed during at-sea surveys in Conservation Zone 1 (eastern Olympic Peninsula and Puget Sound) significantly declined. Numbers of marbled murrelets in the Olympic Peninsula part of Conservation Zone 1 through the 2010 breeding season are estimated to be 4,393 (95 percent CI = 2,689–6,367).

Marbled murrelets are not believed to be present in the vicinity of the Hurd Creek Hatchery due to lack of suitable habitat and historical observations. There are large, contiguous areas of marginal to high quality marbled murrelet habitat within a 1.5-mile radius of the Dungeness Hatchery. In addition, there are numerous historical marbled murrelet detections in this area, including many in stands just to the east of the hatchery across the river. Human activity in the area is relatively light consisting of light traffic on Fish Hatchery Road and a few parcels of land that have been cleared for residential and agricultural purposes. Based on this information, it is reasonable to assume that some portion of the suitable habitat in the action area is reasonably certain to be occupied.

There are large, contiguous areas of high quality or potentially suitable marbled murrelet habitat within a 1.5-mile radius of the Upper Dungeness and Gray Wolf Acclimation Ponds. In addition, numerous detections of marbled murrelets have been documented close to or immediately adjacent to each of these sites in the past. Based on this information, it is reasonable to assume that some portion of the suitable habitat in the action area is currently occupied or could become occupied during the term of this consultation.

Conservation Role of the Action Area

Lands considered essential for the recovery of the marbled murrelet within Conservation Zones 1 include: 1) any suitable habitat in a Late-Successional Reserve; 2) all suitable habitat located in the Olympic Adaptive Management Area; 3) large areas of suitable nesting habitat outside of Late-Successional Reserves on Federal lands; 4) suitable habitat on State lands within 40 miles of the coast; and 5) habitat within occupied murrelet sites on private lands (USFWS 1997, pp. 131-134).

The Upper Dungeness and Gray Wolf Acclimation Ponds are on lands owned by the Olympic National Forest. The upper Dungeness watershed that is within federal ownership (Olympic National Park, Olympic National Forest) provides large, contiguous blocks of suitable murrelet nesting habitat. Because most of the suitable habitat on the Olympic Peninsula is on federal lands and is being managed as Late-Successional Reserves, designated Wilderness Areas, or part of the Olympic Adaptive Management Area, the highest quality marbled murrelet nesting habitat is undisturbed or minimally disturbed by development or human activity. Suitable habitat within these areas is considered essential for the long-term conservation and recovery of the species (USFWS 1997, pp. 131-134). The Dungeness Hatchery is also located adjacent to and near State lands with suitable habitat that are within 40 miles of the coast, and thus are essential to recovery.

Effects of Past and Contemporaneous Actions

The USFWS has previously issued Opinions for actions adversely affecting marbled murrelets in Conservation Zone 1, including earlier actions taken on lands under Olympic National Forest jurisdiction (Olympic National Forest Program of Activities, 2003-2008, USFWS Ref. No. 1-3-03-F-0833; Olympic National Forest Selected Programmatic Forest Management Activities, 2013-2023, USFWS Ref. No. 13410-2009-F-0388). The Upper Dungeness and Gray Wolf Acclimation Ponds occur within the action area. Olympic National Forest programmatic activities that occur or may occur in the vicinity of the acclimation ponds include road maintenance and repair, and campground operation and maintenance (Dungeness Forks Campground near the Upper Dungeness Acclimation Pond). Conservation measures and Terms and Conditions associated with these activities and consultations are intended to minimize disturbance and adverse effects to marbled murrelets. The USFWS determined that these actions were not likely to jeopardize the continued existence of the marbled murrelet, and would not destroy or adversely modify designated critical habitat for the marbled murrelet. Nevertheless, the combined effects of these past and contemporaneous Federal actions have resulted in short- and long-term adverse effects to marbled murrelets and, in some instances, an incremental degradation of the environmental baseline.

The action area includes the existing Dungeness Forks Campground. This is a seasonally-present focus of human activity, and likely represents an area that is subjected to foraging use by corvids. Nest predation by corvids, including crows and jays, is recognized as a significant threat to the marbled murrelet. We expect any marbled murrelets that may be nesting in the vicinity of the Dungeness Forks Campground, and thus the Upper Dungeness Acclimation Pond, are likely encumbered by high rates of nest predation.

EFFECTS OF THE ACTION: Bull Trout and designated Bull Trout Critical Habitat

The effects of the action refers to the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline (50 CFR 402.02). Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur.

Direct effects are those effects from the project that immediately affect bull trout. Indirect effects are those impacts from the projects that are later in time and may occur outside of the areas directly affected by the actions. Indirect effects must be reasonably certain to occur before they can be considered as an effect of the actions. Indirect effects may occur from changes in habitat that affect bull trout ability to use habitat or through other changes such as decreased prey abundance and availability. In this section, we examine the response of bull trout to the various stressors and determine the effects these may have on individual bull trout, the core population, and the Recovery Unit. First we examine the elements of the action to which bull trout will be exposed. Then we assess which actions will result in beneficial effects to bull trout, followed by those aspects with insignificant and/or discountable effects. Lastly, we consider both the direct and indirect effects of actions which will result in adverse effects to bull trout.

Exposure Analysis

Bull trout are found throughout the Dungeness River watershed including the nearshore marine environment. Information on adult movement and distribution is known primarily through the Ogg et al. (2008) study. Spawning and early juvenile rearing occur in the upper watershed, above RM 15.3 (approximately 5 miles upstream from the Dungeness Hatchery). Spawning occurs from September through mid- to late-December in the main channels and side-channels of the Dungeness and Gray Wolf Rivers. Canyon Creek was inaccessible to bull trout until March 2016. We assume that spawning and rearing will now occur here. After spawning, fluvial and anadromous fish move to lower sections of the river to overwinter. Most overwintering (87 percent) occurs between RM 9 and 15.75, although some (13 percent) occurs down to RM 5. Habitat degradation is more severe below RM 9, which may explain the low degree of overwintering downstream from here.

Incubation time and fry emergence time in the Dungeness River are not known, although fry likely emerge from April through July or August. It is generally believed that bull trout fry and subyearlings remain relatively near spawning areas to rear, and that downstream movement does not begin until fish are yearlings or older (McPhail and Baxter 1996, p. 16). Some downstream movement of young juveniles can be expected due to density-dependent displacement and/or displacement from high flow events (Goetz 1989, p. 24-25; McPhail and Baxter 1996, p. 16; Bellerud et al. 1997, p. 36-49; Downs et al. 2006, p. 198). The possible existence of intentional downstream fry or subyearling outmigrations is unknown (e.g., Mesa et al. 2008, p. 71). Limited evidence suggests that Dungeness River bull trout fry and subyearlings do not move or rear far downstream of spawning areas. There are no records or anecdotal accounts of bull trout fry or subyearling-size fish being captured in the WDFW smolt trap near the mouth of the river or being observed in the Dungeness Hatchery water system. Conversely, yearling and larger-size bull trout are routinely captured in the smolt trap and have been observed in the hatchery water system. In the Dungeness River basin, physical habitat conditions and summertime water temperatures become less favorable to young bull trout juveniles downstream from spawning areas. Thus, most or all early juvenile rearing is expected to occur upstream from Canyon Creek, although the possibility of some small degree of early juvenile rearing downstream from here cannot be discounted. Juveniles younger than smolt-aged are believed to remain in the upper watershed near spawning areas, and rear in main channels and side-channels.

Bull trout smolts outmigrate through the lower Dungeness River and into marine waters from mid-March through mid-August, with the peak occurring from mid-May through early- to mid-July (Topping, in litt. 2015a). Adult anadromous bull trout outmigrate to marine habitats primarily from May through August, although some have been observed outmigrating in September, October, and January (Ogg et al. 2008). Distribution in the marine environment is not known. Anadromous adults return to freshwater from July through October based on outmigration timing (Ogg et al. 2008), length of marine residency observed in other studies (Brenkman and Corbett 2005; Hayes et al. 2011), and temporal proximity to known spawning time. WDFW creel surveys from 2003 indicate that bull trout are found in the lower river (at least as low as RM 3.2) through mid-November (Cooper, in litt. 2015). Anadromous and fluvial fish migrate upriver to spawning habitats from mid-July through mid- to late-December (Ogg et al. 2008, p. 23).

This exposure analysis is based on information provided above and in the following sections: Status of the Species; Status of the Species in the Core Area and Foraging, Migration, and Overwintering Area; and, Environmental Baseline.

Beneficial Effects

The conservation-oriented programs operated by the WDFW in the Dungeness watershed for Chinook and pink salmon are expected to provide substantial beneficial effects to bull trout in the long term if they are successful. The 2015 Coastal Recovery Unit Implementation Plan for Bull Trout identifies depressed populations of anadromous salmon and steelhead trout as a primary threat to Dungeness core area bull trout due to the limitation in freshwater forage these depressed populations represent (USFWS 2015b, p. A-17). Abundance of spawning anadromous salmonids has been found to influence abundance, growth rates, and size of bull trout (Kraemer 2003, pp. 5, 9-10; Zimmerman and Kinsel 2010, pp. 26, 30; Copeland and Meyer 2011, pp. 937-938), as well as other species (Bentley et al. 2012; Nelson and Reynolds 2014). Anadromous salmonids provide a forage resource in the form of eggs and freshwater-rearing juveniles, which can make up a substantial proportion of the bull trout diet in freshwater habitats (Lowery and Beauchamp 2015). Spawning fish and carcasses also increase ecosystem productivity, thereby increasing the abundance of aquatic invertebrates and resident fishes (e.g., Cederholm et al. 1999; Moore et al. 2008; Copeland and Meyer 2011; Rinella et al. 2012), which may also provide important components of the bull trout diet (Lowery and Beauchamp 2015). For these reasons, recovered salmon runs are expected to increase growth, survival, and abundance of bull trout populations and therefore strengthen the genetic resiliency of the core area and reduce the risk of extirpation of local populations from stochastic events. Until they are fully successful, the conservation programs for pink and Chinook salmon may have limited benefits, similar to those described below for the steelhead hatchery program.

The production-oriented programs for coho salmon and steelhead trout may provide very limited direct forage benefits to bull trout. In freshwater, only large bull trout (> 500 mm) are likely to consume fish from these programs due to the relatively large body size of the hatchery fish (Keeley and Grant 2001, p. 1126; Lowery 2009, p. 48, 57). In addition, the rapid outmigration of hatchery-released juveniles to the marine environment restricts their temporal availability as bull trout prey in the river. Most hatchery-released coho and steelhead outmigrate to marine waters within 24 hours of release, and nearly all outmigrate within one week. Thus, taken together, hatchery-released coho and steelhead provide a maximum of two weeks of juvenile salmonid prey in the Dungeness River. In nearshore marine habitats, bull trout appear to rely primarily on surf smelt, Pacific herring, and Pacific sand lance for forage, although some salmonids, including coho salmon, may also be consumed (Goetz et al. 2004, p. 101-114). Steelhead trout have not been documented in bull trout diets while in the nearshore (Goetz et al. 2004, p. 101-114).

Hatchery-origin coho adults that stray and spawn naturally are believed to comprise a substantial majority of natural coho production in the Dungeness watershed. Approximately 850 to 2,200 natural- and hatchery-origin adults spawn each year in the Dungeness watershed, based on natural smolt production estimates from WDFW (2015a) and assuming a 50:50 sex ratio and literature-derived (Quinn 2005, p. 254) estimates for fecundity (2,878 eggs per female) and egg-to-smolt survival (1.8 percent). Carcass surveys in 2011 found that the proportion of hatchery origin spawners (pHOS) was 96 percent (Missildine, in litt. 2015). Based on this estimate, 800 to 2,100 hatchery-origin adults per year spawn naturally in the Dungeness River and benefit bull trout by contributing eggs, carcass flesh, and juveniles to the forage base and increasing ecosystem productivity. Juvenile coho salmon can provide a particularly important forage resource to bull trout during important times of the year. Lowery and Beauchamp (2015) evaluated bull trout diets in Illabot and Bacon Creeks, both tributaries to the Skagit River. They found that juvenile coho salmon (fry or age 0+) comprise a substantial majority (79 to 99 percent) of the spring and summer diet for bull trout in the 96 to 300 mm fork length (FL) size range. These findings are important for several reasons:

- The 96 to 300 mm FL size range encompasses pre-smolt-sized fish during the spring growth period. The spring pre-smolt growth period is critical for two reasons: 1) salmonids grow considerably more during the spring than during any other season (Quinn 2005, pp. 200-201, and references therein); and, 2) larger smolt size increases marine survival. This is true for many ages and size classes of salmonids, including those similar in size to bull trout smolts (Quinn 2005, pp. 254-256, and references therein). Thus, in order for juvenile bull trout to maximize their size and marine survival, the spring growth period is essential.

- Growth in streams is often limited by forage abundance. Therefore, abundant forage resources in freshwater rearing areas during the spring pre-smolt growth period are essential for maximizing bull trout smolt survival in the marine environment.

- Metabolic demands and thus food consumption peak during the summer. Although salmonids do not grow as much during the summer as during the spring, abundant forage resources during the summer are important for meeting basic metabolic demands and minimizing starvation, metabolic stress, and associated mortality.

The findings of Lowery and Beauchamp (2015) show that, for up to six months of a given year, including during periods of critical growth and peak metabolic demands, bull trout in coho streams rely on juvenile coho salmon for a substantial majority of their diet.

Bull trout rearing areas in the Lowery and Beauchamp (2015) study streams and the Dungeness River watershed are generally similar in terms of overarching habitat parameters and species composition. The drainage basins are approximately equivalent in terms of size, stream gradients, bankfull widths, and bankfull depths. In all three systems, juvenile bull trout rearing areas overlap spawning and rearing areas for Chinook, pink, and coho salmon, and steelhead and cutthroat trout. Thus, coho salmon fry are not the only forage option in these systems, yet bull trout in the 96 to 300 mm FL size range selectively feed on them during the spring and summer. This is likely due to coho fry's relative abundance, temporal availability, habitat selection, and optimum size for predation by this size class of bull trout. Because there are no significant differences between the Dungeness River and the Lowery and Beauchamp (2015) study streams in terms of species composition or general habitat parameters, we conclude that it is reasonable to apply the findings of the Skagit River study to the Dungeness River.

The steelhead hatchery program is designed to minimize the abundance of hatchery-origin spawners in the wild. Although some straying and natural spawning will occur, this is expected to be minimal, thus providing a very small degree of benefit to bull trout from eggs, carcass flesh, juveniles, and stimulation of ecosystem productivity.

The hatchery may dispose of carcasses of spawned fish, mortalities, or other excess fish by distributing them in the watershed for nutrient enhancement. Watersheds across western Washington, including the Dungeness, experience returns of naturally-spawning salmon that are well below historical estimates. Historically, returns of naturally-spawning salmon delivered large quantities of nutrients to otherwise nutrient-limited aquatic ecosystems. These nutrients, in tandem with other ecological services provided by the spawning salmon (e.g., streambed disturbance, nutrient release and retention, release of aquatic invertebrates and salmon eggs from the substrate), stimulated aquatic ecosystem productivity and supported large populations of resident and freshwater-rearing anadromous salmonids. These services are being provided at very low levels currently due to the relatively low abundances of naturally-spawning salmon and steelhead in the Dungeness River. Distribution of hatchery-origin salmon carcasses in the watershed will help provide some of the functions, albeit likely at relatively minor levels.

Salmon have been noted to transfer contaminants into ecosystems via their carcasses (Ewald et al. 1998; O'Toole et al. 2006). Persistent organic chemicals such as dichlorodiphenyltrichloroethane (DDT) and polychlorinated biphenyls (PCBs) are transferred through the food chain and are retained within the tissues of salmon. Analyses show that as the fish burn fat on their spawning migration, they do not metabolize these pollutants (Ewald et al. 1998). These contaminants, acquired during the salmons' ocean migration, concentrate in their tissues and roe. They are ultimately passed (i.e., bio-transferred) on to the freshwater ecosystem to which the salmon return and are introduced into the food chain.

Because of their trophic position in the food chain, bull trout may bio-accumulate these introduced contaminants more quickly and in greater amounts relative to other salmonids. In mature female bull trout, a proportion of these contaminants could be passed to developing eggs, which could affect their survival rates (Ewald et al. 1998). Over the life of the proposed action, the increase in naturally-spawning fish from supplementation programs and distribution of hatchery-origin carcasses in the watershed may increase contaminant loads within freshwater-rearing fish. Such an increase in contaminants could result in an incremental reduction of fitness for some bull trout and survival rates of their eggs. However, there currently is no evidence to suggest that this is having measurable negative effects to bull trout. In addition, any minor negative effects are outweighed by the substantial and well-documented positive ecological effects of spawning salmonids and carcasses in the watershed. Therefore, we conclude that the effects of increased natural spawners and hatchery carcass distribution will provide a net benefit to bull trout.

Insignificant and/or Discountable Effects

The following effects are anticipated to be insignificant and/or discountable for the reasons described.

Genetic and Ecological Effects to Naturally-reproducing Salmonid Populations

It is generally recognized that hatchery programs and practices may, in some circumstances, suppress the abundance of naturally-reproducing salmon and steelhead populations (e.g., Araki 2008; Naish et al. 2008; Kostow 2009; HSRG 2014, p. 1). This is of concern to bull trout because, as discussed in the preceding section, naturally-reproducing populations of salmon and steelhead often provide a critical forage resource for bull trout. In the Dungeness core area, depressed populations of salmon and steelhead are a primary threat to bull trout due to the resultant limitation in freshwater forage resources (USFWS 2015b, p. A-17). Persistent genetic and ecological hatchery influences that suppress naturally-reproducing salmon and steelhead populations may also suppress growth rates, survival, and abundance of bull trout.

Chinook Salmon and Steelhead Trout

The naturally-reproducing populations of Chinook salmon and steelhead trout in the Dungeness watershed are both listed entities. The Chinook salmon population belongs to the Puget Sound Chinook Salmon ESU, which was listed as threatened in 1999. The steelhead trout population belongs to the Puget Sound Steelhead Trout Distinct Population Segment, which was listed as threatened in 2007. As listed entities under NMFS jurisdiction, the NMFS evaluated effects of the WDFW hatchery programs on these populations (NMFS 2016a; NMFS 2016b). The NMFS concluded that the hatchery programs will not appreciably reduce the likelihood of survival and recovery in the wild of either listed entity. Further, each consultation imposes mandatory Reasonable and Prudent Measures and Terms and Conditions that ensure the WDFW hatchery programs minimize the amount and extent of take of listed, naturally-reproducing Chinook salmon and steelhead trout in the Dungeness watershed. In addition, the NMFS will monitor these activities, and data collected, to ensure that the activities viewed as having potentially negative effects on Chinook salmon and steelhead trout are reduced in effect or adjusted to further reduce effects. The NMFS will also monitor emerging science and information related to interactions between hatchery fish and fish from natural populations and will consider that re-initiation of consultation with the WDFW is required in the event that new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not considered in the existing consultations. For these reasons, we conclude that any effects of the hatchery programs on limiting or suppressing the abundance of naturally-reproducing populations of Chinook salmon and steelhead trout, and by extension the bull trout forage base, are insignificant.

Pink Salmon

Dungeness River pink salmon are not a listed entity, but the very low abundance of returning adults in the 1980s and 1990s resulted in the initiation of a recovery program. The WDFW's pink salmon program is intended to recover self-sustaining, naturally-reproducing pink salmon abundances closer to historical levels. The program is managed and monitored to maintain the natural genetic makeup of the naturally-reproducing population, and to minimize effects of hatchery practices on genetic adaptation to the local environment and survival in the wild. The hatchery program employs techniques found to be successful in other programs for increasing abundance of natural spawners and minimizing deleterious consequences of genetic and ecological effects (e.g., Hess et al. 2012; Fast et al. 2015). These include using only local, naturally-produced fish for each year's broodstock. In addition, pink salmon may be less susceptible to hatchery effects because they are released as fry and spend very little time in the hatchery (Araki et al. 2008, p. 345-346). However, hatchery supplementation is not without its risks, and long-term effects to supplemented naturally-reproducing populations have not been evaluated (Araki et al. 2008). Early indications are that the Dungeness program is helping to boost pink salmon abundance: adult returns have averaged over 22,500 fish per year since the program was implemented in 1997, a substantial increase from the average returns of 440 fish per year from 1981 to 1997 (WDFW 2015b). For these reasons, we conclude that any effects of the hatchery programs on limiting or suppressing the abundance of naturally-reproducing pink salmon, and by extension the bull trout forage base, are insignificant.

Coho Salmon Program

In systems similar to the Dungeness, naturally-rearing juvenile coho salmon are a preferred bull trout prey item that comprise 79 to 99 percent of the spring and summer diet of 96 to 300 mm FL bull trout (Lowery and Beauchamp 2015). Naturally-rearing coho salmon appear to be relatively abundant in the Dungeness watershed based on WDFW smolt trapping data (WDFW 2015a). The current coho salmon population is believed to be a mixed stock with genetic influences from the original endemic population, historical non-native stock introductions, and historical hatchery practices (WDFW 2015b). Preliminary evidence suggests that 850 to 2,200 coho spawn naturally in the Dungeness watershed annually (WDFW 2015a), and that 96 percent of these are returning hatchery-origin fish (i.e., hatchery strays) (Missildine, in litt. 2015). Such a high proportion of hatchery-origin spawners makes it very likely that the other 4 percent of natural spawners are either progeny of hatchery-origin fish themselves, or have been heavily influenced genetically by hatchery-origin fish in their recent ancestry. The abundance of naturally-rearing juvenile coho in the basin is thus currently dictated to a large degree by the abundance of hatchery strays and, by extension, the abundance of smolts released from the hatchery, although interrannual variation in climatic and oceanic conditions also influence year-to-year spawner abundance.

The spring and summer abundance and availability of food resources similar in quality to juvenile coho salmon appear to be low in the Dungeness River watershed. Other populations of anadromous salmonids (chum, Chinook, steelhead trout) are depressed and are not present in large numbers. Chinook salmon abundance may increase during the term of this consultation due in part to the hatchery's recovery program and other watershed restoration efforts. However, Chinook salmon fry emerge from redds earlier in the year than coho salmon, are larger at emergence, and grow faster than coho salmon (Lister and Genoe 1970). Coho and Chinook salmon also occupy different rearing microhabitats when co-occurring, with coho selecting slower, deeper water than Chinook (Lister and Genoe 1970; Taylor 1991). Chinook salmon smolts in the Dungeness River outmigrate primarily as underyearlings, with most leaving freshwater rearing habitats by early July. For these reasons, Chinook salmon fry are likely unavailable to smaller-sized bull trout, are not available for the entire spring-summer period, and are likely not as bioenergetically efficient to prey upon. Pink salmon are also depressed, although their abundance has been increasing in recent years, and abundance may continue to increase due in part to the hatchery's recovery program. However, pink salmon are only abundant during odd-numbered years, and juveniles only available as forage for about a one-month period in mid-spring (Topping and Kishimto 2008, p. 3-25). Therefore, in the Dungeness River watershed, there are no consistently abundant, quality food resources available during the spring and summer other than juvenile coho salmon.

Food abundance is a primary factor determining salmonid abundance in streams (e.g., Grant et al. 1998; Imre et al. 2004). A reduction in prey abundance can be expected to yield a comparable, albeit slightly less (1:0.8 ratio), reduction in abundance of salmonids that rely on that prey (Imre et al. 2004, p. 376, and references therein). For example, a hypothetical 5 percent reduction in the spring and summer forage base would be expected to yield a 4 percent reduction (Imre et al. 2004, p. 376, and references therein) in the end-of-summer abundance of bull trout in the 96 to 300 mm FL size range. In addition, for anadromous salmonids, rapid growth and large smolt size increase marine survival (see discussion in Beneficial Effects section). For example, Ward et al. (1989, p. 1857) found that marine survival of steelhead trout decreased by 9 to 25 percent for each 5 mm reduction in smolt length for fish comparable in size to Dungeness bull trout smolts (130 to 190 mm FL). Zimmerman and Kinsel (2010, p. 48) found that bull trout smolt size in the Skagit River is related to forage resource abundance, as represented by pink and chum salmon spawner abundance (effects of juvenile or adult coho abundance were not considered). These data show that a hypothetical 5 percent decrease in forage resources yields a 0.5 percent decrease in bull trout smolt fork length. This is equivalent to a 1 mm decrease in length for median-size Dungeness River bull trout smolts, and an approximate 4 percent decrease in marine survival based on Ward et al.'s (1989, p. 1857) steelhead data. For these reasons, diminished abundance of naturally-rearing juvenile coho salmon would be expected to limit juvenile bull trout (96 to 300 mm FL) growth, survival, and abundance.

The dominant presence of hatchery-origin (i.e., adipose-clipped and/or coded wire tagged) adults on the spawning grounds precludes reestablishment (natural or otherwise) of a self-sustaining, naturally-reproducing coho population. There is a reasonable certainty that removing or suitably minimizing the persistent genetic and ecological effects imposed by the large annual abundance of highly domesticated hatchery strays on the spawning grounds would, over the term of this consultation, increase survival and abundance of naturally-reproducing coho regardless of their genetic ancestry. This is evidenced by the relative success of naturally-spawning hatchery-origin coho in the watershed, the abundance of resultant smolts, and modelling (HSRG 2014, p. 50) and empirical (Witty 2003, cited in Brannon 2004, p. 24) results that show improved fitness and survival in naturally-reproducing populations previously dominated by hatchery genetic influences. Natural selection processes that act during natural reproduction and rearing would select against deleterious genetic traits acquired during domestication. The genetic make-up of the population would, over generations, reacquire traits better suited to survival in the wild. Natural-origin strays from nearby watersheds may also aid in improving the population's genetic traits, survival, and abundance. Thus, although removing or substantially reducing hatchery strays may result in a short-term decline in juvenile coho abundance (HSRG 2014, p. 50), in the long-term there is a reasonable certainty that a self-sustaining, naturally-reproducing population would fully seed the available habitat. Therefore, we base our analysis of effects to bull trout on any difference in the abundance and distribution of naturally-rearing coho salmon between that provided by the hatchery program and that which would be expected with a naturally-reproducing population.

There are no long-term abundance data for all age classes of naturally-rearing juvenile coho salmon in the Dungeness River. However, the WDFW has operated a smolt trap near the river's mouth in 1998 (Seiler et al. 2003, p. 157), and from 2005 to 2012 (WDFW 2015a). Juvenile coho smolts are primarily one-year-old fish, although some two-year-old fish are typically present. Nonetheless, smolt outmigration estimates provide a reasonable indicator of relative abundance during both the fry rearing stage and pre-smolt outmigration stage. That is, the previous year's fry abundance and current year's pre-smolt abundance are directly correlated with the current year's smolt abundance estimated from trap data. Therefore, we use the smolt trap data as a general indicator of relative abundance of coho fry and pre-smolts.

In the early 2000's, the hatchery reduced coho smolt production (i.e., fish released from the hatchery) from 800,000 to 500,000 smolts per year. Prior to the cut, natural coho production was not monitored, except in 1998 when 28,300 naturally-produced smolts were estimated to have outmigrated (Seiler et al. 2003, p. 157). A natural production estimate for 2001 of 41,600 coho smolts was obtained by extrapolating the 1998 results using an inter-annual variability ratio determined from other nearby streams (Seiler et al. 2002b, p. 7). In 2005, four years after the cut in hatchery production, the WDFW initiated an annual natural smolt production monitoring program. Natural coho production has averaged 33,300 smolts during this time, and has ranged between 22,100 and 57,100 smolts, except in 2015 when production was only 6,000 smolts. These data suggest that natural production may not have changed despite the 38 percent decline in hatchery production, and presumed corresponding decline in natural spawners. If true, this suggests that hatchery-origin coho strays provide enough fish to utilize the available carrying capacity of the watershed. However, there is significant uncertainty associated with this because of the natural variability associated with natural smolt production (e.g., Bradford et al. 1997, pp. 52-53; WDFW 2015a), the fact that only one year of empirical data is available when the hatchery was releasing 800,000 smolts, and the fact that actual natural spawner abundance is not known. Larger data sets than that available for the Dungeness, and more robust analyses, are needed to conclusively evaluate coho carrying capacity in the Dungeness and the extent to which current hatchery production is seeding the available habitat.

Hatchery-origin fish that spawn naturally may concentrate near their release point or the facility where they were acclimated or imprinted on (Quinn 1993; Mackey et al. 2001; Hoffnagle et al. 2008; Dittman et al. 2010; Williamson et al. 2010). This could diminish the abundance and benefits (see discussion in Beneficial Effects section above) of naturally-spawning coho salmon in other areas of the watershed, particularly in areas where juvenile bull trout are rearing in the upper watershed. However, the very limited data available suggests that the carrying capacity for juvenile coho salmon is fully utilized, which suggests that all available coho rearing habitat is utilized, including areas in the upper watershed.

Any limitation in the abundance of naturally-rearing juvenile coho salmon caused by the hatchery coho program would be detrimental to anadromous, fluvial, and resident bull trout. However, for the reasons described above, we conclude that the hatchery coho program does not limit the abundance of naturally-rearing juvenile coho salmon in any area of the watershed where bull trout would be expected to depend on them as a critical forage resource. Therefore, effects of the hatchery coho program on bull trout by limiting the abundance of naturally-rearing juvenile coho salmon are considered insignificant.

Pathogen Risk

Naish et al. (2008, p. 141-149) identify several mechanisms by which salmonid hatchery operations may affect pathogen risk to and disease status of naturally-reproducing or wild fish. Although these risks exist in theory, the authors note that:

> …there are but a few well-documented cases in which hatchery fish have been shown to affect directly the health or infectious disease status of wild stocks. Nevertheless, this remains a considerable area of debate and a major source of scientific uncertainty requiring additional research. (Naish et al. 2008, p. 143)

Many of these risks, including the most severe, are precluded when hatcheries follow good fish health protocols and do not transfer fish to or from distant watersheds (Naish et al. 2008, p. 141-149). The WDFW Dungeness River watershed hatchery programs implement such measures. The hatchery programs are operated in compliance with "The Salmonid Disease Control Policy of the Fisheries Co-managers of Washington State" protocols (WSTIT and WDFW 2006). These are science-based protocols for pathogen prevention, diagnosis, treatment, and control, and corresponding Best Management Practices for hatchery operations and sanitation practices. When implemented, these protocols help contain any pathogen outbreaks at hatchery facilities, minimize release of infected fish from hatcheries, and reduce the risk of fish pathogen transfer and amplification to natural-origin fish (NMFS 2011b). High egg-to-smolt survival rates at the hatchery facilities - as reported in sections 9.1.1 and 9.2.1 of the HGMPs – are an indicator that these protocols are successful at containing disease outbreaks.

Disease and pathogen dynamics between hatcheries and naturally-reproducing fish is not well studied or understood (Naish et al. 2008, pp. 141-149, 166-167). However, the current balance of evidence suggests that hatchery operations managed in accordance with current science-based protocols (e.g., WSTIT and WDFW 2006) do not result in an increased risk of disease and pathogens to bull trout. For these reasons, we conclude that fish pathogen transmission and amplification risks are insignificant.

Discharge of Hatchery Effluent

<u>Assumptions</u>

The following assumptions apply to our analysis of hatchery effluent discharge:

- Hatchery effluent discharge at the Dungeness Hatchery is implemented consistent with NPDES permit number WAG 13-1037 issued by the WDOE.

- Chemotherapeutic agents are used in accordance with Food and Drug Administration and American Fisheries Society guidelines.

- Cleaning agents are used at lowest effective concentrations.

