Agenda Item F.3
Attachment 1 ***(Electronic Only)***
November 2024

DRAFT
REBUILDING PLAN ANALYSIS FOR QUEETS RIVER NATURAL SPRING/SUMMER CHINOOK

OCTOBER 2024

REGULATORY IDENTIFIER NUMBER 0648-BN25

.

TABLE OF CONTENTS

List of Tables

List of Figures

LIST OF ACRONYMS AND ABBREVIATIONS

AABM	aggregate abundance-based management
ABC	acceptable biological catch
ACL	annual catch limit
AEQ	adult equivalent
AM	accountability measures
BC	British Columbia
BY	brood year
CFS	cubic feet per second
Council	Pacific Fishery Management Council
CTC	Chinook Technical Committee
CWT	coded-wire tag
ER	exploitation rate
ERA	exploitation rate analysis
FMP	fishery management plan
F_{MSY}	maximum sustainable yield exploitation rate
FNMCCSC	Far-North-Migrating Coastal Chinook Stock Complex
FRAM	Fishery Regulatory Assessment Model
ISBM	individual stock-based management
MFMT	maximum fishing mortality threshold
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MSE	management strategy evaluation
MSST	minimum stock size threshold
MSY	maximum sustainable yield
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NS1	National Standard 1
NS1G	National Standard 1 Guidelines
ONP	Olympic National Park
OY	Optimum Yield
PFMC	Pacific Fishery Management Council (Council)
PSC	Pacific Salmon Commission
PST	Pacific Salmon Treaty
QDNR	Quinault Department of Natural Resources
QIN	Quinault Indian Nation
QIR	Quinault Indian Reservation
S_{MSY}	MSY spawning escapement
SEAK	Southeast Alaska
STT	Salmon Technical Team
SUS	southern U.S.
T_{max}	maximum rebuilding time
T_{min}	minimum rebuilding time
T_{target}	target rebuilding time
TRS	terminal run size
WDFW	Washington Department of Fish and Wildlife
WNC	Washington north coast

1.0 EXECUTIVE SUMMARY

The status for Queets River natural spring/summer Chinook salmon (Queets sp/su Chinook) was classified as overfished by the Secretary of Commerce in November 2023. In response, the Pacific Fishery Management Council (Council) directed the Salmon Technical Team (STT), in coordination with relevant state and tribal comanagers, to develop a rebuilding plan for Council consideration within one year. This report represents the Queets sp/su Chinook rebuilding plan analysis and includes requirements described in the Pacific Coast Salmon Fishery Management Plan (FMP), including: (1) an evaluation of the roles of fishing, marine and freshwater survival in the overfished determination, (2) any modifications to the criteria for determining when the stock has rebuilt, (3) recommendations for actions the Council could take to rebuild the stock, and (4) specification of the rebuilding period.

An evaluation of potential factors that led to the overfished status revealed that three consecutive years of poor ocean conditions from 2015-2017 correspond closely with the below average spawning escapement that occurred from 2019-2021, and unfavorable freshwater conditions in four years between 2014-2019 likely caused a negative impact on spawning and rearing success. A review of pertinent data indicated that freshwater fisheries have resulted in minimal impacts since the year 2000 and did not play a major role in contributing to the overfished status; ocean harvest data is very limited on this stock, but a cursory review using surrogate stocks indicated that harvest impacts appear to occur at lower levels in Council-area fisheries compared to the estimated ocean impacts occurring in British Columbia (BC), Canada and Southeast Alaska (SEAK) ocean salmon fisheries.

Recommendations for action in this rebuilding plan include: (1) the rebuilt criterion, (2) potential fishery management strategies to be employed during the rebuilding period, (3) comanager recommendations, (4) STT recommendations, and (5) an analysis of rebuilding times.

It is important to note that Queets sp/su Chinook are a naturally occurring stock with no hatchery component and no associated coded-wire tag (CWT) group to directly estimate harvest and exploitation rates (ERs). Absent any direct estimates of ocean harvest impacts on Queets sp/su Chinook, a surrogate CWT group was needed for the analysis of rebuilding times. Geographically, Queets River fall Chinook are the nearest CWT indicator stock with suitable data for the needed analysis; however, there are shortcomings in using a fall stock as a surrogate for a sp/su stock due to differences in run timing, and other key differences. To account for this shortfall, CWT data (although limited) from Quillayute River summer Chinook were compiled and the distribution of recoveries across fisheries and escapement was compared with that of Queets fall Chinook. The comparison suggests that the total ocean ER on coastal fall Chinook may be higher than the ER on coastal sp/su Chinook, therefore the management strategy alternatives are provided with a range of estimated ERs (high and low). It is important to understand these key assumptions used to estimate rebuilding times when considering the management strategy alternatives.

Two management strategy alternatives were evaluated: (1) status quo and (2) suspending all non-treaty Council-area ocean salmon fisheries north of Cape Falcon (NOF), Oregon. For both Alternatives I and II, the probability of achieving rebuilt status stabilized at a maximum of one or two percent, respectively. This is well below the 50 percent threshold used for determining rebuilding times, suggesting that rebuilt status is unlikely to occur within the ideal maximum rebuilding time (T_{max}) of 10 years outlined in National Standard 1 (NS1). The analysis indicated that Council action alone is not likely to result in rebuilt status for Queets sp/su Chinook.

Under the T_{min} scenario (minimum rebuilding time where all ocean salmon fisheries that impact Queets sp/su Chinook are closed) a viable estimate of rebuilding time could only be calculated in one scenario under the assumption of high ocean ERs. In this case the estimated rebuilding time was five years; however, there is high uncertainty in this scenario. When assuming lower ocean ERs, the probability of achieving rebuilt status did not reach the 50 percent threshold and stabilized at a maximum of approximately 15 percent, suggesting that rebuilt status may be unlikely to occur in the foreseeable future, even under a scenario with zero fishing impacts.

