

# CHARACTERIZING BEHAVIOR AND DISTRIBUTION OF ANADROMOUS BULL TROUT IN OFFSHORE MARINE WATERS OF WASHINGTON STATE

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## TABLE OF CONTENTS

SUMMARY .....	1
INTRODUCTION .....	2
<i>Goal 1- Determine the occurrence of bull trout within NWTT .....</i>	<i>2</i>
<i>Goal 2 – Determine which populations of bull trout are within NWTT.....</i>	<i>2</i>
METHODS .....	3
<i>Permitting .....</i>	<i>3</i>
<i>Deploy acoustic tags in bull trout .....</i>	<i>4</i>
<i>Sampling .....</i>	<i>4</i>
<i>Deploy acoustic receiver network.....</i>	<i>5</i>
<i>Analyze acoustic receiver data .....</i>	<i>7</i>
<i>Communicate findings to stakeholders .....</i>	<i>7</i>
REFERENCES .....	8

## LIST OF TABLES

Table 1 Mooring coordinates of marine acoustic receivers .....	5
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## LIST OF FIGURES

Figure 1 Map of receiver mooring locations.....	6
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## SUMMARY

The U.S. Navy conducts military training and testing in Pacific Northwest range areas to prepare combat-ready military forces, whereas the United States Fish and Wildlife Service (USFWS) is responsible for managing species listed under the Endangered Species Act (ESA) within their jurisdiction, which includes bull trout. USFWS and the U.S. Navy share the common goals of minimizing the impact of military training and testing activities on ESA-listed species without compromising training and testing efforts. The proposed work would provide vital geographic and distributional data on bull trout movement within the Navy's Northwest Training and Testing (NWTT) Study Area, allowing the Navy the flexibility to proceed with training and testing. This study benefits the broader community by generating new scientific insights into bull trout use of nearshore and coastal habitats, information that can support more effective conservation and management decisions.

This multi-year project will specifically support Pacific salmonid studies in the nearshore marine waters of the Navy's NWTT Study Area and assess their overlap with ESA-listed bull trout. The project will be conducted and performed through a collaborative team of researchers from Oregon State University (OSU) and the National Oceanic and Atmospheric Administration (NOAA).

## INTRODUCTION

Bull trout (*Salvelinus confluentus*) are the southern-most species of Western North American chars and are listed under the ESA as threatened due to a multitude of human impacts ranging from predator culling in the past to contemporary habitat alteration and climate change. While conservation has often focused on maintaining cold tributary habitat at the upper extent of watersheds, there is increasing recognition that habitats downstream, even in the ocean, could be critical for maintaining migratory life-histories that are key to population resilience. Anadromous bull trout may rely on the ocean not only to forage and grow large (as Pacific salmon do), but also to reach adjacent rivers that offer better habitat during winter. Thus, anadromy within populations of bull trout along the Washington coast may increase adult fecundity and overwinter survival, both of which are important for population dynamics.

The extent to which anadromous bull trout utilize coastal Washington waters is relatively unknown. As the Navy conducts training and testing in these waters, they funded this study to more closely investigate the potential overlap in time and space of Navy activities that could have an adverse effect on anadromous bull trout. The proportion of the bull trout population using coastal waters remains uncertain due to two persistent challenges: (1) sample sizes of tagged anadromous fish are often small because only a fraction of tagged fish exhibit anadromy and (2) prior work had limited detection capacity within 3 nm of shore. We propose to address these challenges to provide a more robust estimate of the proportion of anadromous bull trout that occur within the NWTT Study Area. Specifically, we will distribute acoustic tags in fish captured across natal watersheds and freshwater overwintering habitats to comprehensively represent habitat use and movement patterns across the population. Further, we will deploy acoustic receivers within the nearshore area (0-3 nm) so that we can better detect fish that go to the ocean but do not reach the NWTT Study Area. These research activities will provide an important step forward for understanding how Navy activities overlap with threatened bull trout populations.

### *Goal 1- Determine the occurrence of bull trout within NWTT*

We will monitor for ESA-listed bull trout near the boundaries of NWTT to characterize the prevalence and timing of occurrence within NWTT. Past studies of marine habitat use in bull trout have had relatively small sample sizes because only a subset of tagged fish exhibited anadromy. We will address this challenge by tagging fish in natal and overwintering freshwater habitats. Many overwintering habitats lack spawning habitat and harbor only anadromous adult fish. These data will determine the proportion of the population entering marine waters, the proportion of fish that enter NWTT, and the timing and extent of residence in NWTT.