Factors Considered, Species Response, and Risk of Harm or Mortality

Hatchery operations require the use and discharge of surface and well water into streams adjacent to the operating facilities. Hatchery water discharge may affect several water-quality parameters in the aquatic system. Hatchery facility waste products may include uneaten food, fish waste products (i.e., fecal matter, mucus excretions, proteins, soluble metabolites such as ammonia), chemotherapeutic agents (e.g., Formalin), cleaning agents (e.g., chlorine), drugs and antibiotics, nutrients (e.g., various forms of nitrogen and phosphorus), parasitic microorganisms, and algae. Some of these waste products are in the form of suspended solids and settleable solids, while others are dissolved in the water. Water temperature may increase and dissolved oxygen decrease as water flows through hatchery raceways and holding ponds. Maintenance activities, such as vacuuming and removal of accumulated sediment on the bottoms of hatchery ponds and raceways, may temporarily elevate the concentration of some contaminants in the hatchery water system.

Under its NPDES permit, the Dungeness Hatchery operates an off-line settling pond and artificial wetland to remove suspended solids and settleable solids before the water is released back into the Dungeness River. Required monitoring indicates that these measures are effective at substantially minimizing the release of uneaten food, fecal matter, and associated nutrients. The Hurd Creek Hatchery produces less than the threshold of 20,000 pounds of fish per year set by the WDOE as the limit for concern regarding hatchery effluent discharge effects. Nonetheless, the WDFW operates a pollution abatement pond to remove suspended solids and settleable solids before water is released into Hurd Creek. The acclimation ponds on the Gray Wolf River and the Upper Dungeness River have annual fish production levels (1,000 pounds per year) well below those for which a NPDES permit is required. The number of fish being reared in the ponds is relatively small; therefore, the quantity of feces, uneaten food, and other pollutants in the effluent is correspondingly small. In addition, river flow is generally high when fish are being reared in the ponds and effluent is being discharged. Thus, the effluent would be diluted rapidly near the point of discharge. For these reasons, we do not expect suspended solids or settleable solids to measurably degrade or diminish habitat functions such as water quality or prey resources used by individual bull trout.

The existing NPDES permit does not specify discharge levels or monitoring requirements for dissolved oxygen. The Dungeness River in the vicinity of the hatchery is expected to be well-oxygenated because of its rapid and turbulent flow, cold temperature, and absence of any effects or processes - natural or anthropogenic - which would deplete dissolved oxygen. Dissolved oxygen must be maintained within the hatchery at levels sufficient to support rearing fish. Thus, dissolved oxygen is not depleted to levels detrimental to juvenile salmonids. Dissolved oxygen is expected to be rapidly restored very near the point of discharge due to the combined effects of dilution and agitation associated with cold, rapidly flowing water.

The Dungeness hatchery facilities are relatively small, and water is “single use”, meaning that any given volume of water passes through only one raceway or holding pond prior to being discharged. Water temperatures must be maintained within the hatchery facilities at cold enough levels to support rearing juvenile salmon. Thus, temperatures in the hatchery facilities do not rise to levels that are detrimental to juvenile salmonids. The opportunity for warming prior to the water being discharged into the receiving waterbody is also very minor. In addition, the discharge volume is relatively small compared to the volume of the receiving waters. For these reasons, warming is expected to be very minor and the effect of any warming is expected to be ameliorated very near the point of discharge.

Most, if not all, chemicals used at hatcheries are used sporadically and in relatively low volumes. This is particularly true for chemotherapeutic agents, which must be used at levels that will not appreciably affect the fitness or survival of juvenile salmonids rearing at the hatchery. Although potentially more harmful, cleaning agents are also used sporadically and diluted prior to being discharged. Hatchery effluent is anticipated to be rapidly diluted near the point of discharge to the receiving waterbody, but bull trout may detect and be attracted to the effluent. The likelihood of injury to bull trout from exposure to effluent is related to the frequency of occurrence, length of time they are exposed (e.g., how long bull trout remain in the immediate vicinity of the effluent discharge points), and concentration of substances within the effluent water. Due to the sporadic nature of chemical and chemotherapeutic use, and the low concentrations that are commonly achieved at or very near the point of discharge, we expect that deleterious effects to bull trout are minimal.

Bull trout are opportunistic predators that feed on the eggs and juveniles of anadromous salmon and resident fish. They likely locate profitable feeding areas using chemical cues left in the water by their prey. Effluent from the hatchery likely contains relatively high concentrations of these cues, and could serve as a feeding attractant to bull trout, which is rewarded during the time when smolts are released, but may not be rewarded at other times. This “attractive nuisance” effect may keep bull trout from feeding as efficiently as they might if they were responding to feeding cues from natural food resources. Bull trout are regularly documented below other hatchery facilities during the time of year when hatchery fish are released. However, beyond these anecdotal observations, there are no data or evaluations documenting the scope and magnitude of these effects, or the extent to which this phenomenon may be detrimental to bull trout.

Bull trout may be attracted to or deterred from hatchery effluent at various times depending on the exact physical and chemical properties of the effluent, which is determined by numerous factors including, but not limited to, chemicals in use at the hatchery, usage patterns, and volume of rearing fish present. These behavioral responses and the effects of exposure are not well studied, but appear to be minor. Therefore, we conclude that effects to bull trout growth, reproduction, and survival from discharge of hatchery effluent are insignificant.

Dungeness Weir Installation and Removal

This section pertains only to the installation and removal of the broodstock collection weir, not its operation. Installation and removal occurs during a very short time period (no more than a few days) and generates some disturbance from noise (heavy equipment operation) and fine sediment suspension that are localized near the operation. Some bull trout may be migrating during weir installation (juvenile, subadult, and adult outmigration to saltwater) and removal (upstream migrating adults and subadults). These fish may move through the area during non-work periods (i.e., early morning, late day, and at night), and thus may not be exposed to disturbance from the project. For fish that are exposed to project effects, the life history stages of bull trout exposed are adults, subadults, and large juveniles. These fish are highly mobile and able to detect and avoid areas of disturbance. Any bull trout that are in the vicinity will likely avoid the machinery and easily move around or pass through the sediment plume. For those bull trout that pass through the sediment plume, exposure to turbidity is expected to be brief (less than one hour), and is not expected to reach or exceed levels that will measurably affect them. Noise from heavy equipment is not expected to reach levels that would be harmful to bull trout. Therefore, effects to bull trout associated with short-term exposure to elevated levels of turbidity and/or noise are considered insignificant.

Water Withdrawals at the Hurd Creek Hatchery and the Upper Dungeness and Gray Wolf Acclimation Ponds

Hurd Creek provides two primary functions for bull trout: 1) contributes to the forage base by providing spawning and rearing habitat for salmon; and, 2) provides refuge from seasonal turbid, high flows in the Dungeness River (USFWS 2010, p. 19). There are no discharge data for Hurd Creek. However, the 1999 Salmon and Steelhead Habitat Limiting Factors report did not identify any water quantity concerns in Hurd Creek that would affect the quantity of salmon produced from the creek (Haring 1999, p. 113). In addition, water use at the hatchery is non-consumptive and is returned very near the point of withdrawal. Therefore, the amount of refuge habitat available to bull trout is not affected by water withdrawals. Groundwater extraction and discharge into Hurd Creek may provide a small increase in the volume of water in the creek, potentially benefitting bull trout. However, groundwater use has the potential to reduce the amount of cold water delivered to the lower river, although there is no evidence that this has a measureable effect in the Dungeness River. For these reasons, effects of Hurd Creek Hatchery water withdrawal are considered insignificant.

At the Upper Dungeness and Gray Wolf Acclimation Ponds, effects of water withdrawals are considered insignificant because they occur during a time of year when river flows are high and represent a small fraction of flow in the river.

The risk of entrainment and impingement are discountable because all surface water intakes are screened according to NMFS guidelines which prevents entrainment and/or impingement.

Maintenance Activities

This section pertains to all routine maintenance activities at all Dungeness watershed facilities, except for the following operations at the Gray Wolf Acclimation Pond: 1) sediment removal from the acclimation pond water intake; and, 2) relocation, by hand, of rocks and cobble at the head of the side channel that supplies the acclimation pond with water. The excluded maintenance activities at the Gray Wolf Acclimation Pond are included in the Actions Likely to Adversely Affect Bull Trout section, in the subsection entitled Two Maintenance Activities at the Gray Wolf Acclimation Pond.

Maintenance of “watered” equipment and infrastructure (e.g., weir, fish ladders, holding pond, raceways) occurs intermittently and during short time periods. Such maintenance may generate some disturbance from noise (equipment operation) and fine sediment suspension that are localized near the operation. The life history stages of bull trout exposed to these project effects are adults, subadults, and large juveniles. These fish are highly mobile and able to detect and avoid areas of disturbance. Any bull trout that are in the vicinity will likely avoid the machinery and easily move around or pass through the sediment plume. For those bull trout that pass through the sediment plume, exposure to turbidity is expected to be brief (less than 1 hour), and is not expected to reach or exceed levels that will measurably affect them. Noise from heavy equipment is not expected to reach levels that would be harmful to bull trout. Heavy equipment use in the main Dungeness River intake channel would not affect the main channel of the river. Suspended sediment generated from this activity would move into the Agnew irrigation system or into the hatchery settling pond. Therefore, direct effects to bull trout associated with short-term exposure to elevated levels of turbidity and/or noise from maintenance activities are considered insignificant.

Herbicide application is small in scale, follows manufacturer's label guidelines, and occurs during dry weather conditions (i.e., not raining) to prevent runoff into surface waters. Roundup is used around buildings and landscape, which are greater than 300 feet from the river. Rodeo or a similar aquatic-approved herbicide is used around rearing ponds, the adult collection pond, and the surface water intakes. A backpack sprayer is used for all applications. Herbicides are applied once in the spring and then spot sprayed as needed the rest of the summer. On an annual basis, approximately 104 oz. of Roundup is used, and 20 oz. of Rodeo or other aquatic herbicide is used. For these reasons, herbicide applications are considered insignificant.

Other maintenance activities (e.g., building and grounds maintenance, painting, minor building repairs, lighting and fence repair, weeding and mowing) do not occur near water and are not expected to have any adverse effects to bull trout. Maintenance activities that may affect water quality of effluent (e.g., vacuuming and removal of accumulated sediment on the bottoms of hatchery ponds and raceways) are included in the subsection entitled Discharge of Hatchery Effluent above.

Artificial Lighting

Artificial lighting at night is known to attract and concentrate juvenile salmonids and expose them to increased rates of predation. The response of juvenile bull trout to artificial lighting at night is not known. The main hatchery facilities are located downstream from early juvenile rearing areas. In addition, lights at these facilities do not shine on the river. Approximately 20 feet of the adult collection pond outlet channel is lit by lighting over the pond. There is a low possibility of large juveniles being present in this area. There are no lights associated with the acclimation ponds in the upper watershed in early juvenile rearing areas. For these reasons, effects to bull trout from artificial lighting at night are considered insignificant.

Adverse Effects

The following effects are likely to adversely affect bull trout for the reasons described.

Broodstock Collection Infrastructure

Assumptions

Bull trout captured in the Dungeness River weir and off-channel trap will be released back into the river within 24 hours of capture.

Description of Specific Factors Considered

This section pertains only to the presence and operation of the mainstem Dungeness River weir and the Dungeness Hatchery off-channel trap and holding area. Effects of capture and handling associated with these structures and with lower river broodstock collection activities (e.g., gill netting, seining, angling, gaffing) are discussed in the section entitled "Incidental Capture and Handling." Effects of weir installation are discussed in the section entitled "Dungeness Weir Installation and Removal."

Impacts on bull trout can occur as a result of hatchery broodstock collection activities. Of these collection methods, full river-spanning weirs/traps located in the mainstem river or tributary migration areas may have the greatest impact on fish, as they effectively block upstream and downstream migration, and force adult fish to enter a trap and holding area.

The mainstem Dungeness River weir at RM 2.5 is operated annually between May 1 and October 1. This is a seasonal, removable picket-style weir, which does not result in any permanent physical alteration of instream habitat in the Dungeness River. The weir consists of a frame that remains in place during the entire season, and removable pickets (i.e., pipes). Open spaces between most pickets are a width of 0.94-inch. Some pickets are spaced 2.13 inches wide to facilitate upriver migration of adult pink salmon. During normal operation, Monday through Friday, all pickets are in place and the weir is considered in operation. On weekends, the weir is not operated and several sections (panels) of pickets are removed. Removed pickets create four or five openings that are each two to three feet wide, allowing upstream and downstream fish passage. Occasionally the weir must be operated seven days per week when broodstock returns are low. This has occurred approximately five to ten times over the previous five years. During any one year, the weir may be operated up to three non-consecutive weekends. Sixteen bull trout have been documented entering the weir trap: 14 in 2004 (1 on August 4, 5 on November 23, 5 on December 14, and 3 on December 20), and 2 in 2006 (dates unknown).

The anadromous life history form is the primary form affected by the weir due to its presence low in the river system. Anadromous bull trout likely enter freshwater and migrate upriver to spawn during July, August, September, and October. Thus, approximately 75 percent of the upstream migration period is overlapped by the annual weir operation. The weir is configured with a fish trap to capture upstream-migrating adult and subadult fish. Evidence from the Wenatchee River basin, however, suggests that some adult bull trout may avoid or refuse entering weir traps (Kelly Ringel et al. 2014, p. 59). It is not uncommon for other salmonid species to also avoid or refuse entering weir traps. During normal Dungeness weir operation, the maximum migration delay of migrating bull trout that do not enter the weir trap is 5 days. During non-standard (7 day per week) weir operation, bull trout not entering the weir trap will be delayed for a maximum of 12 days.

Anadromous bull trout outmigrate from freshwater overwintering areas to marine habitats primarily during May, June, July, and August. There is no structure at the weir to provide passage of downstream-migrating adult and subadult bull trout. The picket spacing likely prohibits or delays movement of adult and large subadult bull trout until pickets are removed. No body width data are available for bull trout. However, sockeye salmon from the Fraser River are similar in length to adult anadromous and fluvial bull trout in the Dungeness River, and thus serve as a surrogate. These fish measure approximately 2.4 to 2.8 inches in body width (Crossin et al. 2004, p. 797), larger than the maximum 2.13-inch picket spacing. Downstream migrating bull trout will therefore be delayed for up to 5 days during standard weir operation, and up to 12 days during non-standard operation.

The off-channel collection pond at the Dungeness Hatchery is operated from May through March. There are no weirs or diversion structures in the main channel – fish enter the off-channel collection pond volitionally. Bull trout were routinely observed in the pond from 2000 to 2006, although not in every year. Records were not kept prior to 2000. Between 1 and 19 adult bull trout were reported for five of the years, and no bull trout were captured in two others. Forty-five juvenile bull trout were reported captured in 2001. No bull trout have been captured or observed in the pond since 2006. WDFW records show that bull trout were captured during November and December, although date of capture was recorded for only some years. Based on the dates that were recorded, we suspect that adult bull trout captured in the pond were likely post-spawning adults that moved downstream and entered the pond in search of overwintering habitat and foraging opportunities. We suspect that juvenile bull trout recorded in 2001 were larger juveniles or subadults that also moved downstream and entered the pond in search of overwintering habitat and foraging opportunities.

Species Response

Operation of the weir and off-channel pond is not anticipated to measurably alter habitat conditions for bull trout. However, it is anticipated to delay movement and result in incidental capture and handling, which is addressed later in the sections entitled “Incidental Capture and Handling.” The installation and operation of adult traps and fish weirs in the mainstem may block, delay, or otherwise disrupt the upstream and downstream movements and distribution of fish, resulting in a significant disruption of normal behavior, or in some cases a significant impairment of essential behaviors.

The physical presence of a weir or trap in migratory corridors, such as the mainstem Dungeness River can affect salmonids by:

- Delaying upstream migration, which can result in prolonged exposure to elevated water temperatures and spawning in less than optimum locations;

- Inducing spawning in less favorable habitats downstream of the blockage;
- Delaying downstream migration which can result in prolonged exposure to elevated water temperatures and possible reversion to fluvial life history;
- Contributing to impingement, injury, or mortality as fish attempt to pass through or over the weir;
- Injuring or killing fish that attempt to jump over the weir;
- Injuring or killing fish during confinement in the trap; and
- Increasing fish vulnerability to predation through corralling effects at the weir or trap.

Risk of Injury or Mortality

Risks associated with capture and handling are addressed separately. Though the effects described below may not occur in each year, the extended term of this consultation (years to decades) makes it reasonably certain that such effects will occur. Weirs can interfere with and disrupt normal behaviors such as feeding, sheltering, and moving within the river. They can cause delayed or displaced spawning which could kill eggs or fry. They can also cause stress and could injure or kill adult or subadult fish, or cause fish to be concentrated or confined. Concentration, confinement, and injury may subject bull trout to potential predation from mammalian and avian predators. Prolonged exposure to elevated water temperatures can cause stress and could injure or kill adult or subadult fish.

Results of a 2000 to 2004 USFWS adult bull trout radio-tagging study in the Wenatchee River basin (Kelly Ringel et al. 2014) provide information for evaluating effects at the Dungeness River weir. We are not aware of any other studies that have evaluated bull trout migratory delay at weirs or refusal to enter weir traps. The Kelly Ringel et al. (2014) study monitored tagged bull trout behaviors and delay at a weir on the Chiwawa River. Of 20 tagged bull trout that encountered the weir, 1 fish (5 percent) held near the site for a prolonged period (14 days), did not enter the trap, and passed when the weir was not operating (down). Based on this information, we assume that up to 5 percent of migrating bull trout will not enter the Dungeness River weir trap.

Based on available data, the USFWS anticipates that operation of the Dungeness River weir could disrupt normal behaviors of up to all anadromous adult and large subadult bull trout, currently estimated at 27 percent of the entire Dungeness core area population. Based on current abundance, significant disruption of the normal behaviors of up to 81 adult and subadult bull trout annually would occur. Disruptions will be most severe during non-standard weir operation (i.e., 7 days per week), which occurs infrequently. Significant disruptions are also expected to a large proportion of the population during years of standard weir operation (i.e., 5 days per week) and years when both standard and non-standard operation occurs. This is due to the following: 1) the complete overlap of the adult and subadult outmigration period with the annual weir operation window; and, 2) the substantial overlap (75 percent) of the return upriver migration period with the annual weir operation window. During a scenario where only standard weir operation occurs throughout the year, we estimate that 87 percent of all adult and large subadult anadromous bull trout will experience significant disruptions to normal behaviors due to the weir. This assumes unimpaired upstream and downstream passage 2 days per week when the weir is not operating, and 25 percent of returning upstream migrants passing the weir site in October when the weir is not present. During years when standard weir operation occurs for part of the time and non-standard operation occurs for the remainder of the time, between 87 and 92 percent of all adult and subadult anadromous bull trout per year will experience significant disruptions to behavior. At current abundance estimates, this equates to 77 to 81 bull trout per year.

During non-standard weir operation (7 days per week), up to 5 percent of upstream migrating bull trout will be delayed for up to 12 days due to refusal to enter the weir trap. Prolonged migratory delay is likely to result in delayed and displaced spawning. Female bull trout that spawn in suboptimal locations due to delays in migration may subject their offspring to redd displacement or other effects resulting in injury or death of eggs and fry. Through delayed or displaced spawning, we anticipate that the eggs and fry associated with 2 adult female bull trout may be injured or killed. This is based on 75 percent of bull trout returning during the weir operation period, and 5 percent of these refusing to enter the weir trap.

During non-standard weir operation, downstream migrating adults and large subadults will be delayed for up to 12 days because there is no provision for downstream passage while the weir is operating (up). However, these periods are expected to be infrequent, as they have occurred for at most 10 weekends over the previous 5 years. Further, non-standard weir operation will occur for no more than 3 non-consecutive weekends during any one year. We anticipate that, during the period of this consultation, non-standard weir operation will occur no more frequently than this. Also, we expect that most bull trout will resume their seaward migration once standard operations resume. For these reasons, we do not expect non-standard weir operation to result in harm to bull trout from significant impairment of essential behaviors.

We anticipate that up to 2 adult and subadult bull trout may be directly injured or killed while attempting to avoid the weir structure, or as a result of predation caused by delay or injury at the weir. There are no data quantifying the degree to which these types of effects occur at the Dungeness weir, nor at any other similar type of operation. Therefore, the estimate is based on best professional judgment.

The Dungeness Hatchery off-channel collection pond is not expected to affect upstream-migrating spawning adults, or result in delayed or displaced spawning, or injury or mortality associated with fish attempting avoid the structure. Bull trout that enter the pond are expected to be adult, subadult, and large juveniles seeking overwintering habitat and foraging opportunities. Routine hatchery operations suggest that bull trout that enter the pond will likely be removed and placed back in the river within 24 to 48 hours of entrance. Because the collection pond is within the reach of the river where bull trout are known to overwinter, bull trout removed from the pond are expected to locate other suitable overwintering habitat nearby fairly quickly. Although we expect significant disruptions to the normal behavior for fish that enter the off-channel pond, we do not expect significant impairment of essential behaviors. Because no bull trout have been observed in the pond in 9 years, and observations prior to 2007 fluctuated widely from year to year, we anticipate that up to 6 bull trout per year may enter the off-channel pond during the term of this consultation. Effects of captivity and confinement are discussed in the section entitled "Incidental Capture and Handling."

Dungeness Hatchery Surface Water Withdrawals and Diversions

<u>Description of Specific Factors Considered</u>

The Dungeness hatchery water withdrawal contributes to partial dewatering of approximately 4,600 feet of the mainstem Dungeness River (distance between withdrawal and return). During annual low flow (early September through mid-October); the Dungeness Hatchery typically withdraws 10 to 15 cfs of surface water from the mainstem Dungeness River. The hatchery may withdraw up to 40 cfs, in accordance with current water rights. Median annual low flow in the Dungeness River before water withdrawal is 112 to 150 cfs, based on data from 1989 to 2014 (USGS 2014). USGS (2014) gage records indicate that flow drops to 61 to 84 cfs approximately one year out of every four. These episodes have lasted from a few days up to nearly one month, and usually occur in September, October, or November. The typical and potential amount of water that is withdrawn represent a considerable proportion of river flow during median annual low flow and periodic extreme low flow periods. As effects of climate change intensify, median low flow is expected to decrease, and the frequency, intensity, and duration of extreme low flow events are expected to increase.

Bull trout migrate upriver to spawning habitats from July through December. Approximately 48 percent of upstream migrating bull trout - all anadromous fish and 29 percent of fluvial fish (Ogg et al. 2008) - may originate from below the partially dewatered reach. The annual low flow period overlaps 38 to 43 percent of the time period when bull trout are migrating upriver to spawn. Thus, a significant proportion of the population is affected by partial dewatering associated with hatchery water withdrawals. Some adult and subadult bull trout may also migrate downstream to overwintering habitats during this time (Ogg et al. 2008) and be exposed to reduced water flows.

The magnitude of hatchery water withdrawal effects on passage conditions within the partially dewatered reach is not known. Namely, the relationship between river flow and river geomorphology as it relates to low-flow passage conditions is not known for this reach of the river. Fish passage during low flow conditions was identified as a concern for the lower watershed, particularly downriver from the hatchery (Haring 1999, p. 86). The reach affected by hatchery water withdrawals has not previously been identified as an area of concern for other large-bodied salmonids that migrate at a similar time as bull trout. Two factors that appear primarily responsible for fish passage issues in the lower Dungeness River watershed are irrigation diversions (there are five in total) and river bed aggradation. Four of the five irrigation diversions are located downriver from the hatchery. Areas with excessive aggradation are also located downriver from the hatchery (EDPU 2005, pp. 2.8-23 to 2.8-25, and references therein). Therefore, the reach partially dewatered by hatchery water withdrawals is less affected than the lower watershed by the principal causes of fish passage problems in the basin.

Screening at the Dungeness Hatchery intakes are compliant with 1995 and 1996 NMFS guidelines (NMFS 1995; NMFS 1996). Many aspects of the screening are also compliant with updated NMFS (2011a) standards, but some elements may not meet the updated standards (Carlson, in litt. 2015). The WDFW anticipates replacing these intakes with a new one, which will be screened to current NMFS standards, by 2021 (Carlson, in litt. 2015). There is no in-channel diversion structure in the Dungeness River to direct river flow toward the intake channel. Outmigrating bull trout smolts are expected to use the thalweg of the river, which is the fastest, deepest part of the channel. The intake channel is located away from the thalweg. Thus, few if any bull trout smolts are expected to enter the intake channel. Smaller juveniles (e.g., fry and yearlings) are not expected to be exposed because there is no spawning and rearing habitat nearby. For these reasons, we expect that the probability of a bull trout being exposed to the screening and becoming injured as a result of such exposure is discountable.

The siphon line may be used in emergencies such as when the main intake channel becomes clogged with sediment after a flood or with ice during the winter. These are uncommon and rare events. The siphon line has been used approximately once in the previous 25 years. If used for an emergency, the siphon line would only be in short-term (on the order of a few days) use until the clog is cleared by hatchery staff. In addition, the siphon line intake is small (approximately one foot in diameter), and bull trout presence in the immediate vicinity of this intake is extremely unlikely. Emergency siphon line usage is most likely to occur during times of year when discharge in the Dungeness River is high. Therefore, effects to bull trout downstream of the siphon line due to water withdrawal are insignificant. For these reasons, effects of siphon line usage are insignificant.

Species Response

Surface water withdrawals for hatcheries within migration areas can reduce instream flows. If low enough, this can affect salmonids by:

- Delaying upstream migration which can result in prolonged exposure to elevated water temperatures and spawning in less than optimum locations;
- Injury and mortality to eggs and juveniles associated with delayed or displaced spawning;
- Inducing spawning in less favorable habitats downstream of shallow water blockages;
- Contributing to injury or mortality as fish attempt to migrate through very shallow water;
- Contributing to delayed mortality from stress or injury caused by migrating through very shallow water and/or prolonged exposure to elevated water temperatures;
- Increasing fish vulnerability to predation caused by delay, injury, and/or stress.
- Affecting other stream-dwelling organisms that serve as food for bull trout by reducing the amount of quality habitat and through displacement and physical injury to bull trout forage resources.

Risk of Injury or Mortality

Bull trout present in or migrating through the partially dewatered reach could be subject to significant disruption of their normal behaviors caused by reduced flows that will impede movement. Increased stream temperatures may increase stress and depress feeding. We anticipate that diversion of water and reduced flows may disrupt the normal behaviors of up to 38 percent and 43 percent, respectively, of the proportion of the Dungeness and Gray Wolf local populations migrating below the dewatered reach. These percentages are based on temporal overlap of the seasonal low flow period with known migration timing of each local population (Ogg et al. 2008). All anadromous bull trout (27 percent of each local population) migrate below the partially dewatered reach. Twenty-nine percent of fluvial bull trout (21 percent of each local population) migrate below the dewatered reach (Ogg et al. 2008). Based on these proportions and current abundance estimates, as many as 85 adult and subadult bull trout would be affected by hatchery water withdrawals and partial dewatering of the river, resulting in disruption of normal behaviors and non-lethal effects.

If water levels drop too low, more extreme effects to bull trout would occur, including the following: 1) direct mortality from attempting to migrate through very shallow water; 2) injury and delayed mortality from scraping against substrates; 3) injury and mortality from prolonged exposure to elevated water temperature; 4) predation caused by delay or injury; and, 5) injury and mortality to eggs and juveniles associated with delayed or displaced spawning. There are currently no data describing the relationship between river discharge and passage conditions in the partially dewatered reach. Fish passage through this reach has not been identified as a primary concern for other large-bodied salmonids that migrate during a similar time as bull trout and that are larger than bull trout (i.e., Chinook salmon) (e.g., Haring 1999). Therefore, we assume that passage conditions are adequate for preventing mortality, injury, and significant impairment of essential behaviors during low flow conditions in the partially dewatered reach at typical hatchery water withdrawals. However, passage conditions will be degraded because hatchery water withdrawals represent a significant proportion of the rivers flow during median annual low flow and periodic extreme low flow periods. Therefore, we conclude that diminished flows associated with hatchery surface water withdrawals will cause bull trout migratory delays and exposure to elevated water temperature, resulting in significant disruption of normal behaviors and non-lethal effects.

Incidental Capture and Handling

Assumptions

The following assumptions apply to our analysis of incidental capture and handling:

- Capture and handling can result from broodstock collection and fish rescue efforts (e.g., at the Dungeness off-channel adult collection pond).

- Prior to conducting activities that may involve handling fish, personnel ensure that hands are free of harmful and/or deleterious products, including but not limited to sunscreen, lotion, and insect repellent.

- Effects to bull trout from capture and handling will be minimized by maintaining fish in water as much as possible between capture and release, releasing incidentally captured fish as soon as practicable after capture, and holding fish in areas and using equipment that maintains their health and safety.

- Hook-and-line angling equipment will be used with selective gear (i.e., barbless hooks). This does not apply to snagging operations.

<u>Description of Specific Factors Considered</u>

Anadromous bull trout are present in broodstock collection areas. Entry to freshwater and upstream migration likely occurs during July, August, September, and October. Outmigration to marine waters occurs primarily during May, June, July, and August.

The weir is in place annually between May 1 and October 1. Standard operation is five days per week. Several panels are removed during the other two days (weekends), allowing uninhibited fish passage. Occasionally, the weir may be operated seven days per week during times of low broodstock returns. This has occurred 5 to 10 times over the previous 5 years. We assume that, at most, the weir will be operated for up to 3 weekends in any given year. Bull trout captures in the weir trap have been sporadic and few. This may be due to one or more of the following: 1) low abundance; 2) high mortality in the marine environment or downstream of the weir; 3) avoidance of or refusal to enter the weir trap; 4) passage when the weir is not operating (two days per week during normal operation); and, 5) passage through unintended openings in the weir (e.g., scour holes under the weir).

Results of a 2000 to 2004 USFWS adult bull trout radio-tagging study in the Wenatchee River basin (Kelly Ringel et al. 2014) indicate that some bull trout refuse to enter weir traps. We are not aware of any other studies that have evaluated bull trout refusal to enter weir traps. The Kelly Ringel et al. (2014) study monitored tagged bull trout behaviors and delay at a weir on the Chiwawa River. Of 20 tagged bull trout that encountered the weir, 1 fish (5 percent) held near the site for a prolonged period (14 days), did not enter the trap, and passed when the weir was not operating (down). Based on this information, we assume that up to 5 percent of migrating bull trout will not enter the Dungeness River weir trap.

Opportunistic gill netting, seining, gaffing, snagging, noodling, dip netting, and hook-and-line collection is performed in the lower 3.5 miles of the Dungeness River from May through September to collect pink salmon broodstock. Chinook broodstock may be collected using similar means in areas between the Dungeness Hatchery surface water intake and the river mouth, although activities occasionally occur up to RM 15.8. These broodstock collection methods are conducted in a manner that does not result in any substantial alteration of riverine habitat. Gill netting is conducted during the day when bull trout generally are not migrating, and in locations that target species are known to utilize. In addition, gill nets usually used for broodstock collection have a large mesh size (8.5 inch) relative to Dungeness core area bull trout, which minimizes probability of bull trout capture. However, a smaller-mesh gill net (7.5 inch) may also be used, which would increase the risk of bull trout capture.For these reasons, the risk of capture, injury, or mortality from gill netting is very low. To date, no bull trout have been captured during gill netting. However, irregularities in the netting or its deployment, variability in precise location of gill net use, increased frequency of gill net use, and natural variability in bull trout distribution may result in incidental capture of a small number of bull trout.

Gaffing, snagging, noodling, and dip netting are directed at targeted species and individuals only (i.e., fish targeted are specifically selected by sight as broodstock). Bull trout are not expected to be affected by these methods of broodstock collection, other than minor avoidance behaviors to evade personnel. Other broodstock-collection actions, including gill-netting, may also lead to minor, temporary effects on fish movement and distribution.

Angling is not currently employed as a broodstock collection method. However, this method may be used in the future if circumstances warrant its use. As described in the section Adverse Effects: Broodstock Collection Infrastructure above, bull trout may enter the off-channel adult collection pond at the Dungeness Hatchery. Bull trout that enter the pond would be removed using a seine and placed back in the river.