2.0 INTRODUCTION

This document constitutes the analysis in support of the rebuilding plan for Queets River natural spring/summer Chinook salmon (Queets sp/su Chinook). In 2023, Queets sp/su Chinook met the criteria for overfished status as defined in section 3.1 of the Pacific Coast Salmon Fishery Management Plan (FMP; PFMC 2024). Notice of this status determination was provided to the Pacific Fishery Management Council (Council) by the National Marine Fisheries Service (NMFS) in November 2023. The FMP and the Magnuson-Stevens Fishery Conservation and Management Act (MSA) require that a rebuilding plan be developed and implemented within two years of the formal notification from NMFS to the Council of the overfished status. In response, the Council directed the Salmon Technical Team (STT) to propose a rebuilding plan for Council consideration within one year. Excerpts from the FMP relevant to status determinations and rebuilding plans are provided in Appendix A.

The Council's criteria for overfished is met if the geometric mean of spawning escapement, computed over the most recent three years, falls below the Minimum Stock Size Threshold (MSST) which is defined for applicable stocks in Table 3-1 of the FMP. For Queets sp/su Chinook, the number of adult spawners expected to produce maximum sustainable yield (MSY) is defined as 700 natural-area adult spawners, also known as S_{MSY}. The MSST for Queets sp/su Chinook is defined as 350 natural-area adult spawners, with MSST = 0.50 x S_{MSY}. As reported in 2023, the geometric mean of Queets sp/su Chinook natural-area adult spawners over years 2019-2021 was 314, and thus the stock met the criteria for overfished status (PFMC 2023). Figure 2.0.a displays the time series of Queets sp/su Chinook natural-area adult escapement and the running three-year geometric mean of escapement relative to S_{MSY} and the MSST. The FMP identifies the default criterion for achieving rebuilt status as attainment of a 3-year geometric mean of spawning escapement exceeding S_{MSY}.

Overfished status is defined by recent spawner escapement for salmon stocks, which is not necessarily the result of overfishing. Overfishing occurs when in any one year the exploitation rate (ER) on a stock exceeds the maximum fishing mortality threshold (MFMT), which is intended to be equal to or less than the fishing mortality rate that produces MSY over the long term (F_{MSY}). For Queets sp/su Chinook, the MFMT is defined using a proxy rate of 0.78. It is possible that the current overfished status could represent normal variation, as has been seen in the past for several salmon stocks. However, the occurrence of reduced stock size or spawner escapements, depending on the magnitude of the short-fall, could signal the beginning of a critical downward trend.

Imposing fisheries on top of already low abundances could further jeopardize the capacity of the stock to produce MSY over the long term if appropriate actions are not taken to ensure that conservation objectives are achieved.

In this rebuilding plan, we begin by providing an overview of the Queets sp/su Chinook stock, the physical setting of the Queets River watershed, ocean distribution, and fisheries management. We then review the potential factors that may have contributed to the overfished status. Recommendations regarding alternative rebuilding actions are proposed, as are recommendations for actions outside of the management of salmon fisheries. We end with a socioeconomic analysis of the impact of the recommended rebuilding alternatives.

The long-term (1976-2022) geometric mean of natural escapement of Queets sp/su Chinook is 581 spawners, which includes three years of exceptionally large returns from 1988-1990. Omitting these years, the mean since 1976 is 534. Over the most recent 10 years (2013-2022), the geometric mean of natural spawner escapement is 457 (Figure 2.0.a).