### *Goal 2 – Determine which populations of bull trout are within NWTT*

We will monitor for tagged bull trout in river basins that support spawning populations of bull trout. Bull trout spawn in the fall (Brenkman et al. 2001), so many of the individuals in our study should enter their natal river basin after residing in the ocean (and potentially NWTT). This

approach will help assign individuals to natal populations and reveal if specific populations are more likely to enter the Navy training and testing area, potentially experiencing greater impacts.

## METHODS

The major work is divided into four primary tasks: permitting, fish tagging, receiver deployment/recovery, and data analysis and reporting. These tasks are detailed below:

### *Permitting*

We have identified all permits necessary for the project. All necessary permits for fish handling and tagging have all been completed, which will allow us to commence fish sampling as of January 2025. All permits necessary for marine receiver deployment are in review with an anticipated completion date of March-April 2025.

Disclosed permitting issues: Critical revisions to the experimental design, specifically with regard to mooring placement, were forced due to delayed permit review processing at the Washington Department of Natural Resources (WDNR) that prevented deployment of acoustic receivers within 0-3nm. The Oregon State University research team was notified that the permit may not be processed until 2026 or later. To achieve the project goals as close as possible with this unforeseen constraint, the research team devised an alternative study design placing moorings parallel to the shoreline along the 3nm line, extending north-south for approximately 40 km from just south of La Push to the Queets River. The transect of receivers will allow for monitoring fish crossing the 3-nm line but this effectively changes the purpose of the funding and study for requisite USFWS consultation.

Relevant permit details are provided below:

#### Federal Permits:

1. US Fish and Wildlife Service
  - Description: Amended existing bull trout recovery permit (TE28786C-2)
  - Status: Complete
  
2. NOAA National Marine Sanctuary Permit
  - Description: Receiver deployment within Olympic Coast National Marine Sanctuary (OCNMS)
  - Status: Under review
  
3. ESA Section 10 Permit
  - Description: Environmental compliance permit
  - Status: Under review

#### Federal Consultation and Compliance:

1. ESA Section 7 Consultation
  - Description: Review of potential impacts on protected species
  - Status: Under review

2. ESA Section 106 Consultation

- Description: Review of potential impacts on ecological and cultural resources.
- Status: Under Review

Animal Research Permits:

1. Institutional Animal Care and Use Protocol (IACUC)

- Description: Review of animal research protocol
- Status: Complete

State Permits:

1. Washington Department of Fish and Wildlife

- Description: Permit for bull trout recovery
- Status: Complete

*Deploy acoustic tags in bull trout*

We will deploy up to 60 69 kHz acoustic in adult bull trout captured in natal rivers and non-natal overwintering habitats. Tags will include temperature and/or depth sensors to provide additional information on habitat use.

*Sampling*

We propose to sample adult bull trout for this study (e.g. fish with fork length  $\geq 300$ mm) during the winter and spring of 2025. Fish will be captured via hook and line using artificial lures and barbless hooks. For all captured adult fish, we will measure individuals for length and collect a small fin clip ( $< 1 \text{ cm}^3$ ) for stable isotope and genetic analysis. We will surgically implant acoustic tags using standard methods (Liedtke et al. 2012) and in compliance with USFWS and WDWF permits.

To reduce our required sample size, we will capitalize on non-natal overwintering habitat where all bull trout encountered will presumably be anadromous. These fish must move through the ocean to link freshwater overwintering habitat with fall spawning habitat in adjacent river basins (Brenkman and Corbett 2005, Smith and Huff 2023). However, we do not anticipate that we will be able to capture enough fish in such habitats to meet our needed sample size (based on personal communications with Sam Brenkman and Roger Peters, July 2024), and it could skew our results if we only infer marine habitat use from fish transiting short distances from non-natal overwintering habitat to spawning habitat. Therefore, we will distribute tags across both natal rivers and non-natal overwintering habitat.