Species Response

All weir and adult trapping and collection actions can stress, injure, or kill fish if improperly designed and implemented. Measures can be implemented to minimize these types of impacts. The netting or capturing, handling, and releasing of bull trout can result in injury by increasing the potential for disease by removing the protective mucus coating on the skin, as well as increasing stress in affected individuals which can cause it to become susceptible to disease (and predators and competitors when released), and it can cause potential direct injury. Death can result if fish are handled roughly or kept out of water for extended periods of time. Bull trout protocols for handling stipulate ways to minimize harm associated with handling fish, which include minimizing handling time, using clean hands free of sunscreen, insect repellent, and other contaminants, and stipulating appropriate types of containers for transferring bull trout.

Bull trout are particularly susceptible to capture by angling. Capture by angling causes exhaustive physical exertion, stress, and injury to the fish. Hooking mortality may occur at the time of capture, or may be delayed. Very limited data exist on hooking mortality for bull trout. Estimates of hooking mortality for salmonids vary widely, from less than 5 percent to 30 percent or more. Capture by angling may also cause temporary alterations in post-release behavior, such as rapid downstream movement.

Handling of fish has some potential to result in injury or death. Mortality may be immediate or delayed. Handling of fish increases their stress levels and can reduce disease resistance, increase osmotic-regulatory problems, decrease growth, decrease reproductive capacity, increase vulnerability to predation, and increase chances of mortality (Kelsch and Shields 1996). Fish may suffer from thermal stress during handling, or may receive subtle injuries such as de-scaling and loss of their protective slime layer. Handling can contribute directly or indirectly to disease transmission and susceptibility, or increased post-release predation. Fish that have been stressed are more vulnerable to predation (Mesa et al. 1994; Mesa and Schreck 1989).

In most cases, handling time required to release captured bull trout will be short, minimizing stress. However, some injury or deaths may occur during the handling and/or transfer process. Adult and subadult bull trout are most susceptible to capture at the weir trap, the off channel adult collection pond, and during gill netting and angling. Adults and subadults are likely to be observed and avoided during certain broodstock collection activities (e.g., gaffing, noodling, dip netting). Juveniles can easily pass through weir pickets and gill net mesh, and are not subject to capture by angling because of gape limitation.

<u>Risk of Injury or Mortality</u>

Impacts that may be associated with capture:

- Physically harming the fish during their capture and retention;
- Harming fish by holding them improperly or for long durations;
- Physically harming fish during handling;
- Increasing fish susceptibility to displacement downstream following release;
- Increasing fish susceptibility to predation following release; and
- Latent effects associated with stress.

Incidental handling of migrating bull trout may result from implementation of broodstock collection actions. Bull trout may be incidentally captured, handled, and released at the mainstem weir and off-channel collection pond. Other broodstock collections may also result in capture and handling.

Capture and handling associated with the weir trap is anticipated to affect up to 56 percent of anadromous adult and large subadult bull trout. At present abundance levels, this equates to 50 adult and large subadult bull trout. This is based on the following: 1) the annual weir operating window spans 75 percent of the adult and subadult upstream migration period; 2) non-standard weir operation is expected to occur for at most 3 weekends in any year; and, 3) 5 percent of bull trout are expected to refuse to enter the weir trap. In addition, we anticipate that up to 6 bull trout may be captured annually in the off-channel collection pond. This is based on the fact that bull trout observations in the pond have been sporadic and few. It also assumes that bull trout numbers may increase during the term of this consultation due to habitat restoration and salmon recovery efforts. Our estimate is based on best professional judgment given these facts and assumptions. We anticipate that the actual number captured will be less during most years. Anecdotal and limited empirical (e.g., Schroeder 1996, p. 10) evidence suggest that immediate mortality (time of capture) associated with weir trap and off-channel pond capture and handling is expected to be very low, approximately 2 percent of the number captured. At current abundance levels, this equates to 2 mortalities per year. There are no anecdotal observations or empirical evaluations of post-release (delayed) mortality of adult salmonids due to capture in weir traps or off-channel ponds. Bull trout captured in the Dungeness River weir trap and off-channel pond are released with very minimal handling. The fish are not anesthetized, marked or tagged, or tissue sampled. For these reasons, we anticipate only 1 percent of captured fish will experience delayed mortality due to capture in the weir trap and off-channel pond. At current levels of abundance, this equates to 1 bull trout mortality per year.

We anticipate that up to 4 bull trout may be captured annually in seines and nets during broodstock collection activities in the river. While no bull trout have been captured to date using these techniques, there is a possibility of capture due to the nature of the techniques and their time and place of deployment. These techniques may also be used more frequently in the future, increasing the probability of bull trout capture. We also assume that bull trout numbers will increase during the term of this consultation due to habitat restoration and salmon recovery efforts. Our estimate is based on best professional judgment given these facts and assumptions. We anticipate that the actual number captured will be less during most years. There are no studies of immediate or post-release (delayed) mortality of bull trout associated with net capture. Immediate mortality of adult salmonids captured in various types of nets is usually low, often less than 5 percent (e.g., Donaldson et al. 2011, p. 138; Donaldson et al. 2012, p. 733; Raby et al. 2014, p. 1810). For post-release mortality, Raby et al.'s (2014) results for adult coho salmon captured in lower Fraser River beach seine fisheries most closely approximate the conditions that Dungeness River bull trout experience (freshwater capture, short time spent in net, immediate release with no tagging). After accounting for natural mortality and effects of tagging, Raby et al. (2014, p. 1813) estimated that post-release mortality associated with capture in beach seines was approximately 17 percent. Applying these estimates to Dungeness River bull trout, we anticipate that 1 net-captured bull trout per year will suffer immediate mortality, and an additional 1 net-captured bull trout per year will suffer delayed mortality.

Angling is not currently used for broodstock collection, but may be used in the future. We anticipate that up to 2 bull trout may be captured annually during hook-and-line angling for broodstock collection and should be released immediately following hook-and-line angling due to the stress of capture. We anticipate that up to 1 of these fish would be injured or killed as a result of this capture.

In total, we have described the capture of 62 individual adult and large subadult bull trout associated with various broodstock collection activities. These captures result in significant disruption of normal behaviors, and non-lethal effects from minor injuries and stress. We have also described associated immediate mortality to 3 adult and large subadult bull trout (2 from weir and off-channel pond, 1 from seining and netting), delayed mortality to 2 adult and large subadult bull trout (1 from weir and off-channel pond, 1 from seining and netting), and immediate or delayed mortality to 1 adult or large subadult bull trout from angling. However, we do not anticipate that all of these mortalities will occur in any one year primarily because many of these estimates were rounded up to the nearest whole number from smaller fractions during our calculations. We anticipate that in total, immediate and delayed mortality will affect 2 bull trout and 1 bull trout, respectively, due to all broodstock collection activities combined on an annual basis.

Two Maintenance Activities at the Gray Wolf Acclimation Pond

The following two maintenance activities at the Gray Wolf Acclimation Pond may result in adverse effects to bull trout: clearing intake screens of sediment depositions, and modifying the streambed to direct flow. These actions result in small-scale habitat modification, substrate disturbance, and temporary increases in turbidity and suspended sediment. Adult and subadult bull trout in the vicinity of these activities are likely to detect disturbance and avoid the areas, eliminating the potential for injury or mortality. These actions occur near spawning and early juvenile rearing areas, but do not contain suitable spawning substrates themselves. Thus, there is no threat of redd disturbance, but post-emergent fry and young juveniles may be residing in interstitial spaces in the substrates. They may suffer lethal or sublethal effects associated with crushing, smothering, and/or suffocation during sediment excavation or manual streambed modification.

<u>Risk of Injury or Mortality</u>

The affected areas are small. The intake screen is approximately 1 foot by 8 feet long, and the area where rocks are manually moved at the mouth of the side channel is approximately 5 feet wide by 8 feet long. Assuming conservatively high estimates of juvenile bull trout rearing densities found in other systems (Johnson et al. 2005, p. 11, 32; Cope 2007, p. 21; High et al. 2008, p. 1692), we expect that no more than 2 juvenile bull trout per year will be killed as a result of crushing or entrainment during sediment excavation and manual substrate alterations to 48 ft^2 of the mainstem and side channel.

Inter-specific Competition and Predation

Although bull trout evolved with and continue to coexist with anadromous salmonids (Ratliff and Howell 1992), hatchery releases of anadromous salmonids from production and recovery programs may impose predation, competition, and other pressures on bull trout that are above previous levels. The expected rapid outmigration of smolts and fry released from the hatchery minimizes the potential for predation and competitive interactions with bull trout. However, the recovery efforts for pink and Chinook salmon may also create some level of interspecific competition between salmon, steelhead, and bull trout for food and space; competition for spawning sites; and the potential for juvenile bull trout predation by salmon and steelhead.

The degree to which hatchery-origin salmonids and their progeny interact with bull trout depends upon their characteristics which include: 1) size; 2) behavior; 3) habitat use; 4) relative abundances; and 4) movement patterns. Interaction potential between salmon and steelhead and bull trout can also depend on habitat structure and system productivity. System productivity determines the degree to which fish populations may be food limited, and thus negatively impacted by limited resources. The type and level of interaction between these fish involve complex mechanisms.

Predation

Large releases of hatchery fish may result in direct predation to bull trout, whereby the hatchery fish themselves consume small bull trout, or indirect predation to bull trout, whereby the large concentrations of released hatchery fish attract predators that prey on bull trout. The magnitude and vulnerability to predation from hatchery releases result from a combination of prey and predator abundance, size of bull trout in relation to the size of the hatchery fish, and feeding habitat of hatchery-origin fish.

There are very few studies of predation on juvenile bull trout by piscivorous fishes. In a study focused on lake trout and northern pikeminnow, Zollweg (1998, p.41) did not observe any juvenile bull trout in the stomachs of 7 rainbow trout (O. mykiss) sampled in the Flathead River, Montana. We are not aware of any other studies that have evaluated predation on juvenile bull trout by the species released from the hatcheries. Bull trout fry are the most susceptible life stage to predation due to their small size. However, they tend to be cryptic and associated with the substrate, which helps them avoid predation. Juvenile bull trout typically occupy different habitats than other, larger salmonids, which is believed to minimize predation risk from these other species (Saffel and Scarnecchia 1995, pp. 312-313, and references therein). Bull trout fry typically remain in close proximity to and within the interstitial spaces of gravel and cobble substrates to a much greater extent than other salmonids (Pratt 1992; Rieman and McIntyre 1993), where the potential for predation by salmon and trout would be limited.

With hatchery-released fish, predation on naturally-produced juvenile salmonids and other fishes is a potential concern when the hatchery fish are large enough to be piscivorous, and when there is spatial and temporal overlap of predator and prey (Naman and Sharpe 2012). In general, salmonids become primarily piscivorous at lengths of 310 mm (Keeley and Grant 2001, p. 1126). At lengths of 198 to 210 mm, about 30 percent of salmonids would be expected to have some fish in their stomachs, but fish would not be a primary component of their diet (Keeley and Grant 2001, p. 1125). Most hatchery releases in the Dungeness, including steelhead trout yearlings, coho yearlings, and Chinook salmon subyearlings, occur downstream of bull trout spawning and early rearing habitat. Hatchery-released pink salmon fry are too small to eat fish. The relatively small size and rapid outmigration of hatchery-released Chinook salmon subyearlings (100 mm FL average) and coho yearlings (140 mm FL average) further minimizes predation potential from these species.

Predation risk to bull trout is greatest from the following: 1) Chinook salmon yearlings released from the Upper Dungeness and Gray Wolf Acclimation Ponds, due to the relatively large size of the released fish and their release location within spawning and early rearing habitat; and, 2) steelhead trout yearlings released from the Dungeness Hatchery that may residualize (remain in freshwater instead of migrating to marine habitat). The size of the hatchery-released Chinook salmon yearlings is such that a minority may consume some fish, but they would not be expected to be primarily piscivorous (Keeley and Grant 2001, p. 1125). Limited field studies in the Dungeness River (Topping and Kishimoto 2008, p. 3-15) and the Green River (Seiler et al. 2002a) have reported that hatchery-released Chinook salmon yearlings in these systems eat very few fish. Two other factors further ameliorate the predation risk to bull trout: 1) the release sites are downstream of the majority of bull trout early rearing habitat; and, 2) nearly all hatchery-released fish outmigrate in a matter of days. For these reasons, we expect only a very small degree of predation from hatchery-released Chinook salmon yearlings.

For hatchery-released steelhead, there are no residualization, movement, or predation data for the Dungeness watershed. A meta-analysis of steelhead hatchery programs (mostly in the Columbia River basin) found that steelhead yearlings residualize at an average rate of 5.6 percent, with a range of 0 to 17 percent (Hausch and Melnychuk 2012). Lower rates were associated with the following: hatchery-derived broodstock; intermediate size of released fish (approximately 213 mm FL); and release relatively near marine habitat. The Dungeness program implements these and other measures to minimize risk of residualization. Based on the annual production goal (10,000 steelhead released), relatively few fish are expected to residualize and remain in the river. In addition, bull trout spawning and rearing areas are 5 miles or more upstream from the steelhead release point at the Dungeness Hatchery. Available information suggests that few residualizing steelhead are likely to move upstream this far (Partridge 1986, p. 29; McMichael and Pearsons 2001, p. 945; Brostrom 2006). For these reasons, we expect only a very small degree of predation from residualized hatchery-released steelhead trout.

Returning adult salmon and steelhead are not known to prey on fish upon entering freshwater habitats. Therefore, the threat of predation to bull trout from returning adult hatchery-origin fish is discountable.

The Chinook salmon recovery program is expected to increase the abundance of naturally-produced juvenile Chinook salmon rearing in the Dungeness watershed. Thus, the risk of juvenile bull trout predation would probably increase over the period of implementation and be greatest after full recovery. However, the magnitude of the effect is unknown, and is expected to be offset by benefits to bull trout from Chinook recovery (see Beneficial Effects section).

Juvenile bull trout behavior and habitat use is likely to limit their exposure to predation. However, we cannot rule out the possibility that some number of bull trout may be eaten by hatchery-origin fish and their progeny. Our anticipation that some bull trout may be eaten is theoretical, and is based on their relative sizes, known piscivory, and partial temporal and spatial overlap at the reach-scale. Based on these factors, and the known locations, sizes, numbers, and behaviors of released hatchery fish, our best professional judgment leads us to conclude that no more than 100 bull trout fry may be consumed per year by hatchery-origin fish and their progeny in bull trout early juvenile rearing areas. The number of bull trout fry that may be consumed is likely lower at the present time. However, the extended term of this consultation and expected increase in abundance of naturally-reproducing Chinook salmon resulting from the recovery program makes it reasonably certain that such effects likely would increase as the population status improves.

Competition

Competition for food and space between anadromous salmonids and bull trout may occur in spawning and/or rearing areas, the migration corridor, and in the marine habitat. Competition may result from direct interactions, in which salmon and steelhead interfere with access to limited resources by bull trout, or indirect interactions, in which utilization of a limited resource reduces the amount available for bull trout.

With regard to potential competition for foraging, overwintering, and rearing habitat, juvenile bull trout prefer colder water and are more-closely associated with the deeper portions of rivers. A substantial degree of overlap in habitat use by juvenile bull trout and anadromous salmonids is not anticipated. In the stream environment, microhabitat selection for water depth, water velocity, and substrate generally differs between juvenile bull trout and other salmonids in at least one category (Keeley and Slaney 1996, p. 7). In addition, bull trout are more closely associated with the channel bottom of streams than other salmonids (Goetz 1989; Pratt 1992; Rieman and McIntyre 1993). For these reasons, substantial competitive interactions between anadromous salmonids and bull trout in stream environments are likewise not anticipated.

For recovery programs (Chinook and pink salmon), the frequency and severity of competition, if it occurred, would probably increase over the recovery period, being greatest after full recovery. Adverse competitive interactions between the species could result if salmon populations increased such that they were forced to use habitats marginal to those species, but preferred by bull trout. This risk is considered greatest in the mainstem river. However, because of niche partitioning and historical co-existence of these species in the river basin, we do not expect this potential competitive interaction for food and space to significantly affect bull trout in the Dungeness core area.

The hatchery supplementation program for pink salmon is for the fall run, which spawn in the lower river away from bull trout spawning habitat. Therefore, hatchery-origin pink salmon and their progeny will not compete for spawning habitat or affect bull trout redds by superimposition.

There is some broad-scale spatial overlap of reaches where bull trout spawn and where Chinook and coho salmon and steelhead trout spawn in the Dungeness River watershed. On average, bull trout select different water depths and velocities to spawn in than other salmonids, although the range of depths and velocities that these species may spawn in overlap (Keeley and Slaney 1996, p. 12). In the Dungeness River watershed, bull trout start spawning after Chinook salmon, and continue to spawn after Chinook spawning is concluded. Chinook salmon are also substantially larger than bull trout, and are thus expected to spawn in larger substrates than bull trout.

Winter steelhead spawn later in the season than bull trout; therefore, there is no threat of spawning ground competition. In addition, hatchery practices are intended to minimize natural spawning by hatchery-origin steelhead trout by: 1) keeping them acclimated to the hatchery; 2) keeping the adult collection pond open to remove early, peak, and late returning hatchery steelhead; and, 3) not producing excessive numbers of fish. Spawner surveys suggest that no more than 46 hatchery-origin steelhead per year spawn in the Dungeness River watershed. Steelhead spawner distribution is broad, encompassing upper watershed reaches where bull trout spawn, as well as lower watershed mainstem habitats. In addition, hatchery-origin fish that spawn naturally generally do so near their release point or the facility where they were acclimated or imprinted on, usually a hatchery or acclimation pond (Quinn 1993; Mackey et al. 2001; Hoffnagle et al. 2008; Dittman et al. 2010; Williamson et al. 2010). Hatchery practices that minimize straying distance include using hatchery-origin broodstock, and releasing smolts from the same location where they were reared as juveniles. The Dungeness steelhead program implements both of these measures. Mackey et al.'s (2001) results for steelhead trout in a Willapa River, Washington tributary most closely approximate the Dungeness steelhead program (same species, hatchery-derived broodstock, reared and released at same location). They observed that 75 percent of hatchery strays stayed within 1 mile of the point where they were released as smolts. In the Dungeness River watershed, bull trout spawning habitat is approximately 5 to 13 miles upriver from the hatchery steelhead rearing and release point (i.e., the Dungeness Hatchery). Thus, few hatchery-origin steelhead are expected to spawn in bull trout spawning reaches.

Coho salmon spawn at approximately the same time as bull trout in the Dungeness River watershed. Coho spawner distribution is broad, encompassing upper watershed reaches where bull trout spawn, as well as lower watershed mainstem and tributary habitats. Coho have been observed to stray more than steelhead (Shapovalov and Taft 1954, cited in Quinn 1993, p. 31). Although coho and bull trout may spawn in the same reaches, there is very little overlap in spawning microhabitat selection between the two species (Keeley and Slaney 1996, p. 12). Coho salmon were reported superimposing on a small number of bull trout redds in a tributary of the upper Lewis River. However, this is a small stream, no more than a few feet wide, which may be forcing these two species to spawn in the same very limited habitats. Bull trout spawning reaches in the Dungeness River are significantly wider and more diverse, which may limit the applicability of the Lewis River observations.

Because there is overlap in reach-scale spawning habitat selection between bull trout and hatchery-reared species (Chinook and coho salmon, and steelhead trout), there may be some competition for spawning habitats, destruction of bull trout redds via superimposition, and loss of deposited eggs. However, we expect these losses to be small, affecting no more than 2 redds per year, based on our best professional judgment considering the following: much broader spawner distribution of the hatchery-reared species; lower-watershed imprinting and release of hatchery-released pink salmon, coho salmon, and steelhead trout; absent to minor degree of overlap in spawner microhabitat selection; and, the abundance of hatchery releases.

Effects to Bull Trout Critical Habitat

PCE 1: Springs, seeps, groundwater sources, and subsurface water connectivity (hyporheic flows) to contribute to water quality and quantity and provide thermal refugia.

Bull trout do not tolerate prolonged exposures to temperatures above 16 °C (Poole et al. 2001, p. 5). However, bull trout are known to migrate through areas with higher stream temperatures by utilizing thermal refugia, such as a confluence with a cold water tributary, deep pools, or locations with surface and groundwater exchanges. Cold water refugia are critical for bull trout, especially during the summer when adults are migrating to upstream spawning grounds.

This proposed action is anticipated to affect these sources of water for bull trout critical habitat due to groundwater withdrawals for the Hurd Creek Hatchery. The hatchery wells are within 1,000 ft of the river and withdraw groundwater from a shallow aquifer in an area with high horizontal connectivity and where there is substantial exchange of surface and groundwater (Thomas et al. 1999, pp. 52-53, 75-79). Instream flow in the lower river may get as low as 50 to 60 cfs during seasonal low flow periods. Given the magnitude of the withdrawal relative to flows, the 4.5 cfs hatchery groundwater withdrawal likely reduces the amount of flow to the river through hyporheic or other mechanisms. Effluent discharges from the facility return water removed from the wells to the river via Hurd Creek, affecting an approximately 1,800-foot reach of the Dungeness River. Temperature of the effluent water returning to the river is expected to be warmer than groundwater due to solar exposure and residence time in the facility and in Hurd Creek. Because the action may affect groundwater sources in the Dungeness River, effects to this PCE are considered adverse. We anticipate the effects will be long term for the life of the project. The effects to this PCE will diminish, but not prohibit, the PCEs ability to function.

PCE 2: Migration habitats with minimal physical, biological, or water quality impediments between spawning, rearing, overwintering, and freshwater and marine foraging habitats, including but not limited to permanent, partial, intermittent, or seasonal barriers.

Operation of the Dungeness River weir results in a temporary barrier to bull trout migration. Bull trout are temporarily precluded from both upstream and downstream passage when the weir is operational until the fish are either physically removed from the collection trap and released back into the river, or weir panels are removed, which occurs on most weekends. The weir is a full channel-spanning structure that is in place during the known adult outmigration period, and the presumed return upriver migration period. As a consequence, the weir creates a physical barrier to bull trout between spawning, rearing, overwintering, and freshwater and marine foraging habitats. The migratory function of this PCE is temporarily impaired as bull trout are permitted to continue their movement within a short period of time, no more than 24 hours for upstream migrating fish that enter the trap, and usually no more than 5 days for upstream migrating fish that do not enter the trap and for downstream migrating fish. For upstream migrating fish that do not enter the trap and for downstream migrating fish, migration will be delayed indefinitely during the occasional times when the weir must be operated seven days per week during periods of low broodstock returns. The weir will significantly affect the function of this PCE by temporarily impairing upstream and downstream migration of bull trout. The effects to this PCE from the operation of the weir are considered adverse.

Dungeness hatchery surface water usage is non-consumptive; however, the withdrawal affects a 4,600-foot reach of the river (distance between point of withdrawal and point of discharge). During seasonal low-flow periods, the hatchery water withdrawal represents a reduction in the volume of water in the channel and a resultant degradation in passage conditions through this partially dewatered reach. Adult and subadult bull trout migration periods partially overlap these seasonal low-flow periods. Bull trout migration may be delayed and made more strenuous due to the challenges of navigating riffles that are shallower than they otherwise would be without the water withdrawals. For these reasons, the effects to this PCE are considered adverse. However, the effects to this PCE are temporary (only occurring during seasonal low-flow periods), and passage is not precluded. The effects to this PCE will diminish, but not prohibit, the PCEs ability to function.

PCE 3: An abundant food base, including terrestrial organisms of riparian origin, aquatic macro-invertebrates, and forage fish.

The Chinook and pink salmon recovery programs are expected to increase the abundance of natural spawners of these species. Increased abundance of natural spawners will increase availability of eggs and juveniles, which are important forage resources for bull trout. In addition, spawners and carcasses are expected to increase aquatic ecosystem productivity, abundance of macroinvertebrates, and abundance of resident fishes. These also provide important forage resources to bull trout. Thus, these programs are expected to result in a significant benefit to this PCE in the long term.

The steelhead trout program will provide a direct, albeit small and temporally limited, forage resource to bull trout. Hatchery-origin steelhead may negatively affect fitness and abundance of naturally-reproducing steelhead populations, which may provide an important forage resource to bull trout. However, the NMFS reviewed the steelhead program and determined that it will not appreciably reduce the likelihood of survival and recovery of the naturally-reproducing population. In addition, the NMFS is imposing mandatory Terms and Conditions and will monitor the hatchery program and emerging science to ensure that the naturally-reproducing population is not significantly harmed by the hatchery program. Thus, effects of the steelhead trout program on this PCE are expected to be insignificant.

Limited evidence suggests that the coho salmon program provides an equivalent abundance of naturally-spawning adults and naturally-rearing juveniles as would be expected with a self-sustaining naturally-reproducing population. We expect this to continue under the proposed program. Thus, the effects to this PCE from the coho program are considered insignificant.

PCE 4: Complex river, stream, lake, reservoir, and marine shoreline aquatic environments, and processes that establish and maintain these aquatic environments, with features such as large wood, side channels, pools, undercut banks and unembedded substrates, to provide a variety of depths, gradients, velocities, and structure.

The proposed action would not affect the complexity of habitats within the river or nearshore marine environments.

PCE 5: Water temperatures ranging from 2 to 15 degrees Celsius (°C) (36 to 59 degrees Fahrenheit (°F)), with adequate thermal refugia available for temperatures that exceed the upper end of this range. Specific temperatures within this range will depend on bull trout life-history stage and form; geography; elevation; diurnal and seasonal variation; shading, such as that provided by riparian habitat; streamflow; and local groundwater influence.

As mentioned for PCE 1, the hatchery actions are expected to affect groundwater sources of water for bull trout habitat in the Dungeness River. The hatchery wells are within 1,000 ft of the river and withdraw groundwater from a shallow aquifer in an area with high horizontal connectivity and where there is substantial exchange of surface and groundwater (Thomas et al. 1999, pp. 52-53, 75-79). Instream flow in the lower river may get as low as 50 to 60 cfs during seasonal low flow periods. Given the magnitude of the withdrawal relative to flows, the 4.5 cfs hatchery groundwater withdrawal likely reduces the amount of flow to the river through hyporheic or other mechanisms. Effluent discharges from the facility return water removed from the wells to the river via Hurd Creek, affecting an approximately 1,800-foot reach of the Dungeness River. Temperature of the effluent water returning to the river is expected to be warmer than groundwater due to solar exposure and residence time in the facility and in Hurd Creek. Because effects of the proposed action would be expected to significantly increase the water temperature, the effect to this PCE is considered adverse. We anticipate the effects will be long term for the life of the project. The effects to this PCE will diminish but not prohibit the PCEs ability to function.

Surface water withdrawals at the Dungeness Hatchery may result in increased water temperatures in the partially dewatered reach. However, the withdrawn water is reintroduced to the river 4,600 feet downstream of the withdrawal with what we anticipate is minimal temperature increase through the hatchery. In addition, the introduction of Canyon Creek water, both at its mouth in the Dungeness River and in the hatchery effluent, is expected to at least partially offset temperature increases due to the hatchery water withdrawal. For these reasons, effects to this PCE from the Dungeness Hatchery surface water withdrawal are considered insignificant.

PCE 6: In spawning and rearing areas, substrate 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 sediment, generally ranging in size from silt to coarse sand, embedded in larger substrates, is characteristic of these conditions. The size and amounts of fine sediment suitable to bull trout will likely vary from system to system.

Most hatchery structures and activities are several miles or more downstream from spawning and rearing areas. The acclimation ponds are in the upper watershed where spawning and rearing habitat are located. Certain maintenance activities at the Gray Wolf rearing pond may temporarily release sediment into the water column which may settle downstream. However, these effects will be infrequent and very short in duration. Effects to this PCE are thus considered insignificant.

PCE 7: A natural hydrograph, including peak, high, low, and base flows within historical and seasonal ranges or, if flows are controlled, minimal flow departure from a natural hydrograph.

The proposed action includes removal of surface water from the Dungeness River and Canyon Creek, and the discharge of hatchery effluent into the river. The surface water diversions will result in changes in water quantity, especially during periods of low flow in the river. Water is eventually discharged back into the river; therefore, any effects to the river are limited in area and duration. However, we anticipate that due to these diversions, the effects to water quantity will be measureable between the diversion sites and the point where it reenters the river. Therefore, the effects to this PCE are expected to be adverse.

PCE 8: Sufficient water quality and quantity such that normal reproduction, growth, and survival are not inhibited.

An insignificant decrease in water quality may result from effluent discharges into the Dungeness River from the hatchery facilities due to small, localized concentrations of hatchery chemicals and other pollutants in the effluent, slightly reduced dissolved oxygen levels, and slightly elevated temperature. These effects will not be measurable beyond a very small area at the point of discharge. Surface water diversions to the Dungeness Hatchery are expected to result in changes to water quantity, especially during periods of low flow in the river. Water is eventually discharged back into the river from the hatchery; therefore, any effects to the river are limited in area and duration. However, we anticipate that due to these diversions, the effects to water quantity will be measureable between the points of diversion to the point where it reenters the river. Therefore, the effects to this PCE are expected to be adverse.

PCE 9: Sufficiently low levels of occurrence of nonnative predatory (e.g., lake trout, walleye, northern pike, smallmouth bass); interbreeding (e.g., brook trout); or competing (e.g., brown trout) species that, if present, are adequately temporally and spatially isolated from bull trout.

The hatchery structures and activities are not expected to affect this PCE.

Summary of the Effects of the Action

Summary of Effects to Bull Trout

<u>Effects to Individuals</u>

If successful, the Chinook and pink salmon recovery programs are expected to confer significant benefits to bull trout due to increased forage resources and aquatic ecosystem productivity. The hatchery coho program provides naturally-spawning adults and naturally-rearing juveniles at abundances that are equivalent to a self-sustaining naturally-reproducing population. The hatchery steelhead trout program is not expected to negatively influence the naturally-reproducing population. Therefore, effects to forage resources associated with the hatchery programs are considered insignificant and beneficial.

Bull trout are likely to be captured using a variety of methods, but most bull trout captures are anticipated to occur at the weir. A small number of bull trout may be injured or killed during or following broodstock collection at the weir, the adult collection pond, or below the weir during gill netting.

Some bull trout may have their normal behaviors disrupted by the presence of the weir or entrance into the adult collection pond. Because such disruptions will usually be short in duration, these effects will not be so severe as to kill bull trout or have long-term effects on those individuals, although they may be exposed to increased predation risk in some areas. During times when the weir is operating seven days per week, upstream migrants that do not enter the weir trap, and downstream migrants (due to lack of passage capability at the weir) will be most severely affected. A small number of bull trout are reasonably likely to experience indirect effects from delayed or displaced spawning due to the presence of the weir. Delays in reaching preferred spawning areas may reduce the likelihood of successful reproduction or may reduce the number or viability of offspring. Partial dewatering of the Dungeness River near the Dungeness Hatchery may also disrupt normal bull trout behaviors and expose them to injury and/or elevated predation risk, particularly during periods of extreme low flow.

Bull trout are reasonably likely to experience indirect effects from salmonid spawning due in part to the long period of time that the proposed actions will occur and the even longer period of time over which the effects may manifest themselves. The probability of any particular bull trout redd being displaced by salmon spawning or other effects of inter-species competition is low. However, over the period analyzed in this consultation it is reasonably certain that such displacement and/or other effects will occur because bull trout and species of hatchery-origin salmonids spawn in the same reaches of the river, numbers of bull trout may increase, and numbers of other salmonids spawning may increase.

Some mortality to eggs and small juveniles (e.g., fry) are expected as a result of predation, competition for spawning sites, and redd superimposition from hatchery-origin salmonids and their progeny. This is expected to be offset by benefits to bull trout provided by hatchery-origin salmonids and their progeny, namely increases in bull trout growth, survival, and abundance. A small number of juvenile bull trout are expected to be killed at the Gray Wolf Acclimation Pond during substrate- and sediment- moving maintenance activities that occur annually or less frequently.