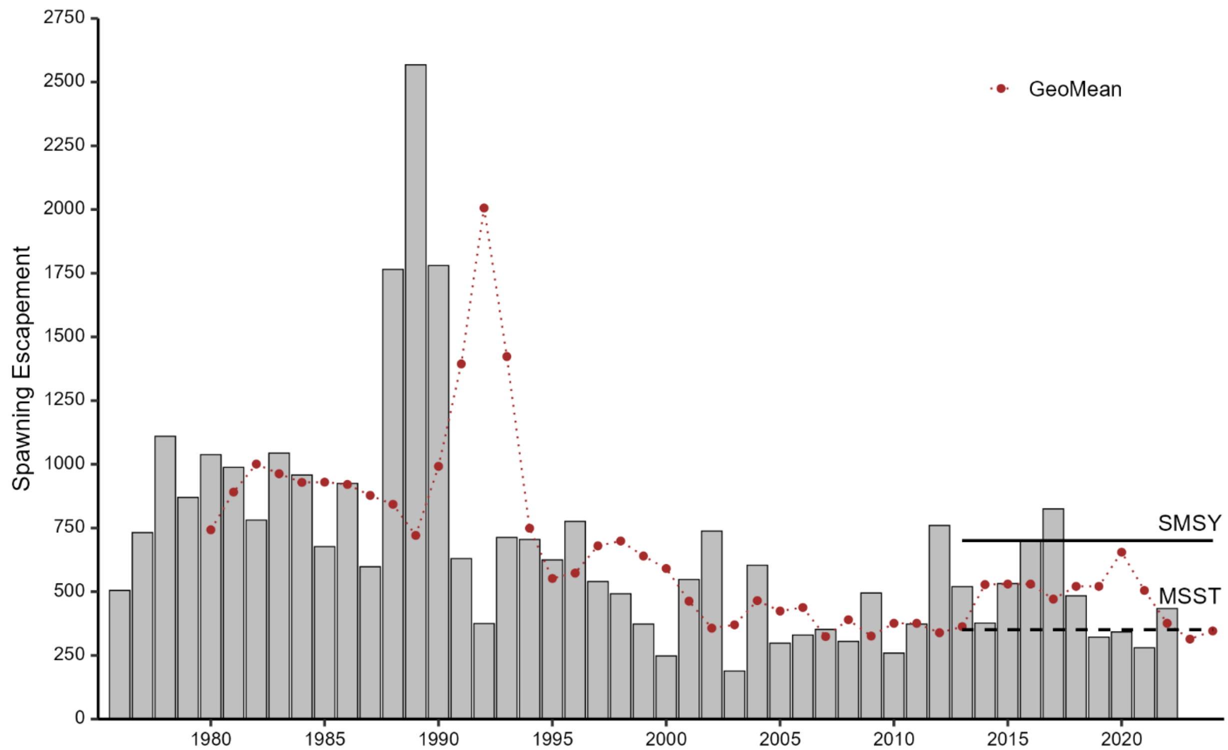

Figure 2.0.a. Spawning escapement of adult Queets sp/su Chinook.

2.1 Magnuson-Stevens Fishery Conservation and Management Act

The following is a review of NMFS' MSA National Standard 1 (NS1) guidelines regarding rebuilding plans (50 CFR 600.310(j)), and how these guidelines interface with the salmon FMP (e.g., required elements T_{target}, T_{min}, and T_{max}). Under these guidelines, rebuilding plans must include elements that estimate the range of time needed to reach rebuilt status and including these elements in rebuilding plan alternatives allows the Council to make an informed decision on adopting rebuilding plans.

T_{target}: the target time for rebuilding the fishery in as short a time as possible, taking into account the status and biology of the overfished stock, the needs of the fishing communities, recommendations by international organizations in which the United States participates, and the interaction of the overfished stock of fish within the marine ecosystem.

T_{min}: the amount of time the stock is expected to take to rebuild to MSY biomass level in the absence of any fishing mortality ("expected" means to have at least a 50 percent probability of attaining MSY, where such probabilities can be calculated). Note that, for salmon, we use spawning escapement for biomass, so the MSY biomass level is termed S_{MSY} in salmon rebuilding plans.

T_{max}: the maximum time for rebuilding a stock to B_{MSY} (S_{MSY} for salmon). If T_{max} is less than 10 years, T_{max} is 10 years. If T_{min} exceeds 10 years, then one of the following methods can be used to determine T_{max}:

1) T_{min} plus the length of time associated with one generation time for that stock or stock complex. "Generation time" is the average length of time between when an individual is born and the birth of its offspring,
2) The amount of time the stock or stock complex is expected to take to rebuild to S_{msy} if fished at 75 percent of MFMT, or
3) T_{min} multiplied by two.

To estimate T_{min}, an impact rate of zero is assumed, meaning all fisheries affecting the stock would cease until the stock was rebuilt. Because the Council does not have jurisdiction over fisheries that occur in Alaska or Canada, or tribal, in-river, and other fisheries that may impact the stock, a 'no-fishing' alternative is not a viable option for the Council to consider. Also, a 'no-fishing' alternative does not meet the purpose and need because it would restrict tribal fisheries in a manner that is inconsistent with their treaty rights. However, because T_{min} does serve as a bookend in the analysis of rebuilding probabilities over a ten-year period when assuming an ER of zero, this 'T_{min} scenario' fulfills the requirement of NS1 in calculating the minimum time (T_{min}) estimated to achieve rebuilt status. It is for this purpose only that the 'T_{min} scenario' is included in this document (see Section 4).

2.2 National Environmental Policy Act

In addition to addressing the requirements of the FMP and MSA, any analysis required under the National Environmental Policy Act (NEPA) will be provided in a separate document.

2.2.1 Proposed Action

The Proposed Action is for the Council to adopt and NMFS to approve a rebuilding plan for the Queets sp/su Chinook salmon stock, which has been determined by NMFS to be overfished under the MSA.

2.2.2 Purpose and Need

The purpose of the proposed action is to rebuild Queets sp/su Chinook, which were declared as overfished by the Secretary of Commerce, to sustainable levels in as short as time as possible taking into account the status and biology of the overfished stock, the needs of the fishing communities, recommendations by international organizations in which the United States participates, and the interaction of the overfished stock of fish within the marine ecosystem.. The proposed action is needed because MSA §304(e)(3) requires Regional Fishery Management

Councils to "prepare a fishery management plan, plan amendment, or proposed regulations" in order to prevent overfishing and implement a plan to rebuild the overfished stocks. MSA §304(e)(3), requires the Council to prepare and implement a plan amendment or proposed regulations within two years of notification that a stock is overfished

2.3 . Stock overview

2.3.1 Stock composition

There is currently only a natural spawning component of the Queets Sp/su Chinook run, though an out-of-basin-stock planting program operated in the late-1970's. During the program, a non-associated spring Chinook release group originating from the Cowlitz River was released into the Queets River in 1976 to supplement the sp/su run which was already showing signs of decline. A tagged group of Quillayute River summer Chinook were also reared at the Quinault Lake Hatchery in net pens before being released as fingerlings into the Queets River near the Sams River confluence. No other supplemental or hatchery Chinook programs have been operated for sp/su Chinook on the Queets River. While genetics is used to evaluate pedigree and parse spring, summer, and fall components in other systems, there has been no genetic analysis of the Queets sp/su Chinook stock.