In natal rivers, we propose to sample up to a total of 100 fish from January through early March, presumably before anadromous fish move into the marine environment. In non-natal streams, we propose to sample a total of 50 fish from February through April. These sample sizes were developed in consultation with the US Fish and Wildlife Service. We propose to sample the following overwintering habitats: Goodman Creek, Mosquito Creek, Steamboat Creek, Raft

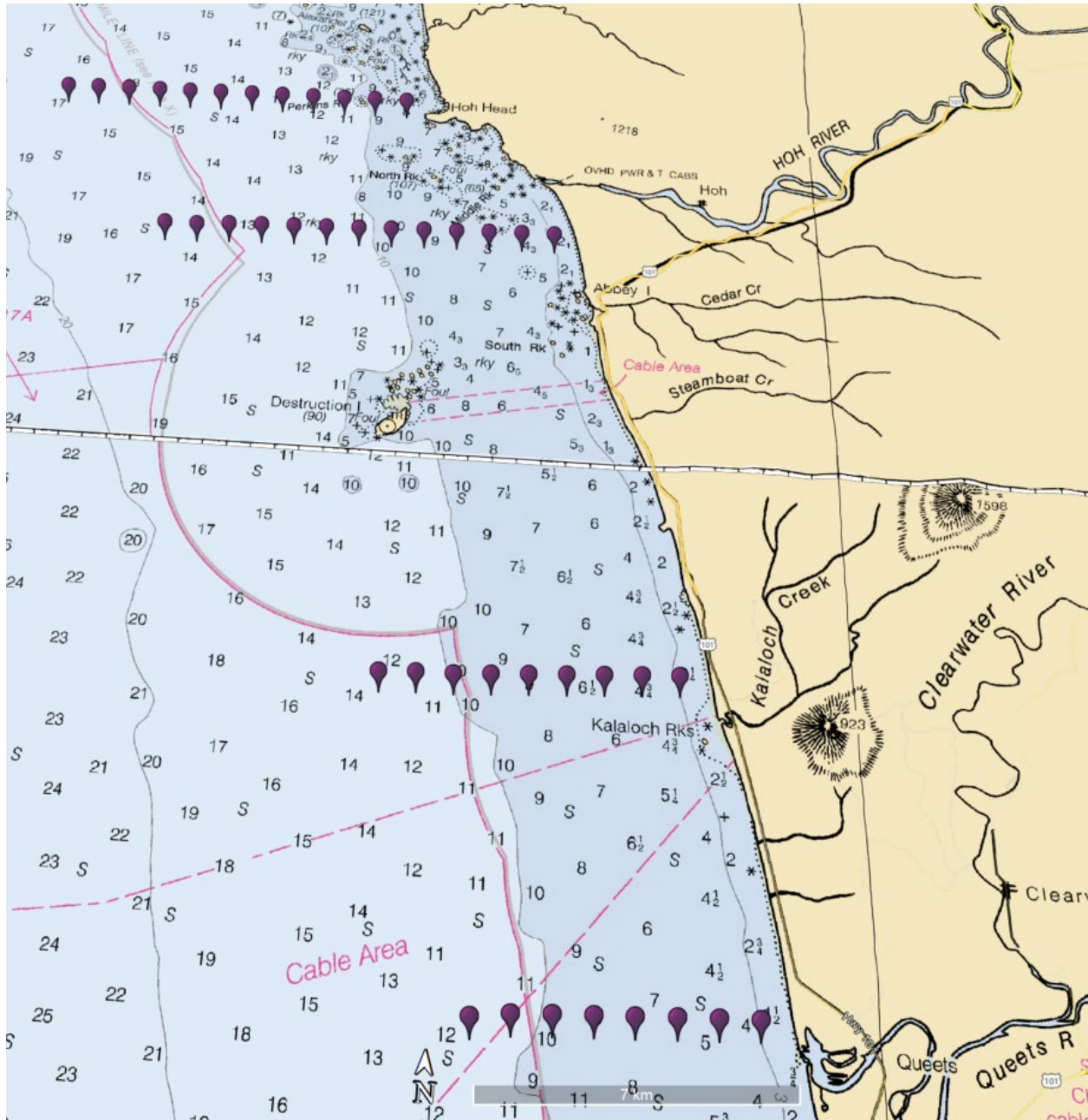
River, Cedar Creek, Whale Creek, Camp Creek, Duck Creek, Moclips River, Copalis River, Chehalis River, Kalaloch Creek; and the following natal rivers: Hoh River, Queets River, Quinault River.