Quantification of Affected Bull Trout

Table 2 provides a summary of the number of bull trout expected to be negatively affected. We anticipate that normal behaviors of 81 adult and subadult bull trout may be disrupted on an annual basis as a result of the weir, and normal behaviors of 85 adult and subadult bull trout may be disrupted on an annual basis as a result of surface water diversion and partial dewatering. Approximately 56 percent of the fish exposed to effects from partial dewatering are anadromous fish that are also exposed to effects of the weir. Therefore, the total number of bull trout anticipated to be disrupted each year is less than the sum of all estimates. In total, we estimate that up to 119 adult and subadult bull trout could be affected by sub-lethal disruption of normal behaviors on an annual basis.

We anticipate that up to 62 adult and subadult bull trout may be captured annually due to broodstock collection activities (50 at the weir, 6 in the off-channel adult collection pond, 4 seine and net, and 2 from hook-and-line). We anticipate that up to 2 adult or subadult bull trout will be injured or killed attempting to avoid the weir structure or as a result of predation at the weir. In addition, as a result of capture, captivity, confinement, and handling, we anticipate the potential immediate mortality to 3 adult and large subadult bull trout (2 from weir and off-channel pond, 1 from seining and netting), delayed mortality to 2 adult and large subadult bull trout (1 from weir and off-channel pond, one from seining and netting), and immediate or delayed mortality to 1 adult and large subadult bull trout from angling. However, we do not anticipate that in any one year all of these mortalities will occur. We anticipate that capture, captivity, confinement, and handling from all broodstock collection activities combined will result in immediate mortality to

2 adult and large subadult bull trout annually, and delayed mortality to 1 adult and large subadult bull trout annually. All sources of mortality combined are expected to affect up to 4 adult and subadult bull trout annually because we do not anticipate that in any one year all sources of mortality to occur to the full extent.

We anticipate that the 62 bull trout captured and 4 bull trout killed will be included in the 119 exposed to nonlethal disruption of normal behaviors. Therefore, a total of 119 adult or subadult bull trout will be subject to capture, injury, death, or disruption of normal behaviors.

We anticipate two sources of injury and mortality to eggs and fry of adult female bull trout:

1. delayed or displaced spawning and capture stress associated with the weir could result in injury or mortality of eggs and fry associated with up to 2 adult female bull trout annually; and,

2. interspecific competition and superimposition of redds on spawning grounds associated with stray hatchery fish in the watershed could result in injury or mortality of eggs and fry associated with up to 2 adult female bull trout annually.

We do not anticipate both sources of injury or mortality to eggs and fry to occur to the full extent each year. Instead, we anticipate that all sources of injury or mortality will affect eggs and fry of no more than 2 adult female bull trout annually.

We anticipate that up to 100 juvenile bull trout will be killed annually as a result of predation from hatchery-origin salmonids or their progeny. In addition, up to 2 juvenile bull trout per year will be killed or injured as a result of sediment moving activities at the Gray Wolf Acclimation Pond.

Table 2. Summary of estimates for annual adverse effects anticipated to occur to bull trout as a result of the WDFW Dungeness River watershed hatchery programs.

Action / Stressor	Non-lethal Disruption [1]	Indirect Effects / Impairment	Non-lethal Capture [1]	Injury / Death [1]
Broodstock Collection Infrastructure				
Weir	81	2[2]		2
Dungeness Hatchery Surface Water Withdrawals and Diversions				
Partial dewatering	85			
Incidental Capture and Handling				
Weir			50	
Collection pond			6	
Weir & collection pond				2 immediate, 1 delayed
Seine / net			4	1 immediate, 1 delayed
Hook-and-line			2	1 immediate or delayed
Two Maintenance Activities at the Gray Wolf Acclimation Pond				
Sediment moving				2 juveniles

Action / Stressor	Non-lethal Disruption [1]	Indirect Effects / Impairment	Non-lethal Capture [1]	Injury / Death [1]
Inter-species competition and predation				
Predation				100 juveniles
Redd superimposition		2[2]		
Total	119[3]	2[2,4]	62	4 adults and subadults[4] 102 juveniles

1 Estimates provided are individual adult and subadult fish, unless indicated otherwise.
2 Estimates provided are number of adult spawning females for which effects would occur to their eggs and/or fry. This may include 1,000 to 10,000 eggs or fry per spawning female.
3 Approximately 56 percent of the fish exposed to effects from partial dewatering are anadromous fish that are also exposed to effects of the weir. Therefore, the total number of bull trout anticipated to be disrupted each year is less than the sum of all estimates.
4 Because individual mortality is not likely to occur each year for each effect, the total number of bull trout anticipated to be killed each year is less than the sum of all estimates.

Effects to Dungeness River Local Populations

The effects to individuals are not expected to have measureable effects on Dungeness River local populations because a small number of individuals are expected to be affected and the anticipated beneficial effects of the proposed action, particularly the Chinook and pink recovery programs, on the Dungeness River local populations are expected to at least partially offset these negative effects. We anticipate the potential loss of up to 4 individual adult or large subadult bull trout, 102 juvenile bull trout, and eggs and fry from 2 redds on an annual basis. The salmon recovery programs are expected to enhance the bull trout forage base thereby increasing growth, survival, and abundance of bull trout. For these reasons, we do not anticipate any decline in the abundance, reproduction, survival, or distribution of bull trout at the scale of the local populations as a result of the overall net effects of the hatchery facilities and operations. Furthermore, we do not anticipate any long-term changes in habitat or function as a result of this proposed action that would affect the numbers, reproduction, survival, or distribution of individual bull trout at the scale of the local population.

Effects to Dungeness River Core Area

Because there are no net effects to bull trout at the scale of the local populations, there are also no effects to bull trout at the scale of the core area.

Summary of Effects to Bull Trout Critical Habitat

Adverse effects are anticipated for PCEs 1, 2, 5, 7, and 8. The weir represents an impediment to adult and large subadult bull trout migration, particularly to downstream migrating bull trout and during periods of 7-day-per-week operation. Surface water diversions during summer low flows will decrease instream flows and have direct effects to critical habitat. In addition, diversion of surface water may increase instream temperatures due to the reduction in flow. The Chinook and pink salmon recovery programs, if successful, are anticipated to increase the forage base for most size classes of bull trout. The coho program provides naturally-rearing juvenile coho salmon - a critical forage resource for some size classes of bull trout - at similar abundances as a naturally-reproducing population. Removal of water from wells may influence groundwater delivery to the lower river. The degree to which this will affect critical habitat is uncertain, but the potential exists for exacerbating summer low flows and instream temperature. None of the hatchery activities will preclude the ability of the PCEs to continue to function; however, some may be impaired.

EFFECTS OF THE ACTION: Marbled Murrelet

Exposure Analysis

Hatchery activities do not involve tree removal and thus would not reduce the amount of available suitable nesting habitat for marbled murrelets. Hatchery activities are entirely ground-based with a defined disturbance threshold of 333 feet (see discussion below). Human activity in these areas during the winter and early spring, including the very beginning of the nesting season, is relatively low. The Dungeness Forks Campground does not open until May, and there is very low recreational use of the area surrounding the hatchery and acclimation ponds until the campground opens and the weather improves.

Because they nest on platforms or branches high in the trees, adverse effects to marbled murrelets will be difficult to detect. Marbled murrelets are cryptic, nest locations are rarely located, and available satellite data, aerial photos, and ground-based observations suggest a patchy and inconsistent distribution. Thus, we are relying on habitat area as a reasonable surrogate to measure and indicate where adverse exposures and effects to nesting marbled murrelets are foreseeable and reasonably certain to occur.

Based on our review of the available science and studies regarding disturbance to nesting birds in the forested environment, we have established distance thresholds for a wide variety of activities that result in visual disturbance and elevated sound levels that cause adverse effects to marbled murrelets if they are conducted during the nesting season. In our Opinion evaluating the effects of forest management activities on the Olympic National Forest (USFWS Reference 13410-2009-F-0388, dated March 25, 2013), increased levels of sound and human activity can disrupt normal nesting behaviors (e.g. flushing, delayed or missed food deliveries). The information provided in Table 2 of that Opinion (p. 6) lists a variety of activities that would either not effect, could cause disturbance or are likely to result in adverse effects, depending on the time of year they are conducted and distance to suitable habitat. Activities conducted at hatcheries or acclimation ponds (use of heavy equipment, generators, chainsaws or other loud machinery) or human activities conducted within 333 feet of suitable habitat where marbled murrelets may be nesting could cause sound and visual disturbance sufficient to result in a flushing response and/or temporary inattention to the nest. The USFWS expects that these exposures would, under a reasonable worst-case scenario, interrupt the brooding of eggs or chicks, and/or the regular feeding of chicks, at one or more locations. These temporary exposures will significantly disrupt marbled murrelet nesting behaviors and creates a likelihood of injury. However, the USFWS expects that most temporary exposures will not lead to nest abandonment or failure because most exposures will be low-level (both pond sites), obscured by noise from nearby flowing rivers (both pond sites), and short duration per exposure (Gray Wolf).

Marbled murrelets that may be nesting in the action area at distances greater than 333 feet from the project activities will be exposed to lower levels of noise or visual disturbances that may result in only minor behavioral responses, such as head-turning or increased vigilance for short periods (USFWS 2003, p. 274). These minor behavioral responses are considered to have insignificant effects to nesting marbled murrelets.

Insignificant and/or Discountable Effects

Operations at the Hurd Creek Hatchery generally occur between the hours of 8 am to 5 pm. This facility is located very low in the watershed and is within 400 feet of small patches of marginal suitable habitat for marbled murrelet (Raphael et al. 2015). These patches are a small component of the landscape, which is dominated by rural residential uses, agricultural fields, and rural roads. Sound levels from routine hatchery activities are very similar to the surrounding residential and agricultural noise and will not exceed background levels in the adjacent forest stands.

Although some elevated sound levels associated with routine hatchery activities could extend into marginally suitable habitat, based on the location and marginal condition of the habitat, it is extremely unlikely that the stands adjacent to these facilities are used by marbled murrelets for nesting. In addition, this facility has existed in its current locations for over 30 years, human presence and activities occur year round, and activities have not changed and are not expected to change during the term of this consultation. Given the setting (rural residential, agricultural), we expect that any nesting marbled murrelets in the vicinity of the hatchery have chosen to nest here despite the human presence, activities, and associated noise. Therefore, we anticipate that any marbled murrelets that might be nesting in the forested areas adjacent to the facility likely are accustomed and acclimated to the low-level noises and other disturbances related to hatchery operations and nearby human activity. For these reasons, effects from activities conducted at the Hurd Creek Hatchery are not expected to measurably disrupt normal marbled murrelet behaviors and are considered insignificant.

The Dungeness Hatchery is located in an area that has previously been logged and only provides a limited amount of marginally suitable habitat. Furthermore, most of the historic marbled murrelet detections that were closest to this facility are in an area that has since been logged and no longer suitable. Hatchery operations at this facility also occur between the hours of 8 am to 5 pm, which coincidentally avoids the primary sensitive feeding times around sunrise and sunset during nesting season. The hatchery has existed in this location for over 100 years, human presence and activities occur year round, and activities have not changed and are not expected to change during the term of this consultation. Therefore, we expect that marbled murrelets that may be nesting in the vicinity of the hatchery have chosen to nest there despite the human presence, activities, and associated noise levels and disturbance. For these reasons, effects to marbled murrelets associated with activities conducted at the Dungeness Hatchery are not expected to measurably disrupt normal behaviors and are considered insignificant.

Adverse Effects

The Upper Dungeness and Gray Wolf Acclimation Ponds are located within or immediately adjacent to suitable nesting habitat which is assumed to be occupied by marbled murrelets. In addition, these facilities are within 100 feet (Upper Dungeness) to 0.4 (Gray Wolf) mile of historically occupied sites with numerous detections. The two acclimation ponds are not operated all year long, and disturbance is seasonal in nature. However, because activities conducted at these facilities commence at about the same time as the marbled murrelet nesting season, there is a potential for adverse effects, including a significant impairment of normal behaviors (disturbance).

Each acclimation pond is setup in early April and operated through June. Setup at the Upper Dungeness site involves bringing the fish rearing tank, associated pump and generator, and small camper to the site. Human presence at this site is continual through the end of the season in order to deter vandals. The generator and pump run continuously during this time. This site is immediately adjacent to a rapidly flowing reach of the river which likely muffles or obscures some of the noise. All activities at the Upper Dungeness site occur at one discrete point location. Setup at the Gray Wolf site involves using a compact Bobcat-style excavator to remove accumulated sediment from the intake screen. A battery-powered lawn trimmer (weed eater) is used to clear the trail to the pond from the road, and the perimeter of the pond. Other setup activities do not involve the use of motorized equipment. Unlike the Upper Dungeness site, human presence at the Gray Wolf site is not continual, and motorized equipment (pump and generator) are not onsite and running continuously. During operation, hatchery staff visit the site twice per day at 8 am and 2 pm to feed the fish. Once per month a battery-powered lawn trimmer may be used to keep the trail and perimeter of the pond clear. Setup and operation at the Gray Wolf site occurs within an approximate 200-foot by 400-foot area. Noise-related disturbance from these operations is expected to encompass areas of 7.8 acres (Upper Dungeness) and 20.8 acres (Gray Wolf) around and inclusive of each site.

Effects to Marbled Murrelets - Disturbance

<u>Background Information: Disturbance to Murrelets from Project Noise and Activity</u>

The use of generators, pumps, lawn trimmers, compact excavators, and other motorized equipment will introduce increased levels of sound and human activity into the project area. Most of the proposed activities will occur during the time of year (early April to late June) that coincides with the peak of the marbled murrelet nesting season, and will occur within and adjacent to potentially occupied murrelet nesting habitat.

The USFWS recently completed an updated review of disturbance effects to marbled murrelets (USFWS 2012a). In that review, we concluded that under certain scenarios the noise and activity associated with motorized equipment is reasonably certain to result in significant disruptions of normal marbled murrelet nesting behaviors. The following behavioral responses are considered significant: 1) an adult marbled murrelet flushing from a nest or perch within the vicinity of a nest site, including delay or avoidance in nest establishment; and, 2) an adult marbled murrelet delaying or aborting one or more feedings of nestlings. We expect these behaviors are reasonably certain to occur when ground-based activity occurs during the nesting season within 333 feet of a nest site. This distance is based on recommendations from marbled murrelet researchers that advised buffers of greater than 333 feet to reduce potential noise and visual disturbance to murrelets (Hamer and Nelson 1998, p. 13; USFWS 2012a, pp. 6-9).

Effects of Ground-Based Disturbance to Marbled Murrelets

Marbled murrelets appear to be most sensitive to noise or visual disturbances when they are approaching a nest site or delivering fish to a nestling. There are several documented instances where ground-based activities caused adult marbled murrelets to abort or delay feedings of nestlings, caused adults to divert their flight paths into nesting habitat, or caused them to vacate suitable habitat (Hamer and Nelson 1998, pp. 8-17, USFWS 2012a). Disturbances that result in a flush response can advertise the location of a nest or chick, thereby increasing the risk of predation of eggs or nestlings (USFWS 2006, p. 27).

Marbled murrelets have evolved several mechanisms to avoid predation; they have cryptic coloration, are silent around the nest, minimize movement at the nest, and limit incubation exchanges and chick feeding to occur primarily during twilight hours (Nelson 1997, p. 14). The relationship between human activities and predators, and their potential impact on marbled murrelet nesting success, has been identified as a significant threat to this species (Peery and Henry 2010, p. 2414). Losses of eggs and chicks to avian predators have been determined to be the primary cause of nest failure (McShane et al. 2004, p. 4-109). The risk of predation by avian predators appears to be highest in close proximity to forest edges and human activity, where many corvid species (e.g., jays, crows, ravens) are in highest abundance (McShane et al. 2004, p. 4-109).

The nature of the activities conducted at the acclimation ponds are such that potential effects to marbled murrelets are minimized to the extent practicable. Human activity associated with setup and operation of the facilities does not occur during the time of day when marbled murrelets are most active at the nest (i.e., dawn and dusk feeding and incubation exchanges). This reduces, but does not eliminate, the potential for disturbance to marbled murrelets that may be nesting close to the acclimation ponds. Chicks are fed primarily during dawn and dusk periods, but may also be fed throughout the day (Nelson 1997, p.18). In some areas, 31 to 46 percent of feedings take place during the mid-day hours (USFWS 2012b, p. 5). Because incubating adults would be continually present on the nest until the egg hatches and feedings can occur at any time of the day, limiting daytime activities does not ensure that all marbled murrelets will be protected from disturbance. Daytime hatchery activities still have the potential to expose and significantly disrupt nesting marbled murrelet.

Sound and visual disturbance that cause an adult marbled murrelet to abort or delay prey delivery creates a likelihood of injury for the adult through an increased energetics cost and exposes eggs and chicks to an increased risk of predation. Hull et al. (2001, p. 1036) report that marbled murrelets spend between 0.3 to 3.5 hours per day (mean 1.2 ± 0.7 h per day) commuting to nests (primarily for food deliveries) during the breeding season. The distance traveled between the nest site and foraging areas ranged from 7 to 63 miles, and requires substantial energy demands. Each flight to the nest is energetically costly, increases the risk of predation from avian predators, and detracts from time spent in other activities such as foraging (Hull et al. 2001, p.

1036). Increases to prey capture and delivery effort results in reduced adult body condition by the end of the breeding season, and increases the predation risks to both adults and chicks as more trips inland are required (Kuletz 2005, pp. 43-45). Missed feedings can also reduce the growth and/or fitness of murrelet chicks. Adults feed chicks 1 to 8 times per day (mean = 3.2 ±1.3 SD) (Nelson and Hamer 1995, p. 61). If we assume an average of 4 feedings per day, a single aborted feeding would constitute a loss of 25 percent of the daily food intake.

Bloxton and Raphael (2009) indicate that in Washington State, many marbled murrelets are not initiating nesting, or are abandoning their nests during incubation or rearing, most likely in response to poor foraging conditions. For those that do initiate nesting, brooding, and rearing, the implications of missed feedings are significant. Missed feedings may cause a delay in the development of the chick, prolonging the time to fledging, and increasing the risk of predation or abandonment by the adults. If disturbance at a nest site is prolonged, each successive day or night of construction and resulting disturbance creates an increasing risk that multiple missed feedings will cause a significant delay in the chick's growth and development, cause permanent stunting, or can result in mortality due to severe malnourishment.

However, due to the daily time schedule during setup and operation of the rearing ponds, we expect that chicks occupying nests close to these areas will receive a minimum of one or more feedings during dawn and dusk hours. We assume that the majority of daily feedings occur during dawn/dusk hours and that these feedings will generally be sufficient to sustain the development of the chick. In situations where prolonged disturbance may result in multiple missed feedings over days or weeks, some chicks may suffer from reduced growth and low fledging weight. This will depend, in part, on the quality of the diet the chick is provided, and the proportion of mid-day feedings that are missed.

Kuletz (2005, p. 85) developed a model to examine the relationship between the energy requirements of marbled murrelet chicks and the number of daily feedings required for fledging. Depending on the energy content of the prey items delivered, minimum daily feedings range from approximately two herring to eight sand lance per day (Kuletz 2005, p. 85). Over the course of the 27- to 40-day period during which the chick matures, the estimated total number of feedings required for successful fledging ranges from 38 (age 1+ herring) to 204 (sand lance) (Kuletz 2005, p. 85).

Because marbled murrelets are somewhat adapted to inconsistent provisioning, and because the nature of the activities that are conducted at the rearing ponds are relatively benign, intermittent, obscured by noise from nearby flowing river water, and short in duration (e.g. feeding fish twice a day), we anticipate the level of disturbance to be relatively low, allowing most feedings to occur each day. We also do not expect these activities to result in nest failure. We expect that most nests exposed to activities conducted at the two acclimation ponds will still fledge chicks, although fledgling weights may be low, or the development time to fledging may be increased.

Although we recognize that prolonged disturbance at a site, resulting in multiple missed feedings over days or weeks, has the potential to result in severe malnourishment (injury) and/or mortality, we are not reasonably certain that these outcomes will occur. Because of inherent variability and uncertainty, the USFWS is not currently able to predict with reasonable certainty the number of missed feedings that would result in injury or death of marbled murrelet chicks.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future state, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this Opinion. Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

Bull Trout and Designated Bull Trout Critical Habitat

Cumulative effects are limited to the lower 26 percent of the watershed because the upper watershed - above RM 13.2 on the Dungeness River, including the entire Gray Wolf River drainage - is federally owned (Olympic National Park and Olympic National Forest). Therefore, cumulative effects will not affect any bull trout spawning or early rearing habitat.

Water rights, water usage, and minimum instream flows are ongoing sensitive and contentious issues in the lower Dungeness River watershed. As discussed in the Environmental Baseline section above, surface water withdrawals from the Dungeness River substantially reduce instream flows (Haring 1999, p. 99-104; EDPU 2005, Chapter 2.3). Water rights for agricultural irrigation are severely overappropriated and, although these rights are apparently not fully utilized, they take a substantial proportion of the river flow from April through October (Haring 1999, pp. 99-104; EDPU 2005, Chapter 2.3). These actions also contribute to elevated surface water temperatures during the summer and early fall. Some water conservation actions have been implemented, and others are expected to be implemented during the term of this consultation (e.g., JST 2007, pp. 79-83; WDOE 2015). However, the population of Clallam County, including the greater Sequim area in the lower Dungeness watershed, is projected to continue growing (EDPU 2005, Chapter 2.2, pp. 2.2-2 to 2.2-4). This will increase demand for surface and groundwater extraction for irrigation, domestic, and business use. It is uncertain if water conservation improvements will offset the growing demand for water. Thus, for the term of this consultation, we expect that instream flows and summer and early-fall water temperatures will remain equivalent to what they are at present. For bull trout, this means that summer and early-fall foraging habitat in the lower watershed will continue to be impaired in terms of quantity and temperature. Bull trout migrating through the lower watershed will continue to encounter barriers represented by extremely shallow riffles. Other anadromous salmonids will face the same obstacles. Lower watershed spawning and rearing habitat will continue to be limited and impaired, and access to upper watershed spawning habitat will continue to be partially or wholly obstructed at times. Because anadromous salmonids provide a critical forage resource to bull trout, the negative impacts to anadromous salmonids represent an additional negative impact to bull trout.

Entities such as the Jamestown S'Klallam Tribe and local conservation organizations have been and are expected to continue to seek and implement restoration projects for the specific benefit of fish and aquatic habitat in the lower Dungeness River and the estuary. These actions are expected to be targeted specifically to anadromous Pacific salmon and steelhead trout rather than bull trout. However, these actions will benefit bull trout because their habitat needs are similar to Pacific salmon and steelhead trout. Thus, minor to moderate improvements are expected in habitat quality and quantity for foraging, migrating, and overwintering bull trout. In addition, by benefitting anadromous Pacific salmon and steelhead, these actions will benefit bull trout by increasing the forage base represented by these species, which is currently a critical deficiency in the Dungeness watershed.

Population growth is projected for the lower Dungeness River watershed and is likely to result in increasing habitat degradation, particularly to riparian areas and water quality, and diminished opportunities for substantial restoration. Despite some local permitting requirements and regulations, our observations are that these activities tend to remove riparian vegetation, interrupt groundwater-surface water interactions, reduce stream shade (and increase stream temperature), reduce the opportunity for large wood recruitment, and increase water pollution. These effects may further degrade in-stream conditions for bull trout foraging in and migrating through the lower watershed. Each action by itself may have only a small incremental effect, but taken together they may substantively degrade the watershed's environmental baseline and undermine the improvements in habitat conditions necessary for listed species to survive and recover. Watershed assessments and other education programs may reduce these adverse effects by continuing to raise public awareness about the potentially detrimental effects of residential development on salmonid habitats and by presenting ways in which a growing human population and healthy fish populations can co-exist.

We expect that negative effects from future habitat degradation and increased demand for surface and groundwater will be partially offset by beneficial effects from restoration and conservation efforts. Therefore, during the term of this consultation, we anticipate that baseline conditions will become further degraded from cumulative effects, but the degradation will not be substantial.

Marbled Murrelet

The acclimation ponds are located entirely on federal lands. Therefore, cumulative effects are not anticipated.

INTEGRATION AND SYNTHESIS OF EFFECTS

The Integration and Synthesis section is the final step in assessing the risk posed to species and critical habitat as a result of implementing the proposed action. In this section, we add the effects of the action and the cumulative effects to the status of the species and critical habitat, and the environmental baseline, to formulate our biological opinion as to whether the proposed action is likely to: 1) appreciably reduce the likelihood of both survival and recovery of the species in the wild by reducing its numbers, reproduction, or distribution; or 2) reduce the value of designated critical habitat for the conservation of the species.

Bull Trout

Throughout its range, the bull trout is threatened by the combined effects of habitat degradation, fragmentation, and alteration. Six segments of the coterminous United States population of the bull trout are essential to the survival and recovery of this species and are identified as Recovery Units. The WDFW hatchery activities are located in the Coastal Recovery Unit's Dungeness core area, which supports two local populations of bull trout. As described in the summary of effects to bull trout, the actions are expected to affect both Dungeness local populations. The core area and the local populations are at increased risk of extirpation from natural, randomly occurring events because of the small number of local populations, low adult abundance, persistence of critical threats, and uncertainties associated with watershed restoration and recovery. Some of the activities considered in this consultation may lessen this risk, while others may contribute to or increase this risk.

This paragraph is a summary of the factors that must be synthesized with the anticipated effects on bull trout. Bull trout spawn, rear, forage, and complete other aspects of their life history in the Dungeness River basin. The conservation role of the Dungeness River basin is to maintain the genetic components of the species and maintain the geographic range of the species. Dungeness River bull trout represent an important component of the Coastal Recovery Unit's geographic range. The Dungeness is one of only 10 core areas that currently exhibit the anadromous life history form. In addition, it is one of only two core areas connected to the Strait of Juan de Fuca. There are no cumulative effects in the upper watershed because it is all in federal ownership. Ongoing issues in the lower watershed with surface water withdrawals and low instream flow during late summer and early fall will continue to present challenges to bull trout migration and survival. Baseline conditions are severely degraded, primarily as a result of historical land and river management practices. This baseline is somewhat dynamic due to climate change, increasing urbanization, and habitat restoration and salmon recovery efforts.

Since the time of the coterminous United States bull trout listing in 1999, the hatchery infrastructure and operations have not been identified as a primary cause of the "high risk" status of Dungeness bull trout. Hatchery programs and infrastructure, including those included in this consultation, have existed for many years or decades in the Dungeness River watershed. Some aspects have changed over the years (e.g., weir location and operations have changed, species and numbers released have changed), but most if not all of the changes have benefitted bull trout. For example, the weir is no longer a complete barrier to fish passage, intakes have been screened to prevent entrainment into the hatchery facilities, and effluent treatment systems have been added to reduce discharge of pollutants into the river. To the extent that the hatchery infrastructure and operations have exacerbated existing threats and/or presented additional pressures inhibiting recovery, these have been reduced in recent years due to these modifications. Additional modifications planned for the near future, such as restoring passage to Canyon Creek, will provide further benefits to bull trout.

Some of the hatchery actions (i.e., Chinook and pink salmon recovery programs) have the potential to significantly benefit bull trout by increasing critically-deficient forage resources. However, success of the programs is dependent upon a variety of factors outside the control of the project, and is therefore not guaranteed. Nonetheless, we anticipate a small to moderate level of success in terms of increased abundance of naturally-spawning Chinook and pink salmon as a result of these programs during the term of this consultation.

Naturally-rearing juvenile coho salmon provide a critical forage resource to some size classes of bull trout in freshwater. The hatchery coho program will prevent a self-sustaining naturally-reproducing population from reestablishing in the watershed. However, the program will function as an ecological surrogate or replacement by providing an equivalent abundance of naturally-spawning hatchery-origin adults and juvenile progeny as compared to a self-sustaining naturally-reproducing population, although this conclusion is based on very limited data. Although the hatchery coho program will preclude the reestablishment of a self-sustaining naturally-reproducing population, it will provide an equivalent abundance of hatchery-origin adults and juveniles as would have been in the system if the hatchery did not exist. Therefore, we do not anticipate the coho program to have an adverse effect to bull trout.

Other hatchery activities will adversely affect bull trout, including the following: 1) partial dewatering of the Dungeness River during low flow periods that span bull trout migration times; 2) lack of downstream passage at the weir during the adult outmigration period; 3) uncertainty associated with upstream trap effectiveness when the weir must be operated 7 days per week; and, 4) capture and handling during broodstock collection activities. As many as 119 adult and subadult bull trout may be affected annually by the project, and these effects are likely to cause the death of up to 4 adult and subadult bull trout, 102 juvenile bull trout, and eggs and fry of up to 2 adult female bull trout annually. Although the action includes partial barriers to migration (weir, partial dewatering), there is sufficient passage available that the reproduction, numbers, and distribution of bull trout at the scale of the local populations and the core area are not anticipated to be appreciably affected. Reproductive success of up to 2 female bull trout annually will be impaired as a result of the project; however, this represents only 2 percent of spawning females and thus is not anticipated to affect reproduction at the scale of the local populations or the core area. For these reasons, we conclude that the combined effects of the action will have no net effect on the reproduction, abundance, or distribution of bull trout at the scale of the local populations or the core area.

Drawing from the above discussion, we conclude that the effects of the determinations by NMFS and associated actions relative to WDFW hatchery activities in the Dungeness River basin, considered with cumulative effects, and in the context of the degraded and changing baseline conditions, will not affect bull trout reproduction, abundance, or distribution within the Dungeness core area. Therefore, the action also will not affect reproduction, survival, or distribution, or the survival and recovery potential of bull trout, at the scale of the Coastal Recovery Unit or the coterminous listed range.

Bull Trout Critical Habitat

The range-wide status of designated critical habitat for bull trout is variable among and within Critical Habitat Units (CHUs), which were designated in five states in a combination of reservoirs/lakes and streams/shoreline. Designated bull trout critical habitat is of two primary use types: 1) spawning and rearing; and, 2) foraging, migration, and overwintering. The conservation role of bull trout critical habitat is to support viable core area populations. The core areas reflect the metapopulation structure of bull trout and are the closest approximation of a biologically functioning unit for the purposes of recovery planning and risk analyses. Thirty-two CHUs and 78 associated subunits are designated as critical habitat under the 2010 final rule.

The status of habitat conditions and the PCEs of designated critical habitat in the action area vary throughout the watershed. The upper watershed (above about RM 10.8), where all spawning and rearing critical habitat is located, is in fair (Dungeness River) to near pristine (Gray Wolf River) condition. In contrast, 7 of 9 PCEs in lower watershed foraging, migration, and overwintering critical habitat are moderately to severely impaired. These include the following: PCE 1 (groundwater), PCE 2 (migration barriers), PCE 3 (food base), PCE 4 (complex habitat), PCE 5 (water temperature), PCE 7 (hydrograph), and PCE 8 (water quality and quantity). The degradation of these PCEs in the lower watershed is caused by overallocation of water rights and excessive water withdrawals, historical land and river management practices (channelization, levee construction, large wood removal, riparian and upland deforestation, and historical timber extraction activities in the upper watershed), and road crossings.

None of the hatchery infrastructure or activities are a primary cause of the degraded condition of critical habitat in the lower watershed. However, the proposed action does, to varying degrees, exacerbate the degraded conditions. The weir is a temporary, seasonally-present structure that obstructs and delays bull trout migration (PCE 2). However, the function of this PCE is not precluded because the upstream trap and normal operational downtime (weekends) allow sufficient passage. In addition, if the Chinook and pink recovery programs are successful, the weir may be operated less or removed altogether during the period of this consultation.