Historical in-river commercial harvest shows that the stock has a prolonged run period relative to Queets fall Chinook from early-May to September (Figure 2.3.1.a). The subtle bimodal distribution in harvest during the spring management period aligns with the typical run timing of other spring and summer runs on the WA coast: the first peak lies between June and July, while the second peak is at the end of August. This could suggest a division in spring and summer run timings in the Queets River, though this feature may also be an artifact of how fishing seasons were structured. Historical Chinook catch patterns suggest that the sp/su and fall run separation occurs in early September between weeks 35-37. First fall rains typically occur at this time, encouraging fall run Chinook to enter the system while the sp/su run move from deeper pools to nearby spawning gravels in the middle and upper portions of the system (Tyler Jurasin, Quinault Fisheries, personal communication, 2024). Currently, only parent spawner abundance is used as a predictor of subsequent brood recruitment and only historical age composition data are available for the stock.

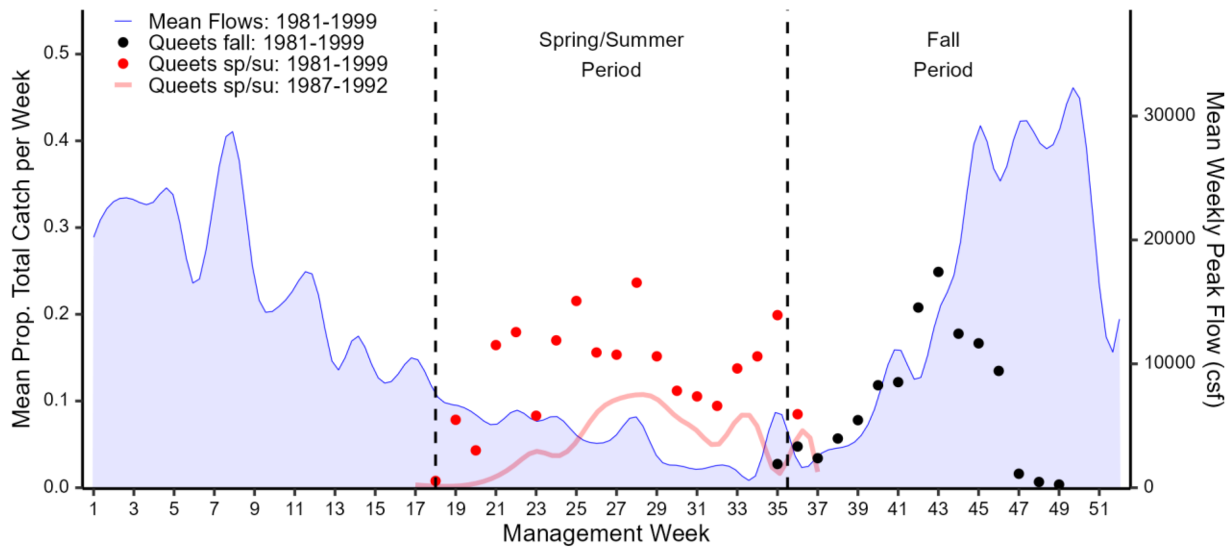

Figure 2.3.1.a. Mean proportions of annual river gillnet harvest in the lower Queets River of Queets natural sp/su and fall Chinook from 1981-1999, as well as a subset of years for the sp/su run from 1987-1992 which saw exceptionally high returns. Shading indicates average weekly flow from 1981-1999. For each year, weekly mean flows were derived from daily peaks, after which mean weekly flow was taken across all year.

Scales recovered from the in-river commercial gillnet fishery which historically targeted the stock provide estimates of age composition. Age denotes the number of years since egg fertilization; an age-5 spawner in 2019 was produced by the 2014 brood year (BY). Until 1989, age-3 fish regularly contributed modestly to spawning escapement, after which their occurrence was greatly diminished (Figure 2.3.1.b). The super BYs of 1988-1990 seen in Figure 2.0.a corresponded with growing contributions of age-3 fish in the prior three years (1985-1987). In the late-1990s, the age-3 and age-4 components contributed very little to escapement, and age-5 fish made up much of the spawning run. While this most recent age data for the stock indicates a shift towards age-5 fish, more recent data from neighboring stocks suggest a shift towards earlier maturation over the last two decades. Queets fall, Hoh fall, and Hoh summer Chinook saw a similar pattern from 1985-1990, though now share a long-term trend in declining age-5 and 6 contributions and a corresponding rise in age-3 and 4 fish since the early-2000's (Figure 2.3.1.b). Annual fluctuations in age structure are reflected across both run and river since 1977 indicating that neighboring stocks may provide the best estimates for current trends in adult spawner age composition for the Queets sp/su run. Assuming that current Queets sp/su Chinook spawner returns are also composed mostly of age-3, 4, and 5 fish, BYs 2014-2018 are of the greatest interest for assessing the poor spawning escapements of 2019-2021.