*Deploy acoustic receiver network*

We will deploy 42 acoustic receivers along the coastline within the OCNMS. These receivers will be arranged in four east-west “fences” near the mouths of the Queets River, Kalaloch Creek, Hoh River, and Hoh Head. The fences will span from the shoreline (5.5-meter isobath) to approximately 1,500 meters beyond the 3nm line (Table 1, Figure 1). Receivers will be spaced approximately 800 meters apart to optimize detection of north-south movements. This mooring design aims to record the timing of movements into major overwintering habitats (e.g., Kalaloch Creek) and the distance fish travel offshore, providing insight into what proportion of fish transit near or within NWTT. If additional receivers are secured, they will be added to the east-west “fences” to extend the arrays further offshore and into NWTT. Marine receivers will be deployed in March or April 2025 and recovered in October or November 2025. Deployment and recovery timing will depend on weather conditions, as receivers cannot be deployed in winter due to wave height and must be recovered before winter to prevent equipment loss or damage.

**Table 1** Mooring coordinates of marine acoustic receivers.

Station ID	Latitude	Longitude	Station ID	Latitude	Longitude
AR01	-124.4875	47.76773	AR22	-124.5378	47.725
AR02	-124.4997	47.76771	AR23	-124.5498	47.72472
AR03	-124.5116	47.76755	AR24	-124.5617	47.72416
AR04	-124.5237	47.7675	AR25	-124.5736	47.72411
AR05	-124.5357	47.76738	AR26	-124.3882	47.61149
AR06	-124.5475	47.76731	AR27	-124.4001	47.61107
AR07	-124.5597	47.7672	AR28	-124.4121	47.61058
AR08	-124.5716	47.76703	AR29	-124.4241	47.61008
AR09	-124.5834	47.76696	AR30	-124.4361	47.60961
AR10	-124.5954	47.76694	AR31	-124.4481	47.60911
AR11	-124.6074	47.76678	AR32	-124.4601	47.60859
AR12	-124.6191	47.76664	AR33	-124.472	47.60847
AR13	-124.4299	47.72717	AR34	-124.4839	47.60804
AR14	-124.4418	47.72704	AR35	-124.3676	47.54079
AR15	-124.4538	47.72679	AR36	-124.3795	47.54047
AR16	-124.4658	47.72653	AR37	-124.3915	47.54011
AR17	-124.4778	47.72628	AR38	-124.4037	47.5397
AR18	-124.4899	47.72602	AR39	-124.4155	47.53937
AR19	-124.5018	47.72576	AR40	-124.4275	47.53899
AR20	-124.5138	47.72552	AR41	-124.4395	47.53854
AR21	-124.5258	47.72524	AR42	-124.4513	47.5375



**Figure 1** Map of receiver mooring locations within the OCNMS and extending into the NWT (3nm line denoted as solid pink line).

To identify the source populations of tagged fish, additional receivers will be placed in nearby rivers with bull trout populations (i.e., Quinault, Queets, Hoh, and Quillayute). To capture the timing of movements away from overwintering habitats, at least one receiver will be deployed in each overwintering habitat where fish are tagged. In key overwintering habitats (e.g., Raft River, Cedar Creek, Kalaloch Creek), up to two receivers will be deployed to ensure redundancy in case receivers are lost during winter floods.

*Analyze acoustic receiver data*

A biologist with animal telemetry expertise will postprocess and analyze the data from acoustic receivers. The specific analyses performed will depend on the nature of the data (i.e., sample sizes, statistical distributions of response variables, etc.). The analysis will quantify the proportion of tagged bull trout that enter the zone of zone of Navy activity. Further, we will analyze detections in the rivers that harbor spawning populations of bull trout to determine return timing and within river movements.

*Communicate findings to stakeholders*

We will disseminate our findings by writing a report to the Navy, presenting our study at relevant conferences, and publishing our results in peer-reviewed journals. We have already held several stakeholder meetings and will continue to do so throughout the study period.

## ACKNOWLEDGEMENTS

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