Dungeness Hatchery surface water withdrawal contributes to degraded passage conditions (PCE 2), temperature conditions (PCE 5), hydrograph (PCE 7), and water quantity (PCE 8). The effects to these PCEs are seasonal and are limited in spatial extent to a 4,600-foot reach of the river. The severity of effects varies from year to year depending on mountain snowpack and watershed-wide rainfall amounts (affecting PCEs 2, 5, 7, and 8), and late spring, summer, and early fall air temperatures (affecting PCEs 2, 5, and 8). The effects of climate change are expected to degrade baseline conditions during the period of this consultation and are likely to exacerbate the magnitude of effects from hatchery water withdrawal.

The weir represents a partial barrier to migration (PCE 2), but it is a temporary structure, its effects are limited in both physical extent and duration, and it does not prevent passage of migrating bull trout. Groundwater withdrawals at the Hurd Creek facility are anticipated to affect a small, localized reach of the river by decreasing groundwater and hyporheic flow (PCE 1) and contributing to elevated water temperatures (PCE 5). These effects are temporary, but long-term, lasting for the duration of the project.

The Chinook and pink salmon recovery programs, if successful, may provide a substantial increase in the general bull trout forage base (PCE 3). Ongoing habitat restoration activities, particularly in the lower watershed, are expected to increase the chances for success. The effects of climate change on freshwater and marine ecosystems are expected to hinder restoration and recovery efforts, and exacerbate the limitation on the abundance of coho salmon available for forage.

Historical habitat degradation, combined with overallocated water rights and non-hatchery surface water withdrawals, are the dominant and primary factors contributing to degraded habitat conditions and PCEs throughout the watershed. The effects of the action exacerbate these, but represent only incremental declines at small spatial scales, and do not preclude bull trout from foraging, migrating, or overwintering within the action area. Within the action area, bull trout critical habitat will retain its current ability to establish and maintain functioning PCEs. The anticipated effects of the action, combined with the effects of interrelated and interdependent actions, and the cumulative effects associated with future State, tribal, local, and private actions will not prevent the PCEs of critical habitat from being maintained, and will not degrade the current ability to establish functioning PCEs at the scale of the action area. Critical habitat within the action area will continue to serve the intended conservation role for the species at the scale of the core area, Coastal Recovery Unit, and coterminous range.

Marbled Murrelet

Summary of Project Effects to Murrelets

The only anticipated adverse effects to marbled murrelets would be noise and visual disturbance associated with human activity and the use of motorized equipment adjacent to suitable nesting habitat during the nesting season. We anticipate that all marbled murrelets associated with approximately 29 acres of nesting habitat near the Upper Dungeness and Gray Wolf Acclimation Ponds are likely to be exposed to noise and visual disturbance during pond operations. Potential responses to these activities include delay in or avoidance of nest establishment, flushing from a nest or branch within nesting habitat, aborted or delayed feeding of juveniles, or increased vigilance/alert behaviors at nest sites with implications for reduced individual fitness and reduced nesting success. These behavioral disruptions create a likelihood of injury by increasing the risk of predation, reduced fitness of nestlings as a result of missed feedings, and/or increased energetic costs to adults that must make additional foraging trips.

We do not expect that noise and visual disturbance will result in actual nest failure, but the anticipated disturbance is reasonably certain to create a likelihood of injury that can indirectly result in nest failure due to predation or reduced fitness of individuals. WDFW operations generally avoid project activities during the peak activity periods (dawn and dusk hours) when nest exchanges and most of the feedings occur. This reduces but does not eliminate the likelihood of adverse effects because feedings and incubation during the mid-day hours could still be disrupted.

Available data suggest a patchy and inconsistent distribution of marbled murrelets and suitable nesting habitat in the action area. Higher quality, more abundant, more contiguous, and more isolated habitat is available within 0.5 mile of the disturbance area associated with each rearing pond. With consideration for these data and the surrounding landscape context, we conclude it is unlikely that habitats located within 333 feet of the rearing ponds and related activities support a significant concentration of nesting marbled murrelets.

The proposed action is unlikely to have any measurable or detectable effect on long-term function or productivity of the stands surrounding the ponds. The action also will have no effect on the core-to-interior ratio of available suitable nesting habitat, patch size, or the average density of available nest trees and platforms. The action will not cause or contribute to significant crowding or displacement of breeding pairs, and will not increase the long-term risk of predation.

Overview of Marbled Murrelet Population Demography and Habitat Relationships

Marbled murrelets are long-lived birds, with high adult survival, low annual fecundity, and delayed maturity (McShane et al. 2004, p. 3-34). It may take a breeding pair several successive years of nesting attempts to replace themselves in the population. Marbled murrelet demography studies and population viability modeling indicate that the populations are most sensitive to changes in adult survival and fecundity (reproductive success) (McShane et al. 2004, pp. 3-53 to 3-58). Although adult annual survival rates are relatively high in marbled murrelets (estimated at 83 to 92 percent), it is likely that recruitment rates throughout the species listed range are too low to reverse the current population decline.

The USFWS recently convened a Recovery Implementation Team which concluded that the primary cause of the continued population decline is sustained low recruitment. Sustained low recruitment can be caused by nest failure, low numbers of nesting attempts, and/or low juvenile survival rates due to 1) terrestrial habitat loss, 2) nest predation, 3) changes in marine forage base which reduce prey resources, and 4) cumulative effects of multiple smaller impacts.

Juvenile ratios, as an index of nest success, indicate that fecundity is well below the level needed to maintain current the abundance of marbled murrelets. In California (Conservation Zones 4, 5 and 6), the leading causes of low fecundity are alternately nest predation or poor food abundance or quality in the marine environment (Peery et al. 2004, p. 1088). We expect these factors may be the leading causes of low fecundity in Washington as well (Conservation Zones 1 and 2).

Recent monitoring efforts in Washington indicated that only 20 percent of monitored marbled murrelet nesting attempts were successful, and only a small portion of the 158 tagged adult birds actually attempted to nest (13 percent) (Raphael and Bloxton 2009, p. 165). The authors note that the apparent low nesting rate coupled with low nesting success suggests the populations in Conservation Zones 1 and 2 do not produce enough young to support a stable population (Raphael and Bloxton 2009, p. 165). The low number of adults attempting to nest is not unique to Washington. Some researchers suspect that the portion of non-breeding adults in marbled murrelet populations can range from about 5 percent to 70 percent depending on the year, but most population modeling studies suggest a range of 5 to 20 percent (McShane et al. 2004, p. 3-5).

The range-wide population estimate for the Northwest Forest Plan area in 2012 was 21,284 marbled murrelets (95 percent confidence interval: 16,700 to 25,867) (Lance et al. 2013, p. i). The largest populations occur in Conservation Zone 3 (Coastal Oregon) and in Conservation Zone 1 (Puget Sound/Strait of Juan de Fuca) (Miller et al. 2012, p. 774). Raphael et al. (2011) showed a strong positive association between regional populations of marbled murrelets and total suitable habitat at the scale of the five Conservation Zones within the Northwest Forest Plan area. At the scale of the entire Northwest Forest Plan (including non-Federal lands), suitable nesting habitat has declined from 3.81 million acres in1994 to 3.54 million acres in 2007, with a loss of over 8.9 percent in Washington alone (Raphael et al. 2011, p. 34).

Surveys from 2000 to present have documented that marbled murrelet populations throughout the listed range have declined at a rate of 3.7 percent per year. This represents an overall population decline of nearly 30 percent since 2000 (Miller et al. 2012, p. 775). The population decline is most severe in the northern part of the listed-range, particularly in Conservation Zone 1 (Puget Sound/Strait of Juan de Fuca). In Washington, the population has declined almost 50 percent in the past 10 years. Rates of habitat loss (primarily from timber harvest on non-federal lands) were also highest in Washington, which suggests that the loss of nesting habitat continues to be an important limiting factor for the recovery of marbled murrelets (Raphael et al. 2011).

Although there are strong correlations between the amount and distribution of nesting habitat and the total numbers of marbled murrelets at a regional scale (Raphael et al. 2011), there are no corresponding data that allow us to accurately enumerate the number or density of marbled murrelets at the scale of individual stands of suitable nesting habitat. Based on radar studies, Raphael et al. (2002) estimated marbled murrelet nest densities ranging from 0.005 to 0.083 nests per acre (1 nest per 12 to 200 acres of nesting habitat), while nest densities estimated from tree climbing efforts ranged from 0.05 to 1.7 per acre (1 nest per 1.7 to 20 acres of nesting habitat) (McShane et al. 2004, various). Given the tremendous variability in the density of marbled murrelets at inland nest sites, we are limited in our ability to accurately correlate direct habitat effects to the actual number of marbled murrelets that may be affected by a given action. However, we are able to reliably quantify habitat effects, and we can infer how these effects may influence marbled murrelet population dynamics at both local and regional scales.

Given all of the above information, there are several key facts that we draw upon in our analysis of effects to marbled murrelet populations:

- Adults are long-lived, have high annual survival rates, and have very low reproductive rates. In any given year, a significant portion of the adult population does not nest or attempt to nest.

- Reproductive success (fecundity) is very low, and is currently insufficient to sustain a stable population. Nest predation and poor marine foraging conditions are implicated as primary causes.

- The density of marbled murrelets at inland nesting sites is highly variable. At a regional scale, marbled murrelets occupy nesting habitat at very low densities (100s of acres of nesting habitat per pair) but densities can be as high as one nest per 12 acres at a watershed scale and one nest per 1.7 acres at a nest patch scale. Loss of nesting habitat continues to be an important factor limiting recovery at a regional scale.

In summary, the species' inherently low annual reproductive potential, coupled with a suite of environmental stressors that limit the species productivity, leads us to conclude that the species will continue to experience local and rangewide population declines in the foreseeable future. For these reasons, the survival and recovery of this species depends upon improving reproductive success.

Effects to the Marbled Murrelet Populations in Conservation Zone 1

The hatchery facilities and acclimation ponds are located within Conservation Zone 1. Consistent with the rangewide trend, the population of marbled murrelets in Conservation Zone 1 has declined significantly over the past decade. The population in Conservation Zone 1 in 2012 was estimated at 8,442 birds (95 percent confidence interval = 5,276 to 12,030) (Lance et al. 2013, p. i). Due to the nature of the survey protocol and seasonal variation in the distribution of marbled murrelets, there is a high level of variation in the annual population estimates. Despite this annual variation, the monitoring surveys indicate the murrelet populations in Conservation Zone 1 have declined at a rate of 3.17 percent per year since 2001 (Lance et al. 2013, p. 5).

As described above in the Exposure Analysis section, we elected to use acres of suitable nesting habitat affected by the action as a surrogate for the number of marbled murrelets likely to be exposed to the effects of the action.

Marbled Murrelet Numbers and Reproduction

In the above analysis, we estimated that marbled murrelets associated with approximately 29 acres of suitable nesting habitat will be exposed to noise and visual disturbance associated with operational activities conducted at the Gray Wolf and Upper Dungeness acclimation ponds. The anticipated disruption of normal nesting behaviors will result in an increased likelihood of injury to marbled murrelets nesting within those affected acres but is not reasonably certain to result in direct nest failures. The anticipated disturbance is not anticipated to appreciably reduce the numbers or reproductive success of marbled murrelets at the scale of the action area or any larger scale because: 1) most nests exposed to disturbance are not expected to fail given the low levels and short durations of noise and visual disturbance associated with the project; 2) the area exposed to disturbance is limited (approximately 29 total acres); and 3) no direct mortality of adult marbled murrelets is anticipated, so there would be no reduction in the current population of breeding adults.

Marbled Murrelet Distribution

We do not expect that the proposed action would affect the distribution of marbled murrelets within either the action area or Conservation Zone 1 because the anticipated disturbance to occupied stands would be temporary, intermittent, and relatively minor. Therefore, the proposed action is not expected to affect the distribution of marbled murrelets in the action area, Conservation Zone 1, or within the listed range of the species.

Given the above analysis, we conclude that the adverse effects to marbled murrelets that would result from the proposed action, and any cumulative effects, are not likely to appreciably reduce the likelihood of survival and recovery of the marbled murrelet in the wild by reducing their numbers, reproduction, or distribution at the scale of the project area, Conservation Zone 1, or within the listed range of the species.

CONCLUSION

Bull Trout and Designated Bull Trout Critical Habitat

After reviewing the current status of bull trout, the environmental baseline for the action area, the effects of the proposed 4(d) authorization and associated hatchery activities, and the cumulative effects, it is the USFWS' Opinion that the action, as proposed, is not likely to jeopardize the continued existence of the bull trout and is not likely to destroy or adversely modify designated critical habitat.

Marbled Murrelet

After reviewing the current status of bull trout, the environmental baseline for the action area, the effects of the proposed 4(d) authorization and associated hatchery activities, and the cumulative effects, it is the USFWS' Opinion that the action, as proposed, is not likely to jeopardize the continued existence of the marbled murrelet.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. *Harm* is defined by the USFWS as an act which actually kills or injures wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavior patterns, including breeding, feeding, or sheltering (50 CFR 17.3). *Harass* is defined by the USFWS as an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering (50 CFR 17.3). Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by the NMFS so that they become binding conditions of any grant, permit, or authorization issued to the WDFW, for the exemption in section 7(o)(2) to apply. The NMFS has a continuing duty to regulate the activities covered by this incidental take statement. If NMFS 1) fails to assume and implement the terms and conditions, or 2) fails to require the WDFW to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the grant, permit, or authorization document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the NMFS and the WDFW must report the progress of the action and its impact on the species to the USFWS as specified in the incidental take statement [50 CFR §402.14(i)(3)].

AMOUNT OR EXTENT OF TAKE

Bull Trout

The USFWS anticipates that incidental take of up to 119 adult and subadult bull trout, offspring of up to 2 adult female bull trout, and 102 juvenile bull trout is reasonably certain to occur as a result of this proposed action. The incidental take is expected to be in the form of harm and harass as detailed below and summarized in Table 2.

Some forms of incidental take will be difficult to detect or quantify for the following reasons: the species is wide-ranging in habitats that are difficult to access; eggs, fry, and juveniles are small and exhibit cryptic behaviors; and some effects will result in delayed injury or mortality.

Pursuant to the authority of section 402.14(i)(1)(i) of the implementing regulations for section 7 of the ESA, a surrogate can be used to express the amount or extent of anticipated take if the following criteria are met: the causal link between the surrogate and take is described; an explanation is provided as to why it is not practical to express the amount or extent of take or to monitor take-related impacts in terms of individuals of the listed species; and a clear standard is set for determining when the level of anticipated take has been exceeded. When it is not practical to monitor take impacts in terms of individual bull trout due to the extremely low likelihood of 1) finding dead or injured individuals in the aquatic environment or 2) detecting significant behavior changes, we use operational criteria or capture rates as a clear standard for take exceedance. Therefore, where appropriate, we have identified surrogates for monitoring and reporting the incidental take of bull trout.

The following incidental take is anticipated due to the proposed action:

1. Incidental take of bull trout in the form of *harassment* resulting from operation of the mainstem weir. We estimate that, at present levels of bull trout abundance, up to 81 adult and large subadult anadromous bull trout would be harassed annually for the period of this consultation. It is not feasible to monitor the actual number of bull trout affected because it is not logistically possible to enumerate all bull trout that will encounter the weir. However, the incidental take that was evaluated was based on an annual operation window of May 1 through October 1, standard operation (5 days per week up, 2 days per week down) during most times, and non-standard operation (7 days per week) that includes up to 10 weekends over any 5-year period, and a maximum of 3 non-consecutive weekends in any one year. The incidental take is a direct function of these operations. Therefore, these operational criteria serve as our surrogate for establishing limits on the amount of take (number of bull trout) described above. Our surrogate for monitoring the number of bull trout taken is the annual time period of weir operation (May 1 through October 1), and the expected frequency of non-standard operation (up to 10 weekends per any 5 year period, and no more than 3 non-consecutive weekends in any one year).

2. Incidental take of bull trout in the form of *harm* resulting from the presence of the weir and associated delays or blockage of migration. We estimate that up to 2 adult or subadult bull trout would be harmed annually as a result of these activities. In addition, the offspring of 2 adult female bull trout would be harmed as a result of these activities annually for the period of this consultation. It is not feasible to monitor the actual number of bull trout that will be affected by the weir for the following reasons: 1) most dead fish at the weir site would not be detected because their carcasses would get washed downstream with the current and/or be carried away by predators; and 2) attempting to correlate bull trout spawning site selection and reproductive success with delays caused by the weir may not be possible due to low bull trout abundance and scientific uncertainties. However, the incidental take that was evaluated was based on an annual operation window of May 1 through October 1, standard operation (5 days per week up, 2 days per week down) during most times, non-standard operation (7 days per week) that includes up to 10 weekends over any 5-year period, and a maximum of 3 non-consecutive weekends in any one year. The incidental take is a direct function of these operations. Therefore, these operational criteria serve as our surrogate for establishing limits on the take of the number of bull trout described above. Our surrogate for detecting and monitoring the number of bull trout taken is the annual time period of weir operation (May 1 through October 1), and the expected frequency of non-standard operation (up to 10 weekends per any 5 year period, and no more than 3 non-consecutive weekends in any one year).

3. Incidental take of bull trout in the form of *harassment* resulting from water withdrawals at the Dungeness Hatchery. We estimate that up to 85 adult or subadult bull trout would be harassed annually as a result of these activities for the period of this consultation. It is not feasible to monitor the actual number of bull trout affected. Our surrogate for monitoring the number of bull trout harassed due to water withdrawals is the quantity of water withdrawn by the hatchery when passage conditions in the partially dewatered

reach are not harmful to bull trout. The incidental take that was evaluated was based on typical hatchery water withdrawals during annual low-flow periods, or 10 to 15 cfs. Thus, our surrogate for establishing limits on the take of the number of bull trout described above is water withdrawal of up to 15 cfs.

4. Incidental take of bull trout in the form of *harassment* resulting from capture and other broodstock collection activities and infrastructure. We estimate that up to 62 adult or subadult bull trout would be captured annually as a result of operations at the weir (50 bull trout), the off-channel adult collection pond (6 bull trout), during seining and/or netting (4 bull trout), and angling (2 bull trout). Many of these bull trout are harassed as well, as described above.

5. Incidental take of bull trout in the form of *harm* resulting from capture, handling, captivity, and confinement related to broodstock collection infrastructure and activities. We anticipate that capture, captivity, confinement, and handling from all broodstock collection activities combined will result in immediate mortality to 2 adult and large subadult bull trout annually, and delayed mortality to 1 adult and large subadult bull trout annually. It is not feasible to monitor delayed mortality because attempting to track every captured bull trout after it has been released would require unduly rigorous and expensive field procedures. Therefore, capture rates identified in number 4 above, and immediate mortality, will serve as surrogates for monitoring and reporting delayed mortality. Exceedances of either the capture rates identified in number 4 or immediate mortality will be considered an exceedance of take from delayed mortality.

6. Incidental take of bull trout in the form of *harm* resulting from crushing or other injuries associated with small-scale riverbed modifications near the Gray Wolf Acclimation Pond. We estimate 2 juvenile bull trout would be injured or killed as a result of these activities annually for the period of this consultation. It is not feasible to monitor the actual number of bull trout that will be affected because most juvenile bull trout that are crushed will not be detected due to being buried in the substrate, or being washed downstream in turbid water. Our surrogate for detecting and monitoring the number of bull trout taken is the area over which sediment excavation and manual substrate alterations will occur. The incidental take that was evaluated was based on a total area of 48 ft^2 of the mainstem and side channel being directly disturbed during these activities. Thus, 48 ft^2 of annual riverbed alterations serves as our surrogate for establishing the limits on the take (number of bull trout) described above.

7. Incidental take of bull trout in the form of *harm* resulting from interspecies interactions, including predation, competition for rearing space and spawning habitat, and superimposition of redds. We estimate that up to 100 juvenile bull trout and the offspring of up to 2 adult female bull trout would be harmed as a result of these activities annually for the period of this consultation. It is not feasible to monitor the actual number of bull trout that will be affected because attempting to monitor spawning bull trout for redd displacement, superimposition of bull trout redds by hatchery-origin fish, and predation on juvenile bull trout is not practical. However, the incidental take anticipated is based on hatchery production goals (number of fish released of each species per year), fish size

at release, and specific time and place of fish release. Therefore, these operational criteria serve as our surrogate for establishing limits on the take of the number of bull trout described above.

Marbled Murrelet

The USFWS anticipates the incidental take of murrelets is reasonably certain to occur as a result of the proposed action. This incidental take will be in the form of harass. We anticipated that all marbled murrelets nesting within 333 feet of hatchery activities will be harassed as a result of exposure to hatchery-related activities (sound and visual disturbance) which result in a significant disruption of normal nesting behaviors that creates a likelihood of injury. All adults and chicks within approximately 29 acres of habitat will be harassed, creating a likelihood of injury, over the course of each nesting season that overlaps with hatchery activities (early April through June, 2016 to 2036).

Incidental take of marbled murrelets will be difficult to detect because individuals are cryptic, nest locations are rarely located, and available data suggest a patchy and inconsistent distribution in the action area. For this reason, we use the amount of suitable nesting habitat that would be exposed to hatchery activities conducted at a distance of 333 feet or less as a surrogate of the extent or amount of incidental take.

EFFECT OF THE TAKE

In the accompanying Opinion, the USFWS determined that this level of anticipated take is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

REASONABLE AND PRUDENT MEASURES

Bull Trout

The USFWS believes the following reasonable and prudent measure(s) (RPMs) are necessary and appropriate to minimize the impacts (i.e., the amount or extent) of incidental take of bull trout:

1. Minimize and monitor adverse effects to bull trout associated with hatchery broodstock collection activities, including incidental capture and handling.

2. Minimize and monitor delay of upstream and downstream migrating adult bull trout at the weir site.

3. Minimize and monitor effects of Dungeness Hatchery water withdrawals on safe bull trout passage through the partially dewatered reach.

4. Monitor effects of adverse inter-species interactions of hatchery-released fish on Dungeness River bull trout.

5. Monitor effects of sediment and substrate moving activities at the Gray Wolf Acclimation Pond.

Marbled Murrelet

The USFWS believes the following RPMs are necessary and appropriate to minimize the impacts (i.e., the amount or extent) of incidental take of marbled murrelet:

1. Minimize, monitor, and report incidental take caused by exposure to temporary, hatchery-related sources of sound and visual disturbance at acclimation pond facilities.

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the Act, the NMFS and the WDFW (the applicant) must comply with the following terms and conditions, which implement the (RPM described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

Bull Trout

Terms and Conditions associated with RPM 1:

1. Individuals engaged in broodstock collection activities and/or may handle bull trout shall be trained and knowledgeable in bull trout identification and safe bull trout handling procedures.

2. All bull trout shall be released as soon as possible and as close as possible to the point of capture. All captured bull trout shall be released with the minimum handling necessary to liberate the fish from the capture gear and safely return it to the river.

3. Ensure that bull trout captured in the weir trap are held for no more than 24 hours before being safely released back in the river.

4. Gill net sets will be of such duration as to avoid killing bull trout. Gill nets and seines shall not be left unattended in the river.

5. WDFW shall ensure that any bull trout that enter the adult collection pond are released back to the river as soon as practicable.

6. All captured bull trout shall be reported to the USFWS. Reports shall include the following: date and location of capture, capture method, approximate size of the fish, condition of the fish at release (including any obvious injuries or descaling, and whether these were the result of WDFW's incidental capture and handling associated with broodstock collection), and whether the fish was released alive or died.

7. Bull trout mortalities shall be kept whole and put on ice or frozen. Frozen specimens shall be wrapped directly in aluminum foil to preserve the specimen in a manner that allows for future analysis. Alternative arrangements regarding the preservation or use of mortalities are allowed if coordinated with the USFWS. The USFWS office listed below must approve of the request in writing prior to the permittee implementing any alternative:

   Jeff Chan, Bull Trout Lead
   Listing and Recovery Division
   U.S. Fish and Wildlife Service
   510 Desmond Dr. SE, Suite 102
   Lacey, Washington 98503
   360-753-9440

8. All incidental visual observations of bull trout, including those made by WDFW staff while snorkeling as part of broodstock collection activities, shall be reported to the USFWS. Reports shall include the following: date and location of each fish observed, and approximate size and condition of each fish observed, including any obvious signs of injury.

Terms and Conditions associated with RPM 2:

9. The WDFW shall, in coordination with the USFWS, develop and implement strategies to minimize upstream and downstream passage impairment and migration delay at the weir during both standard (5 days per week) and non-standard (7 days per week) weir operation. Such strategies shall include, but not be limited to, evaluating the response of upstream and downstream migrating bull trout when they encounter the weir, and using this knowledge to develop and implement effective passage strategies during standard and non-standard weir operation as necessary and to the extent practicable.

10. Report to the USFWS any indications that bull trout may be reluctant to enter the weir trap. Such indications may include observations of numerous bull trout at or near the weir site, but with few or no bull trout captured in the weir trap. Such indications and observation shall be included in the annual report described in Term and Condition 12.

11. The WDFW shall annually report to the USFWS the beginning and ending dates of weir operation, and the number of weekends that the weir was operated, including dates.

Terms and Conditions associated with RPM 3:

12. For the Dungeness Hatchery, the WDFW shall annually report to the USFWS the daily average surface water withdrawal from the Dungeness River (excluding Canyon Creek) during the seasonal low-flow period of September and October.

13. The WDFW shall develop and implement a plan in coordination with and subject to USFWS approval to monitor and evaluate the effects of hatchery water withdrawals on low-flow passage conditions within the partially dewatered reach of the Dungeness River. A draft plan shall be submitted to the USFWS by May 31, 2016, and a final plan shall be submitted by July 31, 2016. These timelines may be extended with USFWS approval. In evaluating the effects of hatchery water withdrawals on passage conditions in the partially dewatered reach, the WDFW shall consider reasonably foreseeable impacts of climate change.

Terms and Conditions associated with RPM 4:

14. The WDFW shall annually report to the USFWS the following information regarding releases of hatchery fish from Dungeness River watershed hatchery facilities: species released, location(s) of fish releases, number of fish released at each location, average size of released fish (in mm FL), and date(s) of release at each location.

Terms and Conditions associated with RPM 5:

15. The WDFW shall annually report to the USFWS the total horizontal area over which sediment and substrate moving activities occur at the Gray Wolf Acclimation Pond site for clearing sediment from the intake screen and for diverting water flow from the river to the side channel that feeds the acclimation pond.

Terms and Conditions associated with RPMs 1 and 2:

16. The WDFW shall annually report to the USFWS all information described in Terms and Conditions 6, 8, 10, 11, 12, 14, and 15. Reporting requirements may be included in the WDFW annual bull trout observation reports that are provided to the USFWS under Section 6 of the Act, provided that: a) the reports clearly differentiate between observations associated with Dungeness River watershed hatchery operations and those associated with Section 6 or other activities (restoration and recovery actions that benefit bull trout); and b) the report transmittal to the USFWS indicates that reporting

requirements pertaining to USFWS Consultation No. 01EWFW00-2014-F-0132, Dungeness River Watershed Hatchery Operations are included in the Section 6 report. A copy of the report shall be provided to:

Mark Celedonia
Federal Activities Branch
Division of Consultation and Conservation Planning
U.S. Fish and Wildlife Service
510 Desmond Dr. SE, Suite 102
Lacey, Washington 98503
360-753-9440

Any reporting requirements that are provided separately from the Section 6 report shall reference the same consultation number and be sent to the same address above. All reporting requirements shall be provided by June 30 for the previous calendar year. This timeline may be adjusted with USFWS approval.

Marbled Murrelet

Terms and Conditions associated with RPM 1:

1. WDFW shall ensure that pumps and generators used at acclimation pond sites are inherently quiet or otherwise insulated to reduce noise levels. As a guideline, an ideal goal would be to limit noise levels from pumps and generators to 60 dBA at 50 feet from the equipment.

2. All food items shall be stored inside vehicles, trailers, campers, or trash dumpsters to reduce attraction of crows, jays, and other wildlife which have been identified as predators of marbled murrelet eggs and young.

3. Project-related activities at the Gray Wolf Acclimation site will be conducted two hours after official sunrise, and will cease 2 hours prior to official sunset during the marbled murrelet nesting season (April 1 to September 23) to the extent practicable. This restriction reduces the potential for disturbance of marbled murrelets during their daily peak activity periods for feeding and incubation exchanges.

4. Project-related activities and human activity outside of vehicles and campers at the Upper Dungeness Acclimation site will be conducted two hours after official sunrise, and will cease 2 hours prior to official sunset during the marbled murrelet nesting season (April 1 to September 23) to the extent practicable.

Bull Trout and Marbled Murrelet

The USFWS believes that no more than 119 bull trout adults and subadults, offspring of 2 adult female bull trout, 102 juvenile bull trout, and marbled murrelets occupying 29 acres of habitat, will be incidentally taken as a result of the proposed action. The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided. The Federal agency must immediately provide an explanation of the causes of the taking and review with the USFWS the need for possible modification of the reasonable and prudent measures.

The USFWS is to be notified within three working days upon locating a dead, injured or sick endangered or threatened species specimen. Initial notification must be made to the nearest U.S. Fish and Wildlife Service Law Enforcement Office. Notification must include the date, time, precise location of the injured animal or carcass, and any other pertinent information. Care should be taken in handling sick or injured specimens to preserve biological materials in the best possible state for later analysis of cause of death, if that occurs. In conjunction with the care of sick or injured endangered or threatened species or preservation of biological materials from a dead animal, the finder has the responsibility to ensure that evidence associated with the specimen is not unnecessarily disturbed. Contact the U.S. Fish and Wildlife Service Law Enforcement Office at (425) 883-8122, or the USFWS's Washington Fish and Wildlife Office at (360) 753-9440.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

1. Because the coho and steelhead hatchery programs produce fish that support commercial, Tribal, and recreational fisheries, and limited data suggests that incidental capture of bull trout in some or all of these fisheries may be high, the NMFS and the WDFW should monitor and evaluate the scope and magnitude of incidental and illegal take of bull trout associated with these fisheries. These include:

    a) Instituting reporting requirements for incidental capture of bull trout in commercial and Tribal fisheries.

    b) Increasing law enforcement presence in the Dungeness River watershed during open recreational fisheries.

c) Increasing angler education and outreach on the following subjects: a) proper identification and handling of bull trout; b) the listed status of bull trout and illegality of intentionally killing or injuring bull trout; c) ecological importance of bull trout, particularly in helping to maintain abundance and vitality of naturally-reproducing salmonid populations, including steelhead trout.

d) Conducting periodic creel surveys to monitor and evaluate bull trout capture in recreational fisheries, and modifying timing and locations of open fisheries as necessary to reduce impacts to bull trout.

2. Because naturally-rearing juvenile coho salmon provide a critical seasonal forage resource to some size classes of bull trout, the WDFW should more fully evaluate the extent to which the coho hatchery program influences the abundance of naturally-rearing[1] coho salmon in the watershed. This should include determining the carrying capacity of naturally-rearing juvenile coho salmon in the Dungeness River watershed, and the extent to which this carrying capacity is utilized under current hatchery practices and production goals. If these evaluations find that the hatchery coho program limits the abundance of natural-rearing juvenile coho salmon, the WDFW should consider methods for more fully utilizing the carrying capacity for the benefit of bull trout. WDFW may consider increasing production of hatchery coho, or transitioning the hatchery program to an integrated one and reestablishing a self-sustaining naturally-reproducing population of coho salmon.

In order for the USFWS to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, the USFWS requests notification of the implementation of any conservation recommendations.