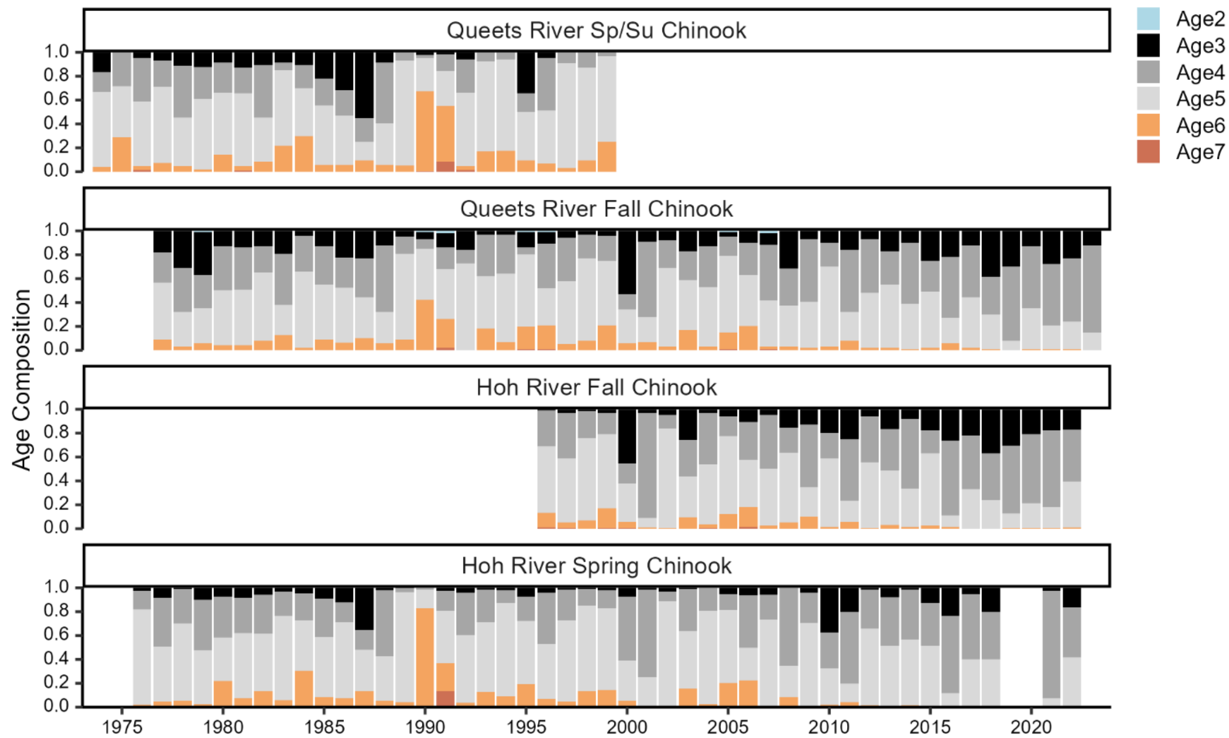

Figure 2.3.1.b. Adult age composition of Chinook spawning runs from the Queets and Hoh Rivers.

2.3.2 Watershed Location and Geography

The Queets River Basin includes several major tributaries: the Clearwater River, Salmon River, Matheny Creek, Sams River, and Tshletshty Creek. Of these, the Clearwater River is the largest tributary and supports a watershed of nearly 400 square km (154.4 square mi) (Figure 2.3.2.a).

The Queets River flows through a relatively low gradient, heavily forested alluvial valley. The Queets River originates at the foot of the Humes Glacier on Mount Olympus, located on the Olympic Peninsula of western Washington, and generally flows southwest before entering the Pacific Ocean near the village of Queets within the Quinault Indian Reservation (QIR). This western Washington river system is 82.7 km (51.4 mi) long and drains a watershed of 1,152 square km (444.8 square mi).

The bedrock geology of the Queets River basin consists of Tertiary sandstone with minor inclusions of basaltic rock; overlain by accumulations of Pleistocene alpine glacial till and outwash, lacustrine deposits, and Holocene alluvium deposited by landslides and fluvial transport (Tabor and Cady 1978).

The Queets River watershed includes a wide range of land-use stakeholders, and historically was almost entirely forested with a large majority of the Queets mainstem running predominantly within the protected old growth forest of the Olympic National Park. The Clearwater River watershed flows through lands managed by the Washington State Department of Natural Resources and private timber companies. The Salmon River is contained almost entirely within the boundaries of the QIR. In addition, Sams River and Matheny Creek run mostly through land managed by the United States Forest Service (USFS). Lands on and off the QIR are subject to various logging practices, both contemporary and historical (STT 2001).