REINITIATION NOTICE

This concludes formal consultation on the action(s) outlined in the (request/reinitiation request). As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: 1) the amount or extent of incidental take is exceeded; 2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; 3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or 4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

[1] There is not believed to be a self-sustaining naturally-reproducing population of coho salmon in the watershed. Based on existing evidence, most naturally-rearing juvenile coho salmon in the Dungeness River watershed are first-generation progeny of hatchery-origin fish that strayed and spawned naturally in the watershed. Therefore, hatchery coho production has a significant influence on the abundance of naturally-rearing juvenile coho salmon in the watershed. See the discussion on pages 40 to 43 in the Genetic and Ecological Effects to Naturally-reproducing Salmonid Populations: Coho Salmon Program section for more information.

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APPENDIX A:
STATUS OF THE SPECIES (RANGEWIDE): BULL TROUT

Appendix A
Rangewide Status of the Species: Bull Trout

Listing Status

The coterminous United States population of the bull trout (*Salvelinus confluentus*) was listed as threatened on November 1, 1999 (64 FR 58910). Bull trout generally occur in the following areas: 1) Klamath River Basin of south-central Oregon; 2) the Jarbidge River in Nevada; 3) the Willamette River Basin in Oregon; 4) Pacific Coast drainages of Washington, including Puget Sound; 5) major rivers in Idaho, Oregon, Washington, and Montana, within the Columbia River Basin; and, 6) the St. Mary-Belly River, east of the Continental Divide in northwestern Montana (Bond 1992, p. 2; Brewin and Brewin 1997, p. 215; Cavender 1978, pp. 165-166; Leary and Allendorf 1997, pp. 716-719).

Throughout its range, bull trout are threatened by the combined effects of habitat degradation, fragmentation, and alterations associated with dewatering, road construction and maintenance, mining, grazing, the blockage of migratory corridors by dams or other diversion structures, poor water quality, entrainment (a process by which aquatic organisms are pulled through a diversion or other device) into diversion channels, and introduced non-native species (64 FR 58910). Although all salmonids are likely to be affected by climate change, bull trout are especially vulnerable given that spawning and rearing are constrained by their location in upper watersheds and the requirement for cold water temperatures (Battin et al. 2007, pp. 6672-6673; Rieman et al. 2007, p. 1552). Poaching and incidental mortality of bull trout during other targeted fisheries are additional threats.

The bull trout was initially listed as three separate Distinct Population Segments (DPSs) (63 FR 31647; 64 FR 17110). The preamble to the final listing rule for the United States coterminous population of the bull trout discusses the consolidation of these DPSs with the Columbia and Klamath population segments into one listed taxon and the application of the jeopardy standard under section 7 of the Endangered Species Act (Act) relative to this species (64 FR 58910):

> Although this rule consolidates the five bull trout DPSs into one listed taxon, based on conformance with the DPS policy for purposes of consultation under section 7 of the Act, we intend to retain recognition of each DPS in light of available scientific information relating to their uniqueness and significance. Under this approach, these DPSs will be treated as interim recovery units with respect to application of the jeopardy standard until an approved recovery plan is developed. Formal establishment of bull trout recovery units will occur during the recovery planning process.

Recovery Planning

Between 2002 and 2004, three separate draft bull trout recovery plans were completed. In 2002, a draft recovery plan that addressed bull trout populations within the Columbia, Saint Mary-Belly, and Klamath River basins (USFWS 2002) was completed and included individual chapters for 24 separate recovery units. In 2004, draft recovery plans were developed for the

Coastal-Puget Sound drainages in western Washington, including two recovery unit chapters (USFWS 2004), and for the Jarbidge River in Nevada (USFWS 2004). None of these draft recovery plans were finalized, but they have served to identify recovery actions across the range of the species and to provide a framework for implementing numerous recovery actions by our partner agencies, local working groups, and others with an interest in bull trout conservation.

The U.S. Fish and Wildlife Service (Service) released a final bull trout recovery plan in September 2015 (USFWS 2015). The recovery plan: 1) incorporates and builds upon new information found in numerous reports and studies regarding bull trout life history, ecology, etc., including a variety of implemented conservation actions, since the draft 2002 and 2004 recovery planning period; and, 2) revises recovery criteria proposed in the 2002 and 2004 draft recovery plans to focus on effective management of threats to bull trout at the core area level, and de-emphasize achieving targeted point estimates of abundance of adult bull trout (demographics) in each core area.

The 2002 and 2004 draft recovery plans provide the general life history information, habitat characteristics, diet, reasons for decline, and distribution and abundance of the different core areas. The 2015 final recovery plan integrates new information collected since the 1999 listing regarding bull trout life history, distribution, demographics, conservation successes, etc., and updates previous bull trout recovery planning efforts across the range of the single DPS currently listed under the Act. The 2015 final recovery plan supersedes and replaces the previous draft recovery plans; however, the 2002 and 2004 draft recovery plans still provide important information on bull trout status and life history.

The 2015 recovery plan establishes four categories of recovery actions for bull trout:

1) Protect, restore, and maintain suitable habitat conditions for bull trout.

2) Minimize demographic threats to bull trout by restoring connectivity or populations where appropriate to promote diverse life history strategies and conserve genetic diversity.

3) Prevent and reduce negative effects of non-native fishes and other non-native taxa on bull trout.

4) Work with partners to conduct research and monitoring to implement and evaluate bull trout recovery activities, consistent with an adaptive management approach using feedback from implemented, site-specific recovery tasks, and considering the effects of climate change.

Current Status and Conservation Needs

Bull trout recovery is based on a geographical hierarchical approach. Bull trout are listed as a single DPS within the five-state area of the coterminous United States. The single DPS is subdivided into six biologically-based recovery units (RUs): 1) Coastal Recovery Unit; 2) Klamath Recovery Unit; 3) Mid-Columbia Recovery Unit; 4) Upper Snake Recovery Unit; 5) Columbia Headwaters Recovery Unit; and, 6) Saint Mary Recovery Unit (USFWS 2015, p. 36). These are viable recovery units that meet the three primary principles of biodiversity: representation (conserving the breadth of the genetic makeup of the species to conserve its adaptive capabilities); resilience (ensuring that each population is sufficiently large to withstand stochastic events); and redundancy (ensuring a sufficient number of populations to provide a margin of safety for the species to withstand catastrophic events) (USFWS 2015, p. 33).

Each of the six RUs contain multiple bull trout core areas, 116 total, which are non-overlapping watershed-based polygons, and each core area includes one or more local populations. Currently there are 109 occupied core areas, which comprise 600 or more local populations. There are also six core areas where bull trout historically occurred but are now extirpated, and one research needs area where bull trout were known to occur historically, but their current presence and use of the area are uncertain.

Core areas can be further described as complex or simple. Complex core areas contain multiple bull trout local populations, are found in large watersheds, have multiple life history forms, and have migratory connectivity between spawning and rearing habitat and foraging, migration, and overwintering habitats (FMO). Simple core areas are those that contain one bull trout local population. Simple core areas are small in scope, isolated from other core areas by natural barriers, and may contain unique genetic or life history adaptations.

A local population is a group of bull trout that spawn within a particular stream or portion of a stream system. A local population is the smallest group of fish known to represent an interacting reproductive unit. For most waters where specific information is lacking, a local population may be represented by a single headwater tributary or complex of headwater tributaries. Gene flow may occur between local populations (*e.g.*, those within a core population), but is assumed to be infrequent compared with that among individuals within a local population.

The habitat requirements of bull trout are often generally expressed as the four "Cs": cold, clean, complex, and connected habitat. Cold stream temperatures, clean water quality that is relatively free of sediment and contaminants, complex channel characteristics (including abundant large wood and undercut banks), and large patches of such habitat that are well connected by unobstructed migratory pathways are all needed to promote conservation of bull trout throughout all hierarchical levels.

Recovery Units

The following is a summary of the description and current status of bull trout within the six RUs. More comprehensive discussions can be found in the 2015 final bull trout recovery plan (USFWS 2015) and the individual RU implementation plans.

<u>Coastal Recovery Unit</u>

The Coastal RU is located within western Oregon and Washington. The Coastal RU is divided into three regions: Puget Sound, Olympic Peninsula, and the Lower Columbia River Regions. This RU contains 21 occupied core areas and 85 local populations, including the Clackamas River core area where bull trout had been extirpated and were reintroduced in 2011. This RU also contains four historically occupied core areas that could be re-established with bull trout. Core areas within Puget Sound and the Olympic Peninsula currently support the only anadromous local populations of bull trout. This RU also contains ten shared FMO habitats that are outside core areas but that allow for the continued natural population dynamics in which the core areas have evolved. There are four core areas within the Coastal RU that have been identified as current population strongholds: Lower Skagit, Upper Skagit, Quinault River, and Lower Deschutes River. These are the most stable and abundant bull trout populations in the RU. The current condition of bull trout in this RU is attributed to: the adverse effects of climate change; loss of functioning estuarine and nearshore marine habitats; residential, commercial, and industrial development and urbanization and related impacts (e.g., flood control, floodplain disconnection, bank armoring, channel straightening; loss of instream habitat complexity); agriculture (e.g., diking, water control structures, draining of wetlands, channelization, and the removal of riparian vegetation, livestock grazing); connectivity impairment and fish passage obstructions (e.g., dams, culverts, instream flows); forest management practices (e.g., timber harvest and associated road building activities); mining; and the introduction of non-native species. Conservation measures or recovery actions implemented include relicensing of major hydropower facilities that have improved upstream and downstream fish passage or complete removal of dams, land acquisition to conserve bull trout habitat, floodplain restoration, culvert removal, riparian revegetation, levee setbacks, road removal, and projects to protect and restore important nearshore marine habitats.

Klamath Recovery Unit

The Klamath RU is located in southern Oregon and northwestern California. The Klamath RU is the most significantly imperiled recovery unit, having experienced considerable extirpation and geographic contraction of local populations and declining demographic condition, and natural re-colonization is constrained by dispersal barriers and presence of nonnative brook trout. This RU currently contains three occupied core areas and eight local populations. Nine historic local populations of bull trout have been extirpated, and restoring additional local populations will be necessary to achieve recovery. All three core areas have been isolated from other bull trout populations for the past 10,000 years. The current condition of bull trout in this RU is attributed to the adverse effects of climate change, habitat degradation and fragmentation, past and present land use practices, agricultural water diversions, nonnative species, and past fisheries management practices. Conservation measures or recovery actions implemented include removal of nonnative fish (e.g., brook trout, brown trout, and hybrids), acquiring water rights for instream flows, replacing diversion structures, installing fish screens, constructing bypass channels, installing riparian fencing, culver replacement, and habitat restoration.

Mid-Columbia Recovery Unit

The Mid-Columbia RU is located within eastern Washington, eastern Oregon, and portions of central Idaho. The Mid-Columbia RU is divided into four geographic regions: Lower Mid-Columbia, Upper Mid-Columbia, Lower Snake, and Mid-Snake Geographic Regions. This IRU contains 25 occupied core areas, two historically occupied core areas, one research needs area, and seven FMO habitats. The current condition of the bull trout in this RU is attributed to the adverse effects of climate change, agricultural practices (e.g. irrigation, water withdrawals, livestock grazing), fish passage barriers (e.g. dams, culverts), nonnative species, forest management practices, and mining. Conservation measures or recovery actions implemented include road removal, channel restoration, mine reclamation, improved grazing management, removal of fish barriers, and instream flow requirements.

Upper Snake Recovery Unit

The Upper Snake RU is located in central Idaho, northern Nevada, and eastern Oregon. The Upper Snake RU is divided inoto seven geographic regions: Salmon River, Boise River, Payette River, Little Lost River, Malheur River, Jarbidge River, and Weiser River. This RU contains 22 occupied core areas and 206 local populations, with almost 60 percent being present in the Salmon River Region. The current condition of the bull trout in this RU is attributed to the adverse effects of climate change, dams, mining, forest management practices, nonnative species, and agriculture (e.g., water diversions, grazing). Conservation measures or recovery actions implemented include instream habitat restoration, instream flow requirements, screening of irrigation diversions, and riparian restoration.

Columbia Headwaters Recovery Unit

The Columbia Headwaters RU is located in western Montana, northern Idaho, and the northeastern corner of Washington. The Columbia Headwaters RU is divided into five geographic regions: Upper Clark Fork, Lower Clark Fork, Flathead, Kootenai, and Coeur d'Alene Geographic Regions. This RU contains 35 occupied core areas: 15 complex core areas represented by larger interconnected habitats, and 20 simple core areas comprising isolated headwater lakes with single local populations. The 20 simple core areas are each represented by a single local population, many of which may have persisted for thousands of years despite small populations and isolated existence. Fish passage improvements within the RU have reconnected previously fragmented habitats. The current condition of bull trout in this RU is attributed to the adverse effects of climate change, mining and contamination by heavy metals, nonnative species, modified instream flows, migratory barriers (e.g., dams), habitat fragmentation, forest practices (e,g., logging, roads), agriculture practices (e.g. irrigation, livestock grazing), and residential development. Conservation measures or recovery actions implemented include habitat improvement, fish passage, and removal of nonnative species. Unlike the other RUs, the Columbia Headwaters RU does not have any anadromous fish overlap. Therefore, bull trout within the Columbia Headwaters RU do not benefit from the recovery actions for salmon.

Saint Mary Recovery Unit

The Saint Mary RU is located in Montana but is heavily linked to downstream resources in southern Alberta, Canada. Most of the watershed in this RU is located in Canada. The United States portion includes headwater spawning and rearing habitat and the upper reaches of FMO habitat. This RU contains four occupied core areas, and eight local populations. The current condition of bull trout in this RU is attributed to the adverse effects of climate change, the Saint Mary Diversion operated by the Bureau of Reclamation (e.g., entrainment, fish passage, instream flows), and nonnative species. The primary issue precluding bull trout recovery in this RU relates to impacts of water diversions, specifically at the Bureau of Reclamations Milk River Project.

Life History

Bull trout exhibit both resident and migratory life history strategies. Both resident and migratory forms may be found together, and either form may produce offspring exhibiting either resident or migratory behavior (Rieman and McIntyre 1993, pp. 1-18). Resident bull trout complete their entire life cycle in the tributary (or nearby) streams in which they spawn and rear. The resident form tends to be smaller than the migratory form at maturity and also produces fewer eggs (Fraley and Shepard 1989, p. 1; Goetz 1989, pp. 15-16). Migratory bull trout spawn in tributary streams where juvenile fish rear 1 to 4 years before migrating to either a lake (adfluvial form), river (fluvial form) (Fraley and Shepard 1989, pp. 135-137; Goetz 1989, pp. 22-25), or saltwater (anadromous form) to rear as subadults and to live as adults (Cavender 1978, pp. 139, 165-68; McPhail and Baxter 1996, p. 14; WDFW et al. 1997, pp. 17-18, 22-26). Bull trout normally reach sexual maturity in 4 to 7 years and may live longer than 12 years. They are iteroparous (they spawn more than once in a lifetime). Repeat- and alternate-year spawning has been reported, although repeat-spawning frequency and post-spawning mortality are not well documented (Fraley and Shepard 1989, pp. 135-137; Leathe and Graham 1982, p. 95; Pratt 1992, p. 6; Rieman and McIntyre 1996, p. 133).

The iteroparous reproductive strategy of bull trout has important repercussions for the management of this species. Bull trout require adult and subadult passage both upstream and downstream, not only for repeat spawning but also for foraging. Most fish ladders, however, were designed specifically for anadromous semelparous salmonids (fishes that spawn once and then die, and require only one-way adult passage upstream). Therefore, dams or other barriers with fish passage facilities may be a factor in isolating bull trout populations if they do not provide a downstream passage route for adults and subadults. Additionally, in some core areas, bull trout that migrate to marine waters must pass both upstream and downstream through areas with net fisheries at river mouths. This can increase the likelihood of mortality to bull trout during these spawning and foraging migrations.

Growth varies depending upon life-history strategy. Resident adults range from 6 to 12 inches total length, and migratory adults commonly reach 24 inches or more (Goetz 1989, pp. 29-32; Pratt 1984, p. 13). The largest verified bull trout is a 32-pound specimen caught in Lake Pend Oreille, Idaho, in 1949 (Simpson and Wallace 1982).

Habitat Characteristics

Bull trout have more specific habitat requirements than most other salmonids (Rieman and McIntyre 1993, p. 7). Habitat components that influence bull trout distribution and abundance include water temperature, cover, channel form and stability, valley form, spawning and rearing substrate, and migratory corridors (Fraley and Shepard 1989, pp. 137, 141; Goetz 1989, pp. 19-26; Bond in Hoelscher and Bjornn 1989, p. 57; Howell and Buchanan 1992, p. 1; Pratt 1992, p. 6; Rich 1996, pp. 35-38; Rieman and McIntyre 1993, pp. 4-7; Rieman and McIntyre 1995, pp. 293-294; Sedell and Everest 1991, p. 1; Watson and Hillman 1997, pp. 246-250). Watson and Hillman (1997, pp. 247-249) 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, p. 7), bull trout should not be expected to simultaneously occupy all available habitats (Rieman et al. 1997, p. 1560).

Migratory corridors link seasonal habitats for all bull trout life histories. The ability to migrate is important to the persistence of bull trout (Gilpin, in litt. 1997, pp. 4-5; Rieman and McIntyre 1993, p. 7; Rieman et al. 1997, p. 1114). Migrations facilitate gene flow among local populations when individuals from different local populations interbreed or stray to nonnatal streams. Local populations that are extirpated by catastrophic events may also become reestablished by bull trout migrants. However, it is important to note that the genetic structuring of bull trout indicates there is limited gene flow among bull trout populations, which may encourage local adaptation within individual populations, and that reestablishment of extirpated populations may take a long time (Rieman and McIntyre 1993, p. 7; Spruell et al. 1999, pp. 118-120). Migration also allows bull trout to access more abundant or larger prey, which facilitates growth and reproduction. Additional benefits of migration and its relationship to foraging are discussed below under "Diet."

Cold water temperatures play an important role in determining bull trout habitat quality, as these fish are primarily found in colder streams (below 15 °C or 59 °F), and spawning habitats are generally characterized by temperatures that drop below 9 °C (48 °F) in the fall (Fraley and Shepard 1989, p. 133; Pratt 1992, p. 6; Rieman and McIntyre 1993, p. 7).

Thermal requirements for bull trout appear to differ at different life stages. Spawning areas are often associated with cold-water springs, groundwater infiltration, and the coldest streams in a given watershed (Baxter et al. 1997, pp. 426-427; Pratt 1992, p. 6; Rieman and McIntyre 1993, p. 7; Rieman et al. 1997, p. 1117). Optimum incubation temperatures for bull trout eggs range from 2 °C to 6 °C (35 °F to 39 °F) whereas optimum water temperatures for rearing range from about 6 °C to 10 °C (46 °F to 50 °F) (Buchanan and Gregory 1997, pp. 121-122; Goetz 1989, pp. 22-24; McPhail and Murray 1979, pp. 41, 50, 53, 55). In Granite Creek, Idaho, Bonneau and Scarnecchia (1996) observed that juvenile bull trout selected the coldest water available in a plunge pool, 8 °C to 9 °C (46 °F to 48 °F), within a temperature gradient of 8 °C to 15 °C (4 °F to 60 °F). In a landscape study relating bull trout distribution to maximum water temperatures, Dunham et al. (2003) found that the probability of juvenile bull trout occurrence does not become high (i.e., greater than 0.75) until maximum temperatures decline to 11 °C to 12 °C (52 °F to 54 °F).

Although bull trout are found primarily in cold streams, occasionally these fish are found in larger, warmer river systems throughout the Columbia River basin (Buchanan and Gregory 1997, pp. 121-122; Fraley and Shepard 1989, pp. 135-137; Rieman and McIntyre 1993, p. 2; Rieman and McIntyre 1995, p. 288; Rieman et al. 1997, p. 1114). Availability and proximity of cold water patches and food productivity can influence bull trout ability to survive in warmer rivers (Myrick et al. 2002). For example, in a study in the Little Lost River of Idaho where bull trout were found at temperatures ranging from 8 °C to 20 °C (46 °F to 68 °F), most sites that had high densities of bull trout were in areas where primary productivity in streams had increased following a fire (Gamett, pers. comm. 2002).

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, pp. 135-137; Goetz 1989, pp. 22-25; Hoelscher and Bjornn 1989, p. 54; Pratt 1992, p. 6; Rich 1996, pp. 35-38; Sedell and Everest 1991, p. 1; Sexauer and James 1997, pp. 367-369; Thomas 1992, pp. 4-5; Watson and Hillman 1997, pp. 247-249). Maintaining bull trout habitat requires stability of stream channels and maintenance of natural flow patterns (Rieman and McIntyre 1993, p. 7). Juvenile and adult bull trout frequently inhabit side channels, stream margins, and pools with suitable cover (Sexauer and James 1997, pp. 367-369). 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, pp. 135-137; Pratt 1992, p. 6; Pratt and Huston 1993, pp. 70-72). Pratt (1992, p. 6) indicated that increases in fine sediment reduce egg survival and emergence.

Bull trout typically spawn from August through November during periods of increasing flows and decreasing water temperatures. Preferred spawning habitat consists of low-gradient stream reaches with loose, clean gravel (Fraley and Shepard 1989, p. 135). Redds are often constructed in stream reaches fed by springs or near other sources of cold groundwater (Goetz 1989, p. 15; Pratt 1992, p. 8; Rieman and McIntyre 1996, p. 133). Depending on water temperature, incubation is normally 100 to 145 days (Pratt 1992, p. 8). After hatching, fry remain in the substrate, and time from egg deposition to emergence may surpass 200 days. Fry normally emerge from early April through May, depending on water temperatures and increasing stream flows (Ratliff and Howell 1992 in Howell and Buchanan 1992, pp. 10, 15; Pratt 1992, pp. 5-6).

Early life stages of fish, specifically the developing embryo, require the highest inter-gravel dissolved oxygen (IGDO) levels, and are the most sensitive life stage to reduced oxygen levels. The oxygen demand of embryos depends on temperature and on stage of development, with the greatest IGDO required just prior to hatching.

A literature review conducted by the Washington Department of Ecology (WDOE 2002) indicates that adverse effects of lower oxygen concentrations on embryo survival are magnified as temperatures increase above optimal (for incubation). In a laboratory study conducted in Canada, researchers found that low oxygen levels retarded embryonic development in bull trout (Giles and Van der Zweep 1996, pp. 54-55). Normal oxygen levels seen in rivers used by bull trout during spawning ranged from 8 to 12 mg/L (in the gravel), with corresponding instream levels of 10 to 11.5 mg/L (Stewart et al. 2007). In addition, IGDO concentrations, water velocities in the water column, and especially the intergravel flow rate, are interrelated variables that affect the survival of incubating embryos (ODEQ 1995). Due to a long incubation period of 220+ days, bull trout are particularly sensitive to adequate IGDO levels. An IGDO level below 8 mg/L is likely to result in mortality of eggs, embryos, and fry.

Migratory forms of bull trout may develop when habitat conditions allow movement between spawning and rearing streams and larger rivers, lakes, or nearshore marine habitat where foraging opportunities may be enhanced (Brenkman and Corbett 2005, pp. 1073, 1079-1080; Frissell 1993, p. 350; Goetz et al. 2004, pp. 45, 55, 60, 68, 77, 113-114, 123, 125-126). For example, multiple life history forms (e.g., resident and fluvial) and multiple migration patterns have been noted in the Grande Ronde River (Baxter 2002). Parts of this river system have retained habitat conditions that allow free movement between spawning and rearing areas and the mainstem Snake River. Such multiple life history strategies help to maintain the stability and persistence of bull trout populations to environmental changes. Benefits to migratory bull trout include greater growth in the more productive waters of larger streams, lakes, and marine waters; greater fecundity resulting in increased reproductive potential; and dispersing the population across space and time so that spawning streams may be recolonized should local populations suffer a catastrophic loss (Frissell 1999, pp. 15-16; Rieman and McIntyre 1993, pp. 18-19; MBTSG 1998, pp. iv, 48-50; USFWS 2004a, Vol. 2, p. 63). In the absence of the migratory bull trout life form, isolated populations cannot be replenished when disturbances make local habitats temporarily unsuitable. Therefore, the range of the species is diminished, and the potential for a greater reproductive contribution from larger fish with higher fecundity is lost (Rieman and McIntyre 1993, pp. 1-18).

Diet

Bull trout are opportunistic feeders, with food habits primarily a function of size and life-history strategy. A single optimal foraging strategy is not necessarily a consistent feature in the life of a fish, because this strategy can change as the fish progresses from one life stage to another (i.e., juvenile to subadult). Fish growth depends on the quantity and quality of food that is eaten (Gerking 1994), and as fish grow, their foraging strategy changes as their food changes, in quantity, size, or other characteristics. Resident and juvenile migratory bull trout prey on terrestrial and aquatic insects, macrozooplankton, and small fish (Boag 1987, p. 58; Donald and Alger 1993, pp. 239-243; Goetz 1989, pp. 33-34). Subadult and adult migratory bull trout feed on various fish species (Brown 1994, p. 21; Donald and Alger 1993, p. 242; Fraley and Shepard 1989, p. 135; Leathe and Graham 1982, p. 95). Bull trout of all sizes other than fry have been found to eat fish up to half their length (Beauchamp and VanTassell 2001). Bull trout may feed heavily on fish eggs in watersheds shared with anadromous salmon (Lowery and Beauchamp 2015). In nearshore marine areas of western Washington, bull trout feed on Pacific herring (*Clupea pallasi*), Pacific sand lance (*Ammodytes hexapterus*), and surf smelt (*Hypomesus pretiosus*) (Goetz et al. 2004, p. 114; WDFW et al. 1997, p. 23).

Bull trout migration and life history strategies are closely related to their feeding and foraging strategies. Migration allows bull trout to access optimal foraging areas and exploit a wider variety of prey resources. Optimal foraging theory can be used to describe strategies fish use to choose between alternative sources of food by weighing the benefits and costs of capturing one source of food over another. For example, prey often occur in concentrated patches of abundance ("patch model") (Gerking 1994). As the predator feeds in one patch, the prey population is reduced, and it becomes more profitable for the predator to seek a new patch rather than continue feeding on the original one. This can be explained in terms of balancing energy acquired versus energy expended. For example, in the Skagit River system, anadromous bull trout make migrations as long as 121 miles between marine foraging areas in Puget Sound and headwater spawning grounds, foraging on salmon eggs and juvenile salmon along their migration route (WDFW et al. 1997). Anadromous bull trout also use marine waters as migration corridors to reach seasonal habitats in non-natal watersheds to forage and possibly overwinter (Brenkman and Corbett 2005, p. 1079; Goetz et al. 2004, pp. 36, 60).

Effects of Climate Change on Bull Trout

The terms "climate" and "climate change" are defined by the Intergovernmental Panel on Climate Change (IPCC). "Climate" refers to the mean and variability of different types of weather conditions over time, with 30 years being a typical period for such measurements, although shorter or longer periods also may be used (IPCC 2007, p. 78). The term "climate change" thus refers to a change in the mean or variability of one or more measures of climate (e.g., temperature or precipitation) that persists for an extended period, typically decades or longer, whether the change is due to natural variability, human activity, or both (IPCC 2007, p. 78). Various types of changes in climate can have direct or indirect effects on species. These effects may be positive, neutral, or negative and they may change over time, depending on the species and other relevant considerations, such as the effects of interactions of climate with other variables (e.g., habitat fragmentation) (IPCC 2007, pp. 8–14, 18–19).

Climate change is likely to play an increasingly important role in determining the abundance of ESA-listed species and the conservation value of designated critical habitats in the Pacific Northwest. These changes will not be spatially homogeneous across the Pacific Northwest. Areas with elevations high enough to maintain temperatures well below freezing for most of the winter and early spring will be less affected. Low-elevation areas are likely to be more affected. During the last century, average regional air temperatures increased by 1.5 °F, with increases as much as 4 °F in isolated areas (USGCRP 2009). Average regional temperatures are likely to increase an additional 3 °F to 10 °F over the next century (USGCRP 2009). Overall, about one-third of the current cold-water fish habitat in the Pacific Northwest is likely to exceed key water temperature thresholds by the end of this century (USGCRP 2009).

Precipitation trends during the next century are less certain than for temperature, but more precipitation is likely to occur during October through March, less may occur during summer months, and more winter precipitation is likely to fall as rain rather than snow (ISAB 2007; USGCRP 2009). Significant reductions in both total snow pack and low-elevation snow pack in the Pacific Northwest is predicted over the next 50 years (Mote and Salathé 2010) – changes that will shrink the extent of the snowmelt-dominated habitat available to salmonids. Where snow occurs, a warmer climate will cause earlier runoff, which will increase flows in early spring but will likely reduce flows and increase water temperature in late spring, summer, and fall (ISAB 2007; USGCRP 2009).

As the snow pack diminishes and seasonal hydrology shifts to more frequent and severe early large storms, stream flow timing and increased peak river flows may limit salmonid survival (Mantua et al. 2010). Lower stream flows and warmer water temperatures during summer will degrade summer rearing conditions, in part by increasing the prevalence and virulence of fish diseases and parasites (USGCRP 2009). To avoid waters above summer maximum temperatures, juvenile rearing may be increasingly found only in the confluence of colder tributaries or other areas of cold water refugia (Mantua et al. 2010). Other adverse effects are likely to include altered migration patterns, accelerated embryo development, premature emergence of fry, variation in quality and quantity of tributary rearing habitat, and increased competition and predation risk from warm-water, non-native species (ISAB 2007).

The earth's oceans are also warming, with considerable interannual and inter-decadal variability superimposed on the longer-term trend (Bindoff et al. 2007). Historically, warm periods in the coastal Pacific Ocean have coincided with relatively low abundances of salmonids, while cooler ocean periods have coincided with relatively high abundances (Scheuerell and Williams 2005; Zabel et al. 2006; USGCRP 2009). Ocean conditions adverse to salmonids may be more likely under a warming climate (Zabel et al. 2006).

Ocean acidification resulting from the uptake of carbon dioxide by ocean waters threatens corals, shellfish, and other living things that form their shells and skeletons from calcium carbonate (Orr et al. 2005; Feely et al. 2012). Such ocean acidification is essentially irreversible over a time scale of centuries (Royal Society 2005). Increasing carbon dioxide concentrations are reducing ocean pH and dissolved carbonate ion concentrations, and thus levels of calcium carbonate saturation. Over the past several centuries, ocean pH has decreased by about 0.1 (an approximately 30 percent increase in acidity) and is projected to decline by another 0.3 to 0.4 pH units (approximately 100 to 150 percent increase in acidity) by the end of this century (Orr et al. 2005; Feely et al. 2012). As aqueous carbon dioxide concentrations increase, carbonate ion concentrations decrease, making it more difficult for marine calcifying organisms to form biogenic calcium carbonate needed for shell and skeleton formation. The reduction in pH also affects photosynthesis, growth, and reproduction of marine organisms. The upwelling of deeper ocean water deficient in carbonate, and thus potentially detrimental to the food chains supporting juvenile salmonids, has recently been observed along the U.S. west coast (Feely et al. 2008).

Climate change is expected to make recovery targets for ESA-listed species more difficult to achieve. Actions improving freshwater and estuarine habitats can offset some of the adverse impacts of climate change. Examples include restoring connections to historical floodplains and estuarine habitats, protecting and restoring riparian vegetation, purchasing or applying easements to lands that provide important cold water or refuge habitat, and leasing or buying water rights to improve summer flows (Battin et al. 2007; ISAB 2007).

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APPENDIX B
STATUS OF THE SPECIES: MARBLED MURRELET

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Appendix B
Rangewide Status of the Species: Marbled Murrelet

The marbled murrelet (*Brachyramphus marmoratus*) (murrelet) was listed by the U.S. Fish and Wildlife Service (Service) as a threatened species in Washington, Oregon, and California in 1992. The primary reasons for listing included extensive loss and fragmentation of the older-age forests that serve as nesting habitat for murrelets, and human-induced mortality in the marine environment from gillnets and oil spills (57 FR 45328 [Oct. 1, 1992]). Although some threats such as gillnet mortality and loss of nesting habitat on Federal lands have been reduced since the 1992 listing, the primary threats to species persistence continue (75 FR 3424 [Jan. 21, 2010]).

Life History

The murrelet is a small, fast-flying seabird in the Alcidae family that occurs along the Pacific coast of North America. Murrelets forage for small schooling fish or invertebrates in shallow, nearshore, marine waters and primarily nest in coastal older-aged coniferous forests. The murrelet lifespan is unknown, but is expected to be in the range of 10 to 20 years based on information from similar alcid species (De Santo and Nelson 1995, pp. 36-37). Murrelet nesting is asynchronous and spread over a prolonged season. In Washington, the murrelet breeding season extends from April 1 to September 23. Egg laying and incubation occur from April to early August and chick rearing occurs between late May and September, with all chicks fledging by late September (Hamer et al. 2003; USFWS 2012a).

Murrelets lay a single-egg which may be replaced if egg failure occurs early in the nesting cycle, but this is rare (Nelson 1997, p. 17). During incubation, one adult sits on the nest while the other forages at sea. Adults typically incubate for a 24-hour period, then exchange duties with their mate at dawn. Chicks hatch between May and August after 30 days of incubation. Hatchlings appear to be brooded by an adult for several days (Nelson 1997, p. 18). Once the chick attains thermoregulatory independence, both adults leave the chick alone at the nest for the remainder of the rearing period, except during feedings. Both parents feed the chick, which receives one to eight meals per day (Nelson 1997, p. 18). Most meals are delivered early in the morning while about a third of the food deliveries occur at dusk and intermittently throughout the day (Nelson and Hamer 1995, p. 62).

Murrelets and other fish-eating alcids exhibit wide variations in nestling growth rates. The nestling stage of murrelet development can vary from 27 to 40 days before fledging (De Santo and Nelson 1995, p. 45). The variations in alcid chick development are attributed to constraints on feeding ecology, such as unpredictable and patchy food distributions, and great distances between feeding and nesting sites (Øyan and Anker-Nilssen 1996, p. 830). Food limitation during nesting often results in poor growth, delayed fledging, increased mortality of chicks, and nest abandonment by adults (Øyan and Anker-Nilssen 1996, p. 836).

Murrelets are believed to be sexually mature at 2 to 4 years of age (Nelson 1997, p. 19). Adult birds may not nest every year, especially when food resources are limited. Recent monitoring efforts in Washington indicated that only 20 percent of monitored murrelet nesting attempts were successful, and only a small portion of the 158 tagged adult birds actually attempted to nest (13 percent) (Raphael and Bloxton 2009, p. 165). The low number of adults attempting to nest is not unique to Washington. Some researchers suspect that the portion of non-breeding adults in murrelet populations can range from about 5 percent to 70 percent depending on the year, but most population modeling studies suggest a range of 5 to 20 percent (McShane et al. 2004, p. 3-5).

Murrelets in the Marine Environment

Marbled murrelets spend most (>90 percent) of their time at sea. Their preferred marine habitat includes sheltered, nearshore waters within 3 miles of shore, although they occur farther offshore in areas of Alaska and during the nonbreeding season (Huff et al. 2006, p. 19). They generally forage in pairs on the water, but they also forage solitarily or in small groups.

Breeding Season

The murrelet is widely distributed in nearshore waters along the west coast of North America. It occurs primarily within 5 km of shore (Alaska, within 50 km), and primarily in protected waters, although its distribution varies with coastline topography, river plumes, riptides, and other physical features (Nelson 1997, p. 3). Murrelet marine distribution is strongly associated with the amount and configuration of terrestrial nesting habitat (Raphael et al. 2015c, p. 17). In other words, they tend to be distributed in marine waters adjacent to areas of suitable breeding habitat. Non-breeding adults and subadults are thought to occur in similar areas as breeding adults. This species does occur farther offshore, but in much reduced numbers (Strachan et al. 1995, p. 247). Their offshore occurrence is probably related to current upwelling and plumes during certain times of the year that tend to concentrate their prey species.

Winter Range

The winter range of the murrelet is poorly documented, but they are present near breeding sites year-round in most areas (Nelson 1997, p. 3). Murrelets exhibit seasonal redistributions during non-breeding seasons. Generally more dispersed and found farther offshore in winter in some areas, although highest concentrations still occur close to shore and in protected waters (Nelson 1997, p. 3). In some areas, murrelets move from the outer exposed coasts of of Vancouver Island and the Straits of Juan de Fuca into the sheltered and productive waters of northern and eastern Puget Sound. Less is known about seasonal movements along the outer coasts of Washington, Oregon, and California (Ralph et al. 1995, p. 9). The farthest offshore records of murrelet distribution are 60 km off the coast of northern California in October, 46 km off the coast of Oregon in February (Adams et al. 2014) and at least 300 km off the coast in Alaska (Piatt and Naslund 1995, p. 287). Known areas of winter concentration include and southern and eastern end of Strait of Juan de Fuca (primarily Sequim, Discovery, and Chuckanut Bays), San Juan Islands and Puget Sound, WA (Speich and Wahl 1995, p. 314).

Foraging and Diet

Murrelets dive and swim through the water by using their wings in pursuit of their prey; their foraging and diving behavior is restricted by physiology. They usually feed in shallow, nearshore water <30 m (98 ft) deep, which seems to provide them with optimal foraging conditions for their generalized diet of small schooling fish and large, pelagic invertebrates: Pacific sand lance (*Ammodytes hexapterus*), northern anchovy (*Engraulis mordax*), Pacific herring (*Clupea harengus*), surf smelt (*Hypomesus* sp.), euphausiids, mysids, amphipods, and other species (Nelson 1997, p. 7). However, they are assumed to be capable of diving to a depth of 47 m (157 ft) based on their body size and diving depths observed for other Alcid species (Mathews and Burger 1998, p. 71).

Contemporary studies of murrelet diets in the Puget Sound–Georgia Basin region indicate that Pacific sand lance now comprise the majority of the murrelet diet (Gutowsky et al. 2009, p. 251). Historically, energy-rich fishes such as herring and northern anchovy comprised the majority of the murrelet diet (Becker and Beissinger 2006, p. 470; Gutowsky et al. 2009, p. 247). This is significant because sandlance have the lowest energetic value of the fishes that murrelets commonly consume. For example, a single northern anchovy has nearly six times the energetic value of a sandlance of the same size (Gutowsky et al. 2009, p. 251), so a murrelet would have to eat six sandlance to get the equivalent energy of a single anchovy. Reductions in the abundance of energy-rich forage fish species is likely a contributing factor in the poor reproduction in murrelets (Becker and Beissinger 2006, p. 470).

The duration of dives appears to depend upon age (adults vs. juveniles), water depth, visibility, and depth and availability of prey. Dive duration has been observed ranging from 8 seconds to 115 seconds, although most dives are between 25 to 45 seconds (Day and Nigro 2000; Jodice and Collopy 1999; Thoresen 1989; Watanuki and Burger 1999). Diving bouts last over a period of 27 to 33 minutes (Nelson 1997, p. 9). They forage in deeper waters when upwelling, tidal rips, and daily activity of prey concentrate prey near the surface (Strachan et al. 1995). Murrelets are highly mobile and some make substantial changes in their foraging sites within the breeding season. For example, Becker and Beissinger (2003, p. 243) found that murrelets responded rapidly (within days or weeks) to small-scale variability in upwelling intensity and prey availability by shifting their foraging behavior and habitat selection within a 100-km (62-mile) area.

For more information on murrelet use of marine habitats, see literature reviews in McShane et al. 2004 and USFWS 2009.

Murrelets in the Terrestrial Environment

Murrelets are dependent upon older-age forests, or forests with an older tree component, for nesting habitat (Hamer and Nelson 1995, p. 69). Specifically, murrelets prefer high and broad platforms for landing and take-off, and surfaces which will support a nest cup (Hamer and Nelson 1995, pp. 78-79). In Washington, murrelet nests have been found in live conifers, specifically, western hemlock (*Tsuga heterophylla*), Sitka spruce (*Picea sitchensis*), Douglas-fir (*Pseudotsuga menziesii*), and western red cedar (*Thuja plicata*) (Hamer and Nelson 1995; Hamer and Meekins 1999). Most murrelets appear to nest within 37 miles of the coast, although occupied behaviors have been recorded up to 52 miles inland, and murrelet presence has been detected up to 70 miles inland in Washington (Huff et al. 2006, p. 10). Nests occur primarily in large, older-aged trees. Overall, nests have been found in trees greater than 19 inches in diameter-at-breast and greater than 98 ft tall. Nesting platforms include limbs or other branch deformities that are greater than 4 inches in diameter, and are at greater than 33 ft above the ground. Substrate such as moss or needles on the nest platform is important for protecting the egg and preventing it from falling off (Huff et al. 2006, p. 13).

Murrelets do not form dense colonies which is atypical of most seabirds. Limited evidence suggests they may form loose colonies in some cases (Ralph et al. 1995). The reliance of murrelets on cryptic coloration to avoid detection suggests they utilize a wide spacing of nests in order to prevent predators from forming a search image (Ralph et al. 1995). Individual murrelets are suspected to have fidelity to nest sites or nesting areas, although this is has only been confirmed with marked birds in a few cases (Huff et al. 2006, p. 11). There are at least 15 records of murrelets using nest sites in the same or adjacent trees in successive years, but it is not clear if they were used by the same birds (McShane et al. 2004, p. 2-14). At the landscape scale, murrelets do show fidelity to foraging areas and probably to specific watersheds for nesting (McShane et al. 2004, p. 2-14). Murrelets have been observed visiting nesting habitat during non-breeding periods in Washington, Oregon, and California which may indicate adults are maintaining fidelity and familiarity with nesting sites and/or stands (Naslund 1993; O'Donnell et al. 1995, p. 125).

Loss of nesting habitat reduces nest site availability and displaces any murrelets that may have had nesting fidelity to the logged area (Raphael et al. 2002, p. 232). Murrelets have demonstrated fidelity to nesting stands and in some areas, fidelity to individual nest trees (Burger et al. 2009, p. 217). Murrelets returning to recently logged areas may not breed for several years or until they have found suitable nesting habitat elsewhere (Raphael et al. 2002, p. 232). The potential effects of displacement due to habitat loss include nest site abandonment, delayed breeding, failure to initiate breeding in subsequent years, and failed breeding due to increased predation risk at a marginal nesting location (Divoky and Horton 1995, p. 83; Raphael et al. 2002, p. 232). Each of these outcomes has the potential to reduce the nesting success for individual breeding pairs, and could ultimately result in the reduced recruitment of juvenile birds into the local population (Raphael et al. 2002, pp. 231-233).

Detailed information regarding the life history and conservation needs of the murrelet are presented in the *Ecology and Conservation of the Marbled Murrelet* (Ralph et al. 1995), the Service’s 1997 *Recovery Plan for the Marbled Murrelet* (USFWS 1997), and in subsequent 5-year status reviews (McShane et al. 2004; USFWS 2009).

Distribution

Murrelets are distributed along the Pacific coast of North America, with birds breeding from central California through Oregon, Washington, British Columbia, southern Alaska, westward through the Aleutian Island chain, with presumed breeding as far north as Bristol Bay (Nelson 1997, p. 2). The federally-listed murrelet population in Washington, Oregon, and California is classified by the Service as a distinct population segment (75 FR 3424). The coterminous United States population of murrelets is considered significant as the loss of this distinct population segment would result in a significant gap in the range of the taxon and the loss of unique genetic characteristics that are significant to the taxon (75 FR 3430).

Murrelets spend most of their lives in the marine environment where they consume a diversity of prey species, including small fish and invertebrates. Murrelets occur primarily in nearshore marine waters within 5 km of the coast, but have been documented up to 300 km offshore in winter off the coast of Alaska (Nelson 1997, p. 3). The inland nesting distribution of murrelets is strongly associated with the presence of mature and old-growth conifer forests. Murrelets have been detected >100 km inland in Washington (70 miles), while the inland distribution in the southern portion of the species range is associated with the extent of the hemlock/tanoak vegetation zone which occurs up to 16-51 km inland (10-32 miles) (Evans Mack et al. 2003, p. 4).

The distribution of murrelets in marine waters during the summer breeding season is highly variable along the Pacific coast, with areas of high density occurring along the Strait of Juan de Fuca in Washington, the central Oregon coast, and northern California (Raphael et al. 2015c, p. 20). Low-density areas or gaps in murrelet distribution occur in central California, and along the southern Washington coast (Raphael et al. 2015c, p. 21). Analysis of various marine and terrestrial habitat factors indicate that the amount and configuration of inland nesting habitat is the strongest factor that influences the marine distribution of murrelets during the nesting season (Raphael et al. 2015c, p. 17). Local aggregations or "hot spots" of murrelets in nearshore marine waters are strongly associated with landscapes that support large, contiguous areas of mature and old-growth forest.

Distribution of Nesting Habitat

The loss of nesting habitat was a major cause of the murrelets decline over the past century and may still be contributing as nesting habitat continues to be lost to fires, logging, and wind storms (Miller et al. 2012, p. 778). Due mostly to historic timber harvest, only a small percentage (~11 percent) of the habitat-capable lands within the listed range of the murrelet currently contain potential nesting habitat (Raphael et al. 2015b, p. 118). Monitoring of murrelet nesting habitat within the Northwest Forest Plan area indicates nesting habitat declined from an estimated 2.53 million acres in 1993 to an estimated 2.23 million acres in 2012, a decline of about 12.1 percent (Raphael et al. 2015b, p. 89). Fire has been the major cause of nesting habitat loss on Federal lands, while timber harvest is the primary cause of loss on non-Federal lands (Raphael et al. 2015b, p. 90). While most (60 percent) of the potential habitat is located on Federal reserved-land allocations, a substantial amount of nesting habitat occurs on non-federal lands (34 percent) (Table 1).

Table 1. Estimates of higher-quality murrelet nesting habitat by State and major land ownership within the area of the Northwest Forest Plan – derived from 2012 data.

State	Habitat capable lands (1,000s of acres)	Habitat on Federal reserved lands (1,000s of acres)	Habitat on Federal non-reserved lands (1,000s of acres)	Habitat on non-federal lands (1,000s of acres)	Total potential nesting habitat (all lands) (1,000s of acres)	Percent of habitat capable land that is currently in habitat
WA	10,851.1	822.4	64.7	456	1,343.1	12 %
OR	6,610.4	484.5	69.2	221.1	774.8	12 %
CA	3,250.1	24.5	1.5	82.9	108.9	3 %
Totals	20,711.6	1,331.4	135.4	760	2,226.8	11 %
Percent		60 %	6 %	34 %	100 %	-

Source: (Raphael et al. 2015b, pp. 115-118)

Population Status

The 1997 *Recovery Plan for the Marbled Murrelet* (USFWS 1997) identified six Conservation Zones throughout the listed range of the species: Puget Sound (Conservation Zone 1), Western Washington Coast Range (Conservation Zone 2), Oregon Coast Range (Conservation Zone 3), Siskiyou Coast Range (Conservation Zone 4), Mendocino (Conservation Zone 5), and Santa Cruz Mountains (Conservation Zone 6) (Figure 1). Recovery zones are the functional equivalent of recovery units as defined by Service policy (USFWS 1997, p. 115). The subpopulations in each Zone are not discrete. There is some movement of murrelets between Zones as indicated by radio-telemetry studies (e.g., Bloxton and Raphael 2006, p. 162), but the degree to which murrelets migrate between Zones is unknown. For the purposes of consultation, the Service treats each of the Conservation Zones as separate sub-populations of the listed murrelet population.

Population Status and Trends

Population estimates for the murrelet are derived from marine surveys conducted during the nesting season as part of the Northwest Forest Plan effectiveness monitoring program. Surveys from 2001 to 2013 indicated that the murrelet population in Conservation Zones 1 through 5 (Northwest Forest Plan area) declined at a rate of -1.2 percent per year (Falxa et al. 2015, pp. 7-8). While the overall trend estimate across this time period is negative, the evidence of a detectable linear decline is not conclusive because the confidence intervals for the estimated trend overlap zero (95% confidence interval [CI]:-2.9 to 0.5 percent) (Falxa et al. 2015, pp. 7-8) (Table 2). This differs from the declines previously reported at the Northwest Forest Plan-scale for the 2001 to 2010 period. This difference was the result of high population estimates for 2011 through 2013 compared to the previous several years, which reduced the slope of the trend and increased variability (Falxa and Raphael 2015, p. 4).

Population monitoring from 2001 to 2013 indicates strong evidence for a linear decline for murrelet subpopulations in Washington, while trends in Oregon and northern California indicate potentially stable or increasing subpopulations with no conclusive evidence of a positive or negative trend over the monitoring period (Falxa et al. 2015, p. 26). While the direct causes for subpopulation declines in Washington are unknown, potential factors include the loss of nesting habitat, including cumulative and time-lag effects of habitat losses over the past 20 years (an individual murrelets potential lifespan), changes in the marine environment reducing the availability or quality of prey, increased densities of nest predators, and emigration (Miller et al. 2012, p. 778).

The most recent population estimate for the entire Northwest Forest Plan area in 2013 was 19,700 murrelets (95 percent CI: 15,400 to 23,900 birds) (Falxa et al. 2015, p. 7). The largest and most stable murrelet subpopulations now occur off the Oregon and northern California coasts, while subpopulations in Washington have experienced the greatest rates of decline. Murrelet zones are now surveyed on an every other-year basis, so the last year that a range-wide estimate for all zones combined is 2013 (Table 2). Subsequent surveys in Washington, Oregon, and California have been completed during the 2014 and 2015 seasons. Summaries of these more recent surveys are presented in Table 3.

The murrelet subpopulation in Conservation Zone 6 (central California- Santa Cruz Mountains) is outside of the Northwest Forest Plan area and is monitored separately by the University of California as part of an oil-spill compensation program (Henry et al. 2012, p. 2). Surveys in Zone 6 indicate a small subpopulation of murrelets with no clear trends. Population estimates from 2001 to 2014 have fluctuated from a high of 699 murrelets in 2003, to a low of 174 murrelets in 2008 (Henry and Tyler 2014, p. 3). In 2014, surveys indicated an estimated population of 437 murrelets in Zone 6 (95% CI: 306-622) (Henry and Tyler 2014, p. 3) (Table 3).

Table 2. Summary of murrelet population estimates and trends (2001-2013) at the scale of Conservation Zones and States (estimates combined across Zones within the Northwest Forest Plan area).

Zone	Year	Estimated number of murrelets	95% CI Lower	95% CI Upper	Average density (at sea) (murrelets /km^{2})	Average annual rate of change (%)	95% CI Lower	95% CI Upper	Cumulative change over 10 years (%)
1	2013	4,395	2,298	6,954	1.26	-3.9	-7.6	0.0	-32.8
2	2013	1,271	950	1,858	0.77	-6.7	-11.4	-1.8	-50.0
3	2013	8,841	6,819	11,276	5.54	+1.3	-1.1	+3.8	+6.2
4	2013	6,046	4,531	9,282	5.22	+1.5	-0.9	+4.0	+16.1
5	2013	71	5	118	0.08	-1.0	-8.3	+6.9	-9.6
Zones 1-5	2013	19,662	15,398	23,927	2.24	-1.2	-2.9	+0.5	-11.3
Zone 6	2013	628	386	1,022	na	na	na	na	na
WA	2013	5,665	3,217	8,114	1.10	-5.1	-7.7	-2.5	-37.6
OR	2013	9,819	6,158	13,480	4.74	0.3	-1.8	2.5	+3.0
CA	2013	4,178	3,561	4,795	2.67	2.5	-1.1	6.2	+28.0

Sources: (Falxa et al. 2015, pp. 41-43; Henry and Tyler 2014, p. 3).

Table 3. Summary of the most recent murrelet population estimates by Zone (2014-2015).

Zone	Year	Estimated number of murrelets	Estimated population 95% CI Lower	Estimated population 95% CI Upper	Average annual rate of decline (2001-2015)
1	2015	4,290	2,783	6,492	-5.3 %
2	2015	3,204	1,883	5,609	-2.8 %
3	2014	8,841	6,819	11,276	nc
4	2015	8,743	7,409	13,125	nc
5	2013	71	5	118	nc
6	2014	437	306	622	nc

Sources: (Henry and Tyler 2014, p. 3; Lance and Pearson 2016, pp. 4-5; NWFPEMP 2016, pp. 2-3).

Factors Influencing Population Trends

Murrelet populations are declining in Washington, stable in Oregon, and stable in California where there is a non-significant but positive population trend (Raphael et al. 2015a, p. 163). Murrelet population size and distribution is strongly and positively correlated with the amount and pattern (large contiguous patches) of suitable nesting habitat and population trend is most strongly correlated with trend in nesting habitat although marine factors also contribute to this trend (Raphael et al. 2015a, p. 156). From 1993 to 2012, there was a net loss of about 2 percent of potential nesting habitat from on federal lands, compared to a net loss of about 27 percent on nonfederal lands, for a total cumulative net loss of about 12.1 percent across the Northwest Forest Plan area (Raphael et al. 2015b, p. 66). Cumulative habitat losses since 1993 have been greatest in Washington, with most habitat loss in Washington occurring on non-Federal lands due to timber harvest (Raphael et al. 2015b, p. 124) (Table 4).

Table 4. Distribution of higher-suitability murrelet nesting habitat by Conservation Zone, and summary of net habitat changes from 1993 to 2012 within the Northwest Forest Plan area.

Conservation Zone	**1993**	**2012**	**Change (acres)**	**Change (percent)**
Zone 1 - Puget Sound/Strait of Juan de Fuca	829,525	739,407	-90,118	-10.9 %
Zone 2 - Washington Coast	719,414	603,777	-115,638	-16.1 %
Zone 3 - Northern to central Oregon	662,767	610,583	-52,184	-7.9 %
Zone 4 - Southern Oregon - northern California	309,072	256,636	-52,436	-17 %
Zone 5 - north-central California	14,060	16,479	+2,419	+17.2 %

Source: (Raphael et al. 2015b, p. 121).

The decline in murrelet populations from 2001 to 2013 is weakly correlated with the decline in nesting habitat, with the greatest declines in Washington, and the smallest declines in California, indicating that when nesting habitat decreases, murrelet abundance in adjacent marine waters may also decrease. At the scale of Conservation Zones, the strongest correlation between habitat loss and murrelet decline is in Zone 2, the zone where both murrelet habitat and murrelet abundance has declined the greatest. However these relationships are not linear, and there is much unexplained variation (Raphael et al. 2015a, p. 163). While terrestrial habitat amount and configuration (i.e., fragmentation) and the terrestrial human footprint (i.e., cities, roads, development) appear to be strong factors influencing murrelet distribution in Zones 2-5; terrestrial habitat and the marine human footprint (i.e., shipping lanes, boat traffic, shoreline development) appear to be the most important factors that influence the marine distribution and abundance of murrelets in Zone 1 (Raphael et al. 2015a, p. 163).

As a marine bird, murrelet survival is dependent on their ability to successfully forage in the marine environment. Despite this, it is apparent that the location, amount, and landscape pattern of terrestrial nesting habitat are strongest predictors of the spatial and temporal distributions of murrelets at sea during the nesting season (Raphael et al. 2015c, p. 20). Various marine habitat features (e.g., shoreline type, depth, temperature, etc.) apparently have only a minor influence on murrelet distribution at sea. Despite this relatively weak spatial relationship, marine factors, and especially any decrease in forage species, likely play an important role in explaining the apparent population declines, but the ability to model these relationships is currently limited (Raphael et al. 2015c, p. 20).

Population Models

Prior to the use of survey data to estimate trend, demographic models were more heavily relied upon to generate predictions of trends and extinction probabilities for the murrelet population (Beissinger 1995; Cam et al. 2003; McShane et al. 2004; USFWS 1997). However, murrelet population models remain useful because they provide insights into the demographic parameters and environmental factors that govern population stability and future extinction risk, including stochastic factors that may alter survival, reproductive, and immigration/emigration rates.

In a report developed for the *5-year Status Review of the Marbled Murrelet in Washington, Oregon, and California* (McShane et al. 2004, p. 3-27 to 3-60), models were used to forecast 40-year murrelet population trends. A series of female-only, multi-aged, discrete-time stochastic Leslie Matrix population models were developed for each conservation zone to forecast decadal population trends over a 40-year period with extinction probabilities beyond 40 years (to 2100). The authors incorporated available demographic parameters (Table 5) for each conservation zone to describe population trends and evaluate extinction probabilities (McShane et al. 2004, p. 3-49).

McShane et al. (2004) used mark-recapture studies conducted in British Columbia by Cam et al. (2003) and Bradley et al. (2004) to estimate annual adult survival and telemetry studies or at-sea survey data to estimate fecundity. Model outputs predicted -3.1 to -4.6 percent mean annual rates of population change (decline) per decade the first 20 years of model simulations in murrelet Conservation Zones 1 through 5 (McShane et al. 2004, p. 3-52). Simulations for all zone populations predicted declines during the 20 to 40-year forecast, with mean annual rates of -2.1 to -6.2 percent per decade (McShane et al. 2004, p. 3-52). While these modeled rates of decline are similar to those observed in Washington (Falxa and Raphael 2015, p. 4), the simulated projections at the scale of Zones 1-5 do not match the potentially stable or increasing populations observed in Oregon and California during the 2001-2013 monitoring period.

Table 5. Rangewide murrelet demographic parameter values based on four studies all using Leslie Matrix models.

Demographic Parameter	**Beissinger 1995**	**Beissinger and Nur 1997***	**Beissinger and Peery (2007)**	**McShane et al. 2004**
Juvenile Ratio (Ŕ)	0.10367	0.124 or 0.131	0.089	0.02 - 0.09
Annual Fecundity	0.11848	0.124 or 0.131	0.06-0.12	-
Nest Success	-	-	0.16-0.43	0.38 - 0.54
Maturation	3	3	3	2 - 5
Estimated Adult Survivorship	85 % – 90%	85 % – 88 %	82 % - 90 %	83 % – 92 %

*In U.S. Fish and Wildlife (1997).

Reproduction

Generally, estimates of murrelet fecundity are directed at measures of breeding success, either from direct assessments of nest success in the terrestrial environment, marine counts of hatch-year birds, or computer models. Telemetry estimates are typically preferred over marine counts for estimating breeding success due to fewer biases (McShane et al. 2004, p. 3-2). However, because of the challenges of conducting telemetry studies, estimating murrelet reproductive rates with an index of reproduction, referred to as the juvenile ratio (Ŕ),[1] continues to be important, despite the debate over use of this index (see discussion in Beissinger and Peery 2007, p. 296).

Although difficult to obtain, nest success rates[2] are available from telemetry studies conducted in California (Hebert and Golightly 2006; Peery et al. 2004) and Washington (Bloxton and Raphael 2006). In northwest Washington, Bloxton and Raphael (2005, p. 5) documented a nest success rate of 0.20 (2 chicks fledging from 10 nest starts). In central California, murrelet nest success is 0.16 (Peery et al. 2004, p. 1098) and in northern California it is 0.31 to 0.56 (Hebert and Golightly 2006, p. 95). No studies or published reports from Oregon are available.

Unadjusted and adjusted values for estimates of murrelet juvenile ratios suggest extremely low breeding success in northern California (0.003 to 0.008 - Long et al. 2008, pp. 18-19), central California (0.035 and 0.032 - Beissinger and Peery 2007, pp. 299, 302), and in Oregon (0.0254 - 0.0598 - Crescent Coastal Research 2008, p. 13). Estimates for **Ŕ** (adjusted) in the San Juan Islands in Washington have been below 0.15 every year since surveys began in 1995, with three of those years below 0.05 (Raphael et al. 2007, p. 16).

[1] The juvenile ratio (**Ŕ**) for murrelets is derived from the relative abundance of hatch-year (HY; 0-1 yr-old) to after-hatch-year (AHY; 1+ yr-old) birds (Beissinger and Peery 2007, p. 297) and is calculated from marine survey data.
[2] Nest success here is defined by the annual number of known hatchlings departing from the nest (fledging) divided by the number of nest starts.

These estimates of **Ŕ** are assumed to be below the level necessary to maintain or increase the murrelet population. Demographic modeling suggests murrelet population stability requires a minimum reproductive rate of 0.18 to 0.28 (95 % CI) chicks per pair per year (Beissinger and Peery 2007, p. 302; USFWS 1997). Even the lower levels of the 95 percent confidence interval from USFWS (1997) and Beissinger and Peery (2007, p. 302) is greater than the current range of estimates for Ŕ (0.02 to 0.13 chicks per pair) for any of the Conservation Zones (Table 4).

The current estimates for **Ŕ** also appear to be well below what may have occurred prior to the murrelet population decline. Beissinger and Peery (2007, p. 298) performed a comparative analysis using historic data from 29 bird species to predict the historic **Ŕ** for murrelets in central California, resulting in an estimate of 0.27 (95% CI: 0.15 - 0.65). Therefore, the best available scientific information of murrelet fecundity from model predictions and trend analyses of survey-derived population data appear to align well. Both indicate that the murrelet reproductive rate is generally insufficient to maintain stable population numbers throughout all or portions of the species' listed range.

Summary: Murrelet Abundance, Distribution, Trend, and Reproduction

Although murrelets are distributed throughout their historical range, the area of occupancy within their historic range appears to be reduced from historic levels. The distribution of the species also exhibits five areas of discontinuity: a segment of the border region between British Columbia, Canada and Washington; southern Puget Sound, WA; Destruction Island, WA to Tillamook Head, OR; Humboldt County, CA to Half Moon Bay, CA; and the entire southern end of the breeding range in the vicinity of Santa Cruz and Monterey Counties, CA (McShane et al. 2004, p. 3-70).

A statistically significant decline was detected in Conservation Zones 1 and 2 for the 2001-2014 period (Table 2). The overall population trend from the combined 2001-2013 population estimates (Conservation Zones 1 - 5) indicate a decline at a rate of -1.2 percent per year (Falxa et al. 2015, pp. 7-8). This decline across the listed range is most influenced by the significant declines in Washington, while subpopulations in Oregon and California are potentially stable.

The current range of estimates for **Ŕ**, the juvenile to adult ratio, is assumed to be below the level necessary to maintain or increase the murrelet population. Whether derived from marine surveys or from population modeling (**Ŕ** = 0.02 to 0.13, Table 4), the available information is in general agreement that the current ratio of hatch-year birds to after-hatch year birds is insufficient to maintain stable numbers of murrelets throughout the listed range. The current estimates for **Ŕ** also appear to be well below what may have occurred prior to the murrelet population decline (Beissinger and Peery 2007, p. 298).

Considering the best available data on abundance, distribution, population trend, and the low reproductive success of the species, the Service concludes the murrelet population within the Washington portion of its listed range currently has little or no capability to self-regulate, as indicated by the significant, annual decline in abundance the species is currently undergoing in Conservation Zones 1 and 2. Populations in Oregon and California are apparently more stable, but threats associated with habitat loss and habitat fragmentation continue to occur in those areas. The Service expects the species to continue to exhibit further reductions in the distribution and abundance into the foreseeable future, due largely to the expectation that the variety of environmental stressors present in the marine and terrestrial environments (discussed in the *Threats to Murrelet Survival and Recovery* section) will continue into the foreseeable future.

Threats to Murrelet Survival and Recovery

When the murrelet was listed under the Endangered Species Act in 1992, several anthropogenic threats were identified as having caused the dramatic decline in the species:

- habitat destruction and modification in the terrestrial environment from timber harvest and human development caused a severe reduction in the amount of nesting habitat
- unnaturally high levels of predation resulting from forest "edge effects" ;
- the existing regulatory mechanisms, such as land management plans (in 1992), were considered inadequate to ensure protection of the remaining nesting habitat and reestablishment of future nesting habitat; and
- manmade factors such as mortality from oil spills and entanglement in fishing nets used in gill-net fisheries.