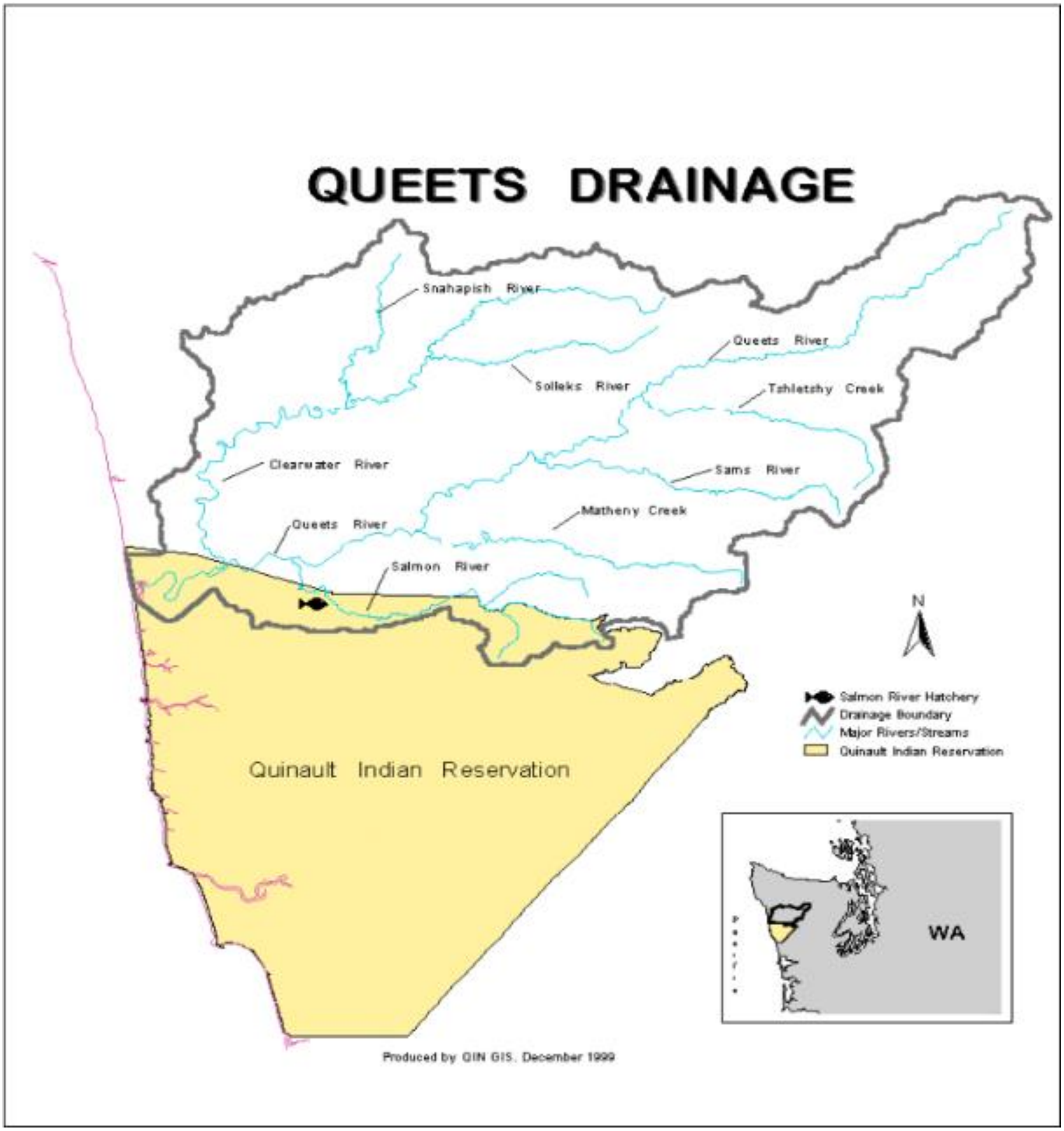

Figure 2.3.2.a. Location of the Queets River Basin.

2.3.3 Ocean Distribution

Washington coast fall Chinook have a northern migration on the Pacific coast of North America, distributing along the narrow continental shelf and among the island matrix of the British Columbia (BC) and Southeast Alaska (SEAK) coastline (Riddell et al., 2018). There has been only one coded-wire tagged (CWT) group of Chinook released into the Queets River that originated from a coastal spring or summer stock, offering very limited CWT recovery information from which ocean distribution can be inferred. The single Queets sp/su release group was composed of

Quillayute summer Chinook from BY 1978 that were reared at Quinault Lake Hatchery prior to release into a mainstem Queets River tributary in 1979. Alternatively, at least 134 spring and 132 summer Chinook hatchery releases have occurred throughout the Washington North Coast (WNC) and Grays Harbor regions since 1960. To augment our analysis of how Queets sp/su Chinook are typically distributed along the Pacific coast of North America, as well as the distribution of offspring from the 2014-2018 BYs, we also take a subset of other tagged fall, summer, and spring Chinook releases from the WNC. Queets fall Chinook and Quillayute summer Chinook from the 2014-2019 BYs were selected because our assessment of spawner age composition in Figure 2.3.1.b indicates that these BYs would have been the largest contributors to the 2019-2021 spawner returns. Additionally, environmental conditions are a potential cause for interannual variability in Queets sp/su Chinook ocean distribution and CWT distributions from other stocks during the years of concern may offer important insight regarding the overfished declaration. The Quillayute summer 2016 BY was removed for having too few CWT recoveries to confidently evaluate catch distributions. Spring Chinook from BYs 1977 and 1979 are among the only tagged spring or summer release groups from the Hoh River, though adequate recoveries from these release groups offer a solid basis to compare with. Together, these four stocks and the range of years we evaluate provide a solid foundation to infer general large-scale patterns of ocean distribution for Washington coast Chinook stocks, and thus the likely ocean distribution of Queets natural sp/su Chinook.

A look at the expanded CWT recoveries in ocean waters summarized spatially (Figure 2.3.3.a) strongly suggests that spring and summer Chinook from the WA coast are predominantly caught northwards of the border between Washington and BC, like their fall counterparts. Ocean fisheries in Washington and Oregon accounted for the smallest proportions of impacts for all four stocks in the years evaluated, however, the proportion of recoveries in Washington were higher for the spring and summer run stocks, particularly the Quillayute summer stock. Relative proportions in Figure 2.3.3.b are for ocean fishery recoveries only and do not include freshwater recoveries due to incomplete escapement reporting for some stocks. As a result, the distribution of recoveries across ocean areas can be compared, but we cannot infer or compare the magnitude of overall ocean exploitation rates. CWT recoveries were expanded for tag and sampling rates only, and do not incorporate incidental mortality (i.e., drop off and release mortality). Overall, the patterns of ocean distribution displayed here are consistent with the current grouping of WA coast Chinook stocks within the Far-North-Migrating Coastal Chinook Stock Complex (FNMCCSC) of the FMP and are a likely representation of the distribution of ocean encounters on the Queets sp/su Chinook in the years leading to their overfished designation.

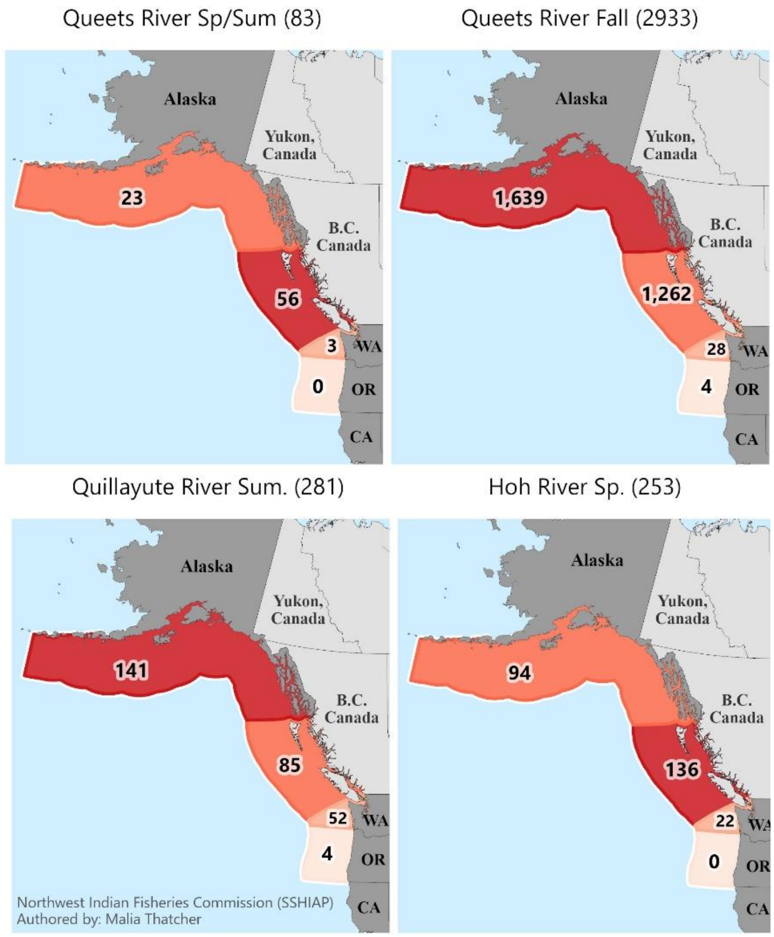

Figure 2.3.3.a. Spatial distribution of expanded ocean fishery CWT recoveries for Queets sp/su (top left; BY 1978), Queets fall (top right; BYs 2014 – 2018), Quillayute summer (bottom left; BYs 2014 – 2015 & 2017 – 2018), and Hoh spring run Chinook (bottom right; BYs 1977 & 1979)

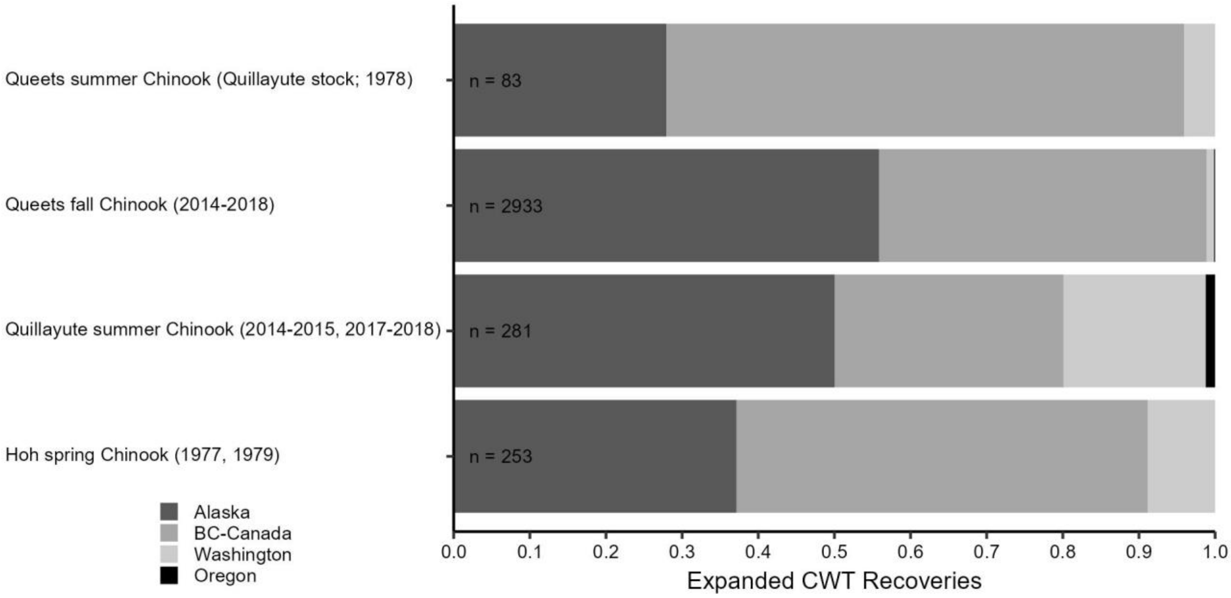

Figure 2.3.3.b. Distribution of expanded ocean fishery CWT recoveries across regions for Queets summer Chinook, Queets fall Chinook, Quillayute summer Chinook, and Hoh spring Chinook (BYs used indicated in axis labels).

2.4 Management Overview

Queets sp/su Chinook are included as a non-target stock within the FNMCCSC of the FMP. Indicator stocks for the Washington coastal component of this complex are Quillayute, Hoh, Queets, and Grays Harbor fall Chinook. Queets sp/su Chinook is a natural stock with limited hatchery influence. Queets sp/su Chinook are considered to have significant contributions to SEAK and BC ocean fisheries and minor contributions to ocean fisheries off Washington (FMP Table 1-1, PFMC 2024).