The regulatory mechanisms implemented since 1992 that affect land management in Washington, Oregon, and California (for example, the Northwest Forest Plan) and new gill-netting regulations in northern California and Washington have reduced the threats to murrelets (USFWS 2004, pp. 11-12). However, additional threats were identified in the Service's 2009, 5-year review for the murrelet (USFWS 2009, pp. 27-67). These stressors are due to several environmental factors affecting murrelets in the marine environment. These stressors include:

- Habitat destruction, modification, or curtailment of the marine environmental conditions necessary to support murrelets due to:
  - elevated levels of polychlorinated biphenyls in murrelet prey species;
  - changes in prey abundance and availability;
  - changes in prey quality;
  - harmful algal blooms that produce biotoxins leading to domoic acid and paralytic shellfish poisoning that have caused murrelet mortality; and
  - climate change in the Pacific Northwest.
- Manmade factors that affect the continued existence of the species include:
  - derelict fishing gear leading to mortality from entanglement;
  - disturbance in the marine environment (from exposures to lethal and sub-lethal levels of high underwater sound pressures caused by pile-driving, underwater detonations, and potential disturbance from high vessel traffic).

Since the time of listing, the murrelet population has continued to decline due to lack of successful reproduction and recruitment. The murrelet Recovery Implementation Team identified five major mechanisms that appear to be contributing to this decline (USFWS 2012b, pp. 10-11):

- Ongoing and historic loss of nesting habitat.
- Predation on murrelet eggs and chicks in their nests.
- Changes in marine conditions, affecting the abundance, distribution, and quality of murrelet prey species.
- Post-fledging mortality (predation, gill-nets, oil-spills).
- Cumulative and interactive effects of factors on individuals and populations.

Climate Change

In the Pacific Northwest, mean annual temperatures rose 0.8° C (1.5° F) in the 20th century and are expected to continue to warm from 0.1° to 0.6° C (0.2° to 1° F) per decade (Mote and Salathe 2010, p. 29). Climate change models generally predict warmer, wetter winters and hotter, drier summers and increased frequency of extreme weather events in the Pacific Northwest (Salathé et al. 2010, pp. 72-73). Predicted climate changes in the Pacific Northwest have implications for forest disturbances that affect the quality and distribution of murrelet habitat. Both the frequency and intensity of wildfires and insect outbreaks are expected to increase over the next century in the Pacific Northwest (Littell et al. 2010, p. 130).

One of the largest projected effects on Pacific Northwest forests is likely to come from an increase in fire frequency, duration, and severity. Westerling et al. (2006, pp. 940-941) analyzed wildfires and found that since the mid-1980s, wildfire frequency in western forests has nearly quadrupled compared to the average of the period from 1970-1986. The total area burned is more than 6.5 times the previous level and the average length of the fire season during 1987-2003 was 78 days longer compared to 1978-1986 (Westerling et al. 2006, p. 941). The area burned annually by wildfires in the Pacific Northwest is expected to double or triple by the 2080s (Littell et al. 2010, p. 140). Wildfires are now the primary cause of murrelet habitat loss on Federal lands, with over 21,000 acres of habitat loss attributed to wildfires from 1993 to 2012 (Raphael et al. 2015b, p. 123). Climate change is likely to further exacerbate some existing threats such as the projected potential for increased habitat loss from drought related fire, mortality, insects and disease, and increases in extreme flooding, landslides and windthrow events in the short-term (10 to 30 years).
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Within the marine environment, effects on the murrelet food supply (amount, distribution, quality) provide the most likely mechanism for climate change impacts to murrelets. Studies in British Columbia (Norris et al. 2007) and California (Becker and Beissinger 2006) have documented long-term declines in the quality of murrelet prey, and one of these studies (Becker and Beissinger 2006, p. 475) linked variation in coastal water temperatures, murrelet prey quality during pre-breeding, and murrelet reproductive success. These studies indicate that murrelet recovery may be affected as long-term trends in ocean climate conditions affect prey resources

and murrelet reproductive rates. While seabirds such as the murrelet have life-history strategies adapted to variable marine environments, ongoing and future climate change could present changes of a rapidity and scope outside the adaptive range of murrelets (USFWS 2009, p. 46).

Conservation Needs of the Species

Reestablishing an abundant supply of high quality murrelet nesting habitat is a vital conservation need given the extensive removal during the 20th century. However, there are other conservation imperatives. Foremost among the conservation needs are those in the marine and terrestrial environments to increase murrelet fecundity by increasing the number of breeding adults, improving murrelet nest success (due to low nestling survival and low fledging rates), and reducing anthropogenic stressors that reduce individual fitness or lead to mortality.

The overall reproductive success (fecundity) of murrelets is directly influenced by nest predation rates (reducing nestling survival rates) in the terrestrial environment and an abundant supply of high quality prey in the marine environment during the breeding season (improving potential nestling survival and fledging rates). Anthropogenic stressors affecting murrelet fitness and survival in the marine environment are associated with commercial and tribal gillnets, derelict fishing gear, oil spills, and high underwater sound pressure (energy) levels generated by pile-driving and underwater detonations (that can be lethal or reduce individual fitness).

General criteria for murrelet recovery (delisting) were established at the inception of the Plan and they have not been met. More specific delisting criteria are expected in the future to address population, demographic, and habitat based recovery criteria (USFWS 1997, p. 114-115). The general criteria include:

- documenting stable or increasing population trends in population size, density, and productivity in four of the six Conservation Zones for a 10-year period and
- implementing management and monitoring strategies in the marine and terrestrial environments to ensure protection of murrelets for at least 50 years.

Thus, increasing murrelet reproductive success and reducing the frequency, magnitude, or duration of any anthropogenic stressor that directly or indirectly affects murrelet fitness or survival in the marine and terrestrial environments are the priority conservation needs of the species. The Service estimates recovery of the murrelet will require at least 50 years (USFWS 1997)

Recovery Plan

The Marbled Murrelet Recovery Plan outlines the conservation strategy with both short- and long-term objectives. The Plan places special emphasis on the terrestrial environment for habitat-based recovery actions due to nesting occurring in inland forests.

In the short-term, specific actions identified as necessary to stabilize the populations include protecting occupied habitat and minimizing the loss of unoccupied but suitable habitat (USFWS 1997, p. 119). Specific actions include maintaining large blocks of suitable habitat, maintaining and enhancing buffer habitat, decreasing risks of nesting habitat loss due to fire and windthrow, reducing predation, and minimizing disturbance. The designation of critical habitat also contributes towards the initial objective of stabilizing the population size through the maintenance and protection of occupied habitat and minimizing the loss of unoccupied but suitable habitat.

Long-term conservation needs identified in the Plan include:

- increasing productivity (abundance, the ratio of juveniles to adults, and nest success) and population size;
- increasing the amount (stand size and number of stands), quality, and distribution of suitable nesting habitat;
- protecting and improving the quality of the marine environment; and
- reducing or eliminating threats to survivorship by reducing predation in the terrestrial environment and anthropogenic sources of mortality at sea.

Recovery Zones in Washington

Conservation Zones 1 and 2 extend inland 50 miles from marine waters. Conservation Zone 1 includes all the waters of Puget Sound and most waters of the Strait of Juan de Fuca south of the U.S.-Canadian border and the Puget Sound, including the north Cascade Mountains and the northern and eastern sections of the Olympic Peninsula. Conservation Zone 2 includes marine waters within 1.2 miles (2 km) off the Pacific Ocean shoreline, with the northern terminus immediately south of the U.S.-Canadian border near Cape Flattery along the midpoint of the Olympic Peninsula and extending to the southern border of Washington (the Columbia River) (USFWS 1997, pg. 126).

Lands considered essential for the recovery of the murrelet within Conservation Zones 1 and 2 are 1) any suitable habitat in a Late Successional Reserve (LSR), 2) all suitable habitat located in the Olympic Adaptive Management Area, 3) large areas of suitable nesting habitat outside of LSRs on Federal lands, such as habitat located in the Olympic National Park, 4) suitable habitat on State lands within 40 miles off the coast, and 5) habitat within occupied murrelet sites on private lands (USFWS 1997).

Summary

At the range-wide scale, murrelet populations have declined at an average rate of 1.2 percent per year since 2001. The most recent population estimate for the entire Northwest Forest Plan area in 2013 was 19,700 murrelets (95 percent CI: 15,400 to 23,900 birds) (Falxa et al. 2015, p. 7). The largest and most stable murrelet subpopulations now occur off the Oregon and northern California coasts, while subpopulations in Washington have experienced the greatest rates of decline (-4.4 percent per year; 95% CI: -6.8 to -1.9%) (Lance and Pearson 2016, p. 5).

Monitoring of murrelet nesting habitat within the Northwest Forest Plan area indicates nesting habitat declined from an estimated 2.53 million acres in 1993 to an estimated 2.23 million acres in 2012, a decline of about 12.1 percent (Raphael et al. 2015b, p. 89). Murrelet population size is strongly and positively correlated with amount of nesting habitat, suggesting that conservation of remaining nesting habitat and restoration of currently unsuitable habitat is key to murrelet recovery (Raphael et al. 2011, p. iii).

The species decline has been largely caused by extensive removal of late-successional and old growth coastal forest which serves as nesting habitat for murrelets. Additional factors in its decline include high nest-site predation rates and human-induced mortality in the marine environment from disturbance, gillnets, and oil spills. In addition, murrelet reproductive success is strongly correlated with the abundance of marine prey species. Overfishing and oceanographic variation from climate events have likely altered both the quality and quantity of murrelet prey species (USFWS 2009, p. 67).

Although some threats have been reduced, most continue unabated and new threats now strain the ability of the murrelet to successfully reproduce. Threats continue to contribute to murrelet population declines through adult and juvenile mortality and reduced reproduction. Therefore, given the current status of the species and background risks facing the species, it is reasonable to assume that murrelet populations in Conservation Zones 1 and 2 and throughout the listed range have low resilience to deleterious population-level effects and are at high risk of continual declines. Activities which degrade the existing conditions of occupied nest habitat or reduce adult survivorship and/or nest success of murrelets will be of greatest consequence to the species. Actions resulting in the further loss of occupied nesting habitat, mortality to breeding adults, eggs, or nestlings will reinforce the current murrelet population decline throughout the coterminous United States.

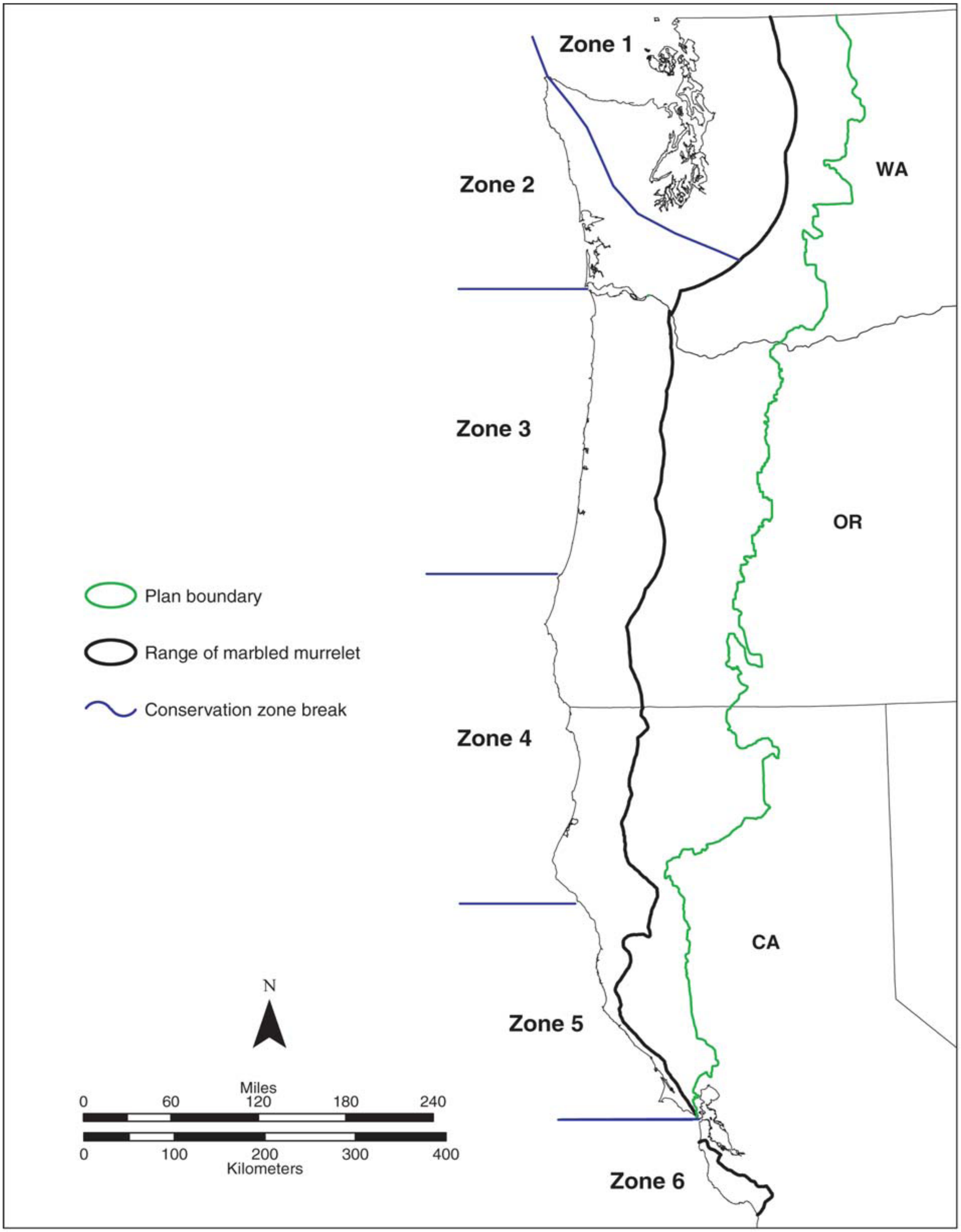

Figure 1. The six geographic areas identified as Conservation Zones in the recovery plan for the marbled murrelet (USFWS 1997). Note: "Plan boundary" refers to the Northwest Forest Plan. Figure adapted from Huff et al. (2006, p. 6).

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APPENDIX C
STATUS OF THE DESIGNATED CRITICAL HABITAT: BULL TROUT

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Appendix C
Status of Designated Critical Habitat: Bull Trout

Legal Status

Current Designation

The U.S. Fish and Wildlife Service (Service) published a final critical habitat designation for the coterminous United States population of the bull trout on October 18, 2010 (70 FR 63898); the rule became effective on November 17, 2010. A justification document was also developed to support the rule and is available on our website (http://www.fws.gov/pacific/bulltrout). The scope of the designation involved the species' coterminous range, including six draft recovery units [Mid-Columbia, Saint Mary, Columbia Headwaters, Coastal, Klamath, and Upper Snake (75 FR 63927)]. The Service's 1999 coterminous listing rule identified five interim recovery units (50 CFR Part 17, pg. 58910), which includes the Jarbidge River, Klamath River, Columbia River, Coastal-Puget Sound, and Saint Mary-Belly River population segments (also considered as interim recovery units). Our five year review recommended re-evaluation of these units based on new information (USFWS 2008, p. 9). However, until the bull trout draft recovery plan is finalized, the current five interim recovery units will be used for purposes of section 7 jeopardy analyses and recovery planning. The adverse modification analysis in this biological opinion does not rely on recovery units, relying instead on the listed critical habitat units and subunits.

Rangewide, the Service designated reservoirs/lakes and stream/shoreline miles as bull trout critical habitat (Table 1). Designated bull trout critical habitat is of two primary use types: 1) spawning and rearing, and 2) foraging, migration, and overwintering (FMO).

Table 1. Stream/shoreline distance and reservoir/lake area designated as bull trout critical habitat by state.

State	Stream/Shoreline Miles	Stream/Shoreline Kilometers	Reservoir /Lake Acres	Reservoir /Lake Hectares
Idaho	8,771.6	14,116.5	170,217.5	68,884.9
Montana	3,056.5	4,918.9	221,470.7	89,626.4
Nevada	71.8	115.6	-	-
Oregon	2,835.9	4,563.9	30,255.5	12,244.0
Oregon/Idaho	107.7	173.3	-	-
Washington	3,793.3	6,104.8	66,308.1	26,834.0
Washington (marine)	753.8	1,213.2	-	-
Washington/Idaho	37.2	59.9	-	-
Washington/Oregon	301.3	484.8	-	-
Total	19,729.0	31,750.8	488,251.7	197,589.2

The 2010 revision increases the amount of designated bull trout critical habitat by approximately 76 percent for miles of stream/shoreline and by approximately 71 percent for acres of lakes and reservoirs compared to the 2005 designation.

This rule also identifies and designates as critical habitat approximately 1,323.7 km (822.5 miles) of streams/shorelines and 6,758.8 ha (16,701.3 acres) of lakes/reservoirs of unoccupied habitat to address bull trout conservation needs in specific geographic areas in several areas not occupied at the time of listing. No unoccupied habitat was included in the 2005 designation. These unoccupied areas were determined by the Service to be essential for restoring functioning migratory bull trout populations based on currently available scientific information. These unoccupied areas often include lower main stem river environments that can provide seasonally important migration habitat for bull trout. This type of habitat is essential in areas where bull trout habitat and population loss over time necessitates reestablishing bull trout in currently unoccupied habitat areas to achieve recovery.

The final rule continues to exclude some critical habitat segments based on a careful balancing of the benefits of inclusion versus the benefits of exclusion. Critical habitat does not include: 1) waters adjacent to non-Federal lands covered by legally operative incidental take permits for habitat conservation plans (HCPs) issued under section 10(a)(1)(B) of the Endangered Species Act of 1973, as amended (Act), in which bull trout is a covered species on or before the publication of this final rule; 2) waters within or adjacent to Tribal lands subject to certain commitments to conserve bull trout or a conservation program that provides aquatic resource protection and restoration through collaborative efforts, and where the Tribes indicated that inclusion would impair their relationship with the Service; or 3) waters where impacts to national security have been identified (75 FR 63898). Excluded areas are approximately 10 percent of the stream/shoreline miles and 4 percent of the lakes and reservoir acreage of designated critical habitat. Each excluded area is identified in the relevant Critical Habitat Unit (CHU) text, as identified in paragraphs (e)(8) through (e)(41) of the final rule. See Tables 2 and 3 for the list of excluded areas. It is important to note that the exclusion of waterbodies from designated critical habitat does not negate or diminish their importance for bull trout conservation. Because exclusions reflect the often complex pattern of land ownership, designated critical habitat is often fragmented and interspersed with excluded stream segments.

Table 2. Stream/shoreline distance excluded from bull trout critical habitat based on Tribal ownership or other plan.

Ownership and/or Plan	Kilometers	Miles
Lewis River Hydro Conservation Easements	7.0	4.3
DOD – Dabob Bay Naval	23.9	14.8
HCP – Cedar River (City of Seattle)	25.8	16.0
HCP – Washington Forest Practices Lands	1,608.30	999.4
HCP – Green Diamond (Simpson)	104.2	64.7
HCP – Plum Creek Central Cascades (WA)	15.8	9.8
HCP – Plum Creek Native Fish (MT)	181.6	112.8
HCP–Stimson	7.7	4.8
HCP – WDNR Lands	230.9	149.5
Tribal – Blackfeet	82.1	51.0
Tribal – Hoh	4.0	2.5
Tribal – Jamestown S'Klallam	2.0	1.2
Tribal – Lower Elwha	4.6	2.8

Ownership and/or Plan	Kilometers	Miles
Tribal – Lummi	56.7	35.3
Tribal – Muckleshoot	9.3	5.8
Tribal – Nooksack	8.3	5.1
Tribal – Puyallup	33.0	20.5
Tribal – Quileute	4.0	2.5
Tribal – Quinault	153.7	95.5
Tribal – Skokomish	26.2	16.3
Tribal – Stillaguamish	1.8	1.1
Tribal – Swinomish	45.2	28.1
Tribal – Tulalip	27.8	17.3
Tribal – Umatilla	62.6	38.9
Tribal – Warm Springs	260.5	161.9
Tribal – Yakama	107.9	67.1
Total	3,094.9	1,923.1

Table 3. Lake/Reservoir area excluded from bull trout critical habitat based on Tribal ownership or other plan.

Ownership and/or Plan	Hectares	Acres
HCP – Cedar River (City of Seattle)	796.5	1,968.2
HCP – Washington Forest Practices Lands	5,689.1	14,058.1
HCP – Plum Creek Native Fish	32.2	79.7
Tribal – Blackfeet	886.1	2,189.5
Tribal – Warm Springs	445.3	1,100.4
Total	7,849.3	19,395.8

Conservation Role and Description of Critical Habitat

The conservation role of bull trout critical habitat is to support viable core area populations (75 FR 63898:63943 [October 18, 2010]). The core areas reflect the metapopulation structure of bull trout and are the closest approximation of a biologically functioning unit for the purposes of recovery planning and risk analyses. CHUs generally encompass one or more core areas and may include FMO areas, outside of core areas, that are important to the survival and recovery of bull trout.

Thirty-two CHUs within the geographical area occupied by the species at the time of listing are designated under the final rule. Twenty-nine of the CHUs contain all of the physical or biological features identified in this final rule and support multiple life-history requirements. Three of the mainstem river units in the Columbia and Snake River basins contain most of the physical or biological features necessary to support the bull trout's particular use of that habitat, other than those physical biological features associated with Primary Constituent Elements (PCEs) 5 and 6, which relate to breeding habitat.

The primary function of individual CHUs is to maintain and support core areas, which 1) contain bull trout populations with the demographic characteristics needed to ensure their persistence and contain the habitat needed to sustain those characteristics (Rieman and McIntyre 1993, p. 19); 2) provide for persistence of strong local populations, in part, by providing habitat conditions that encourage movement of migratory fish (Rieman and McIntyre 1993, pp. 22-23; MBTSG 1998, pp. 48-49); 3) are large enough to incorporate genetic and phenotypic diversity, but small enough to ensure connectivity between populations (Hard 1995, pp. 314-315; Healey and Prince 1995, p. 182; Rieman and McIntyre 1993, pp. 22-23; MBTSG 1998, pp. 48-49); and 4) are distributed throughout the historic range of the species to preserve both genetic and phenotypic adaptations (Hard 1995, pp. 321-322; Rieman and McIntyre 1993, p. 23; Rieman and Allendorf 2001, p. 763; MBTSG 1998, pp. 13-16).

The Olympic Peninsula and Puget Sound CHUs are essential to the conservation of anadromous[1] bull trout, which are unique to the Coastal-Puget Sound population segment. These CHUs contain marine nearshore and freshwater habitats, outside of core areas, that are used by bull trout from one or more core areas. These habitats, outside of core areas, contain PCEs that are critical to adult and subadult foraging, overwintering, and migration.

Primary Constituent Elements for Bull Trout

Within the designated critical habitat areas, the PCEs for bull trout are those habitat components that are essential for the primary biological needs of foraging, reproducing, rearing of young, dispersal, genetic exchange, or sheltering. Based on our current knowledge of the life history, biology, and ecology of this species and the characteristics of the habitat necessary to sustain its essential life-history functions, we have determined that the following PCEs are essential for the conservation of bull trout.

1. Springs, seeps, groundwater sources, and subsurface water connectivity (hyporheic flows) to contribute to water quality and quantity and provide thermal refugia.

2. Migration habitats with minimal physical, biological, or water quality impediments between spawning, rearing, overwintering, and freshwater and marine foraging habitats, including but not limited to permanent, partial, intermittent, or seasonal barriers.

3. An abundant food base, including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.

[1] Bull trout migrate from saltwater to freshwater to reproduce are commonly referred to as anadromous. However, bull trout and some other species that enter the marine environment are more properly termed amphidromous. Unlike strictly anadromous species, such as Pacific salmon, amphidromous species often return seasonally to fresh water as subadults, sometimes for several years, before returning to spawn (Brenkman and Corbett 2005, p. 1075; Wilson 1997, p. 5). Due to its more common usage, we will refer to bull trout has exhibiting anadromous rather than amphidromous life history patterns in this document.

4. Complex river, stream, lake, reservoir, and marine shoreline aquatic environments, and processes that establish and maintain these aquatic environments, with features such as large wood, side channels, pools, undercut banks and unembedded substrates, to provide a variety of depths, gradients, velocities, and structure.

5. Water temperatures ranging from 2 °C to 15 °C (36 °F to 59 °F), with adequate thermal refugia available for temperatures that exceed the upper end of this range. Specific temperatures within this range will depend on bull trout life-history stage and form; geography; elevation; diurnal and seasonal variation; shading, such as that provided by riparian habitat; streamflow; and local groundwater influence.

6. In spawning and rearing areas, substrate 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 sediment, generally ranging in size from silt to coarse sand, embedded in larger substrates, is characteristic of these conditions. The size and amounts of fine sediment suitable to bull trout will likely vary from system to system.

7. A natural hydrograph, including peak, high, low, and base flows within historic and seasonal ranges or, if flows are controlled, minimal flow departure from a natural hydrograph.

8. Sufficient water quality and quantity such that normal reproduction, growth, and survival are not inhibited.

9. Sufficiently low levels of occurrence of non-native predatory (e.g., lake trout, walleye, northern pike, smallmouth bass); interbreeding (e.g., brook trout); or competing (e.g., brown trout) species that, if present, are adequately temporally and spatially isolated from bull trout.

The revised PCE's are similar to those previously in effect under the 2005 designation. The most significant modification is the addition of a ninth PCE to address the presence of nonnative predatory or competitive fish species. Although this PCE applies to both the freshwater and marine environments, currently no non-native fish species are of concern in the marine environment, though this could change in the future.

Note that only PCEs 2, 3, 4, 5, and 8 apply to marine nearshore waters identified as critical habitat. Also, lakes and reservoirs within the CHUs also contain most of the physical or biological features necessary to support bull trout, with the exception of those associated with PCEs 1 and 6. Additionally, all except PCE 6 apply to FMO habitat designated as critical habitat.

Critical habitat includes the stream channels within the designated stream reaches and has a lateral extent as defined by the bankfull elevation on one bank to the bankfull elevation on the opposite bank. Bankfull elevation is the level at which water begins to leave the channel and move into the floodplain and is reached at a discharge that generally has a recurrence interval of

1 to 2 years on the annual flood series. If bankfull elevation is not evident on either bank, the ordinary high-water line must be used to determine the lateral extent of critical habitat. The lateral extent of designated lakes is defined by the perimeter of the waterbody as mapped on standard 1:24,000 scale topographic maps. The Service assumes in many cases this is the full-pool level of the waterbody. In areas where only one side of the waterbody is designated (where only one side is excluded), the mid-line of the waterbody represents the lateral extent of critical habitat.

In marine nearshore areas, the inshore extent of critical habitat is the mean higher high-water (MHHW) line, including the uppermost reach of the saltwater wedge within tidally influenced freshwater heads of estuaries. The MHHW line refers to the average of all the higher high-water heights of the two daily tidal levels. Marine critical habitat extends offshore to the depth of 10 meters (m) (33 ft) relative to the mean lower low-water (MLLW) line (zero tidal level or average of all the lower low-water heights of the two daily tidal levels). This area between the MHHW line and minus 10 m MLLW line (the average extent of the photic zone) is considered the habitat most consistently used by bull trout in marine waters based on known use, forage fish availability, and ongoing migration studies and captures geological and ecological processes important to maintaining these habitats. This area contains essential foraging habitat and migration corridors such as estuaries, bays, inlets, shallow subtidal areas, and intertidal flats.

Adjacent shoreline riparian areas, bluffs, and uplands are not designated as critical habitat. However, it should be recognized that the quality of marine and freshwater habitat along streams, lakes, and shorelines is intrinsically related to the character of these adjacent features, and that human activities that occur outside of the designated critical habitat can have major effects on physical and biological features of the aquatic environment.

Activities that cause adverse effects to critical habitat are evaluated to determine if they are likely to "destroy or adversely modify" critical habitat by no longer serving the intended conservation role for the species or retaining those PCEs that relate to the ability of the area to at least periodically support the species. Activities that may destroy or adversely modify critical habitat are those that alter the PCEs to such an extent that the conservation value of critical habitat is appreciably reduced (75 FR 63898:63943; USFWS 2004, Vol. 1. pp. 140-193, Vol. 2, pp. 69-114). The Service's evaluation must be conducted at the scale of the entire critical habitat area designated, unless otherwise stated in the final critical habitat rule (USFWS and NMFS 1998, pp. 4-39). Thus, adverse modification of bull trout critical habitat is evaluated at the scale of the final designation, which includes the critical habitat designated for the Klamath River, Jarbidge River, Columbia River, Coastal-Puget Sound, and Saint Mary-Belly River population segments. However, we consider all 32 CHUs to contain features or areas essential to the conservation of the bull trout (75 FR 63898:63901, 63944). Therefore, if a proposed action would alter the physical or biological features of critical habitat to an extent that appreciably reduces the conservation function of one or more critical habitat units for bull trout, a finding of adverse modification of the entire designated critical habitat area may be warranted (75 FR 63898:63943).

Current Critical Habitat Condition Rangewide

The condition of bull trout critical habitat varies across its range from poor to good. Although still relatively widely distributed across its historic range, the bull trout occurs in low numbers in many areas, and populations are considered depressed or declining across much of its range (67 FR 71240). This condition reflects the condition of bull trout habitat. The decline of bull trout is primarily due to habitat degradation and fragmentation, blockage of migratory corridors, poor water quality, past fisheries management practices, impoundments, dams, water diversions, and the introduction of nonnative species (63 FR 31647, June 10 1998; 64 FR 17112, April 8, 1999).

There is widespread agreement in the scientific literature that many factors related to human activities have impacted bull trout and their habitat, and continue to do so. Among the many factors that contribute to degraded PCEs, those which appear to be particularly significant and have resulted in a legacy of degraded habitat conditions are as follows: 1) fragmentation and isolation of local populations due to the proliferation of dams and water diversions that have eliminated habitat, altered water flow and temperature regimes, and impeded migratory movements (Dunham and Rieman 1999, p. 652; Rieman and McIntyre 1993, p. 7); 2) degradation of spawning and rearing habitat and upper watershed areas, particularly alterations in sedimentation rates and water temperature, resulting from forest and rangeland practices and intensive development of roads (Fraley and Shepard 1989, p. 141; MBTSG 1998, pp. ii - v, 20-45); 3) the introduction and spread of nonnative fish species, particularly brook trout and lake trout, as a result of fish stocking and degraded habitat conditions, which compete with bull trout for limited resources and, in the case of brook trout, hybridize with bull trout (Leary et al. 1993, p. 857; Rieman et al. 2006, pp. 73-76); 4) in the Coastal-Puget Sound region where amphidromous bull trout occur, degradation of mainstem river FMO habitat, and the degradation and loss of marine nearshore foraging and migration habitat due to urban and residential development; and 5) degradation of FMO habitat resulting from reduced prey base, roads, agriculture, development, and dams.

Effects of Climate Change on Bull Trout Critical Habitat

One objective of the final rule was to identify and protect those habitats that provide resiliency for bull trout use in the face of climate change. Over a period of decades, climate change may directly threaten the integrity of the essential physical or biological features described in PCEs 1, 2, 3, 5, 7, 8, and 9. Protecting bull trout strongholds and cold water refugia from disturbance and ensuring connectivity among populations were important considerations in addressing this potential impact. Additionally, climate change may exacerbate habitat degradation impacts both physically (e.g., decreased base flows, increased water temperatures) and biologically (e.g., increased competition with non-native fishes).

Consulted on Effects for Critical Habitat

The Service has formally consulted on the effects to bull trout critical habitat throughout its range. Section 7 consultations include actions that continue to degrade the environmental baseline in many cases. However, long-term restoration efforts have also been implemented that provide some improvement in the existing functions within some of the critical habitat units.

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