2.4.1 Conservation objectives

Table 3-1 of the FMP defines the following conservation objectives and reference points governing status determination criteria for Queets sp/su Chinook (PFMC 2024):

- S_{MSY} = 700
- MSST = 350
- MFMT (F_{MSY} Proxy) = 78% (SAC 2011)

The S_{MSY} escapement goal for Queets sp/su Chinook was derived based on a spawner-recruit analysis for BYs 1969 to 1976, developed by Quinault Department of Natural Resources (1982) and Cooney (1984). This S_{MSY} escapement goal is also used by the Pacific Salmon Commission (PSC) and was reviewed and accepted by the PSC's Chinook Technical Committee (CTC) in 2004 (CTC 2024). Annual natural spawning escapement targets may vary from FMP conservation objectives if agreed to by WDFW and treaty tribes under the provisions of Hoh v. Baldrige and subsequent U.S. District Court orders. For Queets sp/su Chinook the MSST is defined as half of S_{MSY}, which equates to 350 fish. The F_{MSY} Proxy is based on the mean of F_{MSY} values calculated for 20 stocks of Chinook salmon from the Sacramento River to Northern Washington (SAC 2011, Appendix C).

2.4.2 Management Strategy

For stocks that are managed under an international agreement in which the United States participates, the MSA provides an exception to the requirement to specify an annual catch limit (ACL) and accountability measures (AMs). This exception applies to Queets sp/su Chinook, as they are managed under the Pacific Salmon Treaty (PST), thus, specification of acceptable biological catch (ABC), ACLs, and AMs is not required.

Based on limited CWT recoveries of other Washington coast sp/su stocks, Queets sp/su Chinook likely have a far north migration pattern, with fishery interceptions occurring mostly in SEAK and BC, and to a lesser degree off the coast of Washington (Figure 2.3.3.a)). A similar pattern is evident for Queets fall Chinook, based on a CWT indicator stock that is evaluated annually by the CTC (CTC 2023). Without a representative CWT indicator stock for Queets sp/su Chinook, however, it is not possible to quantitatively estimate ocean fishery impacts on the stock. As a result, the stock is not represented in fishery models such as the Chinook Fishery Regulation Assessment Model (FRAM) used by the Council or the PSC Chinook Model used by the CTC, and ocean fishery impacts are not directly estimated for preseason or postseason assessments.

Terminal fisheries in the Queets basin are managed for a 30 percent harvest rate on the terminal return of Queets sp/su Chinook, but with an escapement floor of no less than 700 natural adult spawners. Since 1991, returns have rarely exceeded the escapement floor (Figure 2.0.a) and as a result, freshwater fisheries have been significantly restricted. Beginning in 2000, recreational freshwater fisheries have required the release of all Chinook during the summer period, and tribal freshwater net fisheries have been restricted to only a single day, for ceremonial and subsistence purposes (CTC 2024).

3.0 REVIEW OF POTENTIAL FACTORS LEADING TO OVERFISHED STATUS

A number of factors may contribute to a stock falling below the MSST and becoming classified as overfished. Fisheries may have occurred at too high a level, particularly if fishing rates exceed the MFMT, resulting in overfishing. Alternatively, freshwater and/or marine survival may be low enough, that even if anticipated, there will simply be too few adults produced to prevent the stock from falling below the MSST, even in the absence of fishing. The FMP specifies that the roles of freshwater survival, marine survival, and fishing should be considered in any rebuilding plan analysis. The overfished status designation was based on adult spawner escapement during 2019-2021. Given the life cycle of ocean-type Chinook salmon, these return years coincide predominately with the 2014-2018 BYs.

3.1 Freshwater survival

3.1.1 Review of freshwater conditions

Though there is no smolt trapping data for the Queets stock, fry are thought to emerge from January through March and migrate to the ocean within their first year of life. Washington coast sp/su Chinook exhibit an ocean-type life history in which outmigration timing of juveniles is variable. Some fry remain in the river for multiple months but many travel downstream soon after emerging to rear in the river estuary from February through May (Healey, 1991). Spawning adults in the 2014-2018 brood years were in the river from May through September and their progeny reared and outmigrated over the subsequent winter, spring, and summer. Thus, spawning adults returning from 2019-2021 would have been influenced by river conditions from 2014-2019 in early life.

Adult sp/su Chinook are typically observed holding in the mainstem of the Queets River, with the exception of a few tributaries, before moving onto riffles within the mainstem to spawn when water temperatures drop in September/early-October. (Tyler Jurasin, Quinault Fisheries, personal communication, 2024). Annual redd surveys thoroughly cover the available spawning habitat and summarizing the most recent five years of surveys show that spawners are concentrated in the middle and upper mainstem of the Queets River and five mainstem tributaries (Figure 3.1.1.a). Lower reaches of Tshletshy, Harlow, and Paradise Creeks., and upper reaches of the lower mainstem Queets River harbor relatively high concentrations of spawners, though the highest concentration is seen within a roughly 6.5-mile (10.5 km) section on the middle portion of the mainstem Queets River upstream of Tshletshy Cr. and downstream of Paradise Creek. The hydrology of Paradise Creek. is later presented in greater detail but importantly, this mainstem tributary is spring fed and provides a consistent input cool water to the mainstem Queets River year-round, offering a possible explanation for the concentration of spawners close by. Spawner abundance tapers off at the upper most extent of the surveyed reaches on the mainstem, which fits with the general suspicion among regional managers that Kilkelly Rapids is a natural migration barrier for the stock in the summer months. The concentration of spawners in the middle mainstem of the river and a handful of tributaries may be the result of long-term trends in deteriorating freshwater conditions. Decreasing low flows and increasing temperatures consolidate spawners to mainstem pools during the summer that ultimately restricts their use of otherwise suitable spawning habitat higher in tributaries once favorable hydrologic conditions for spawning present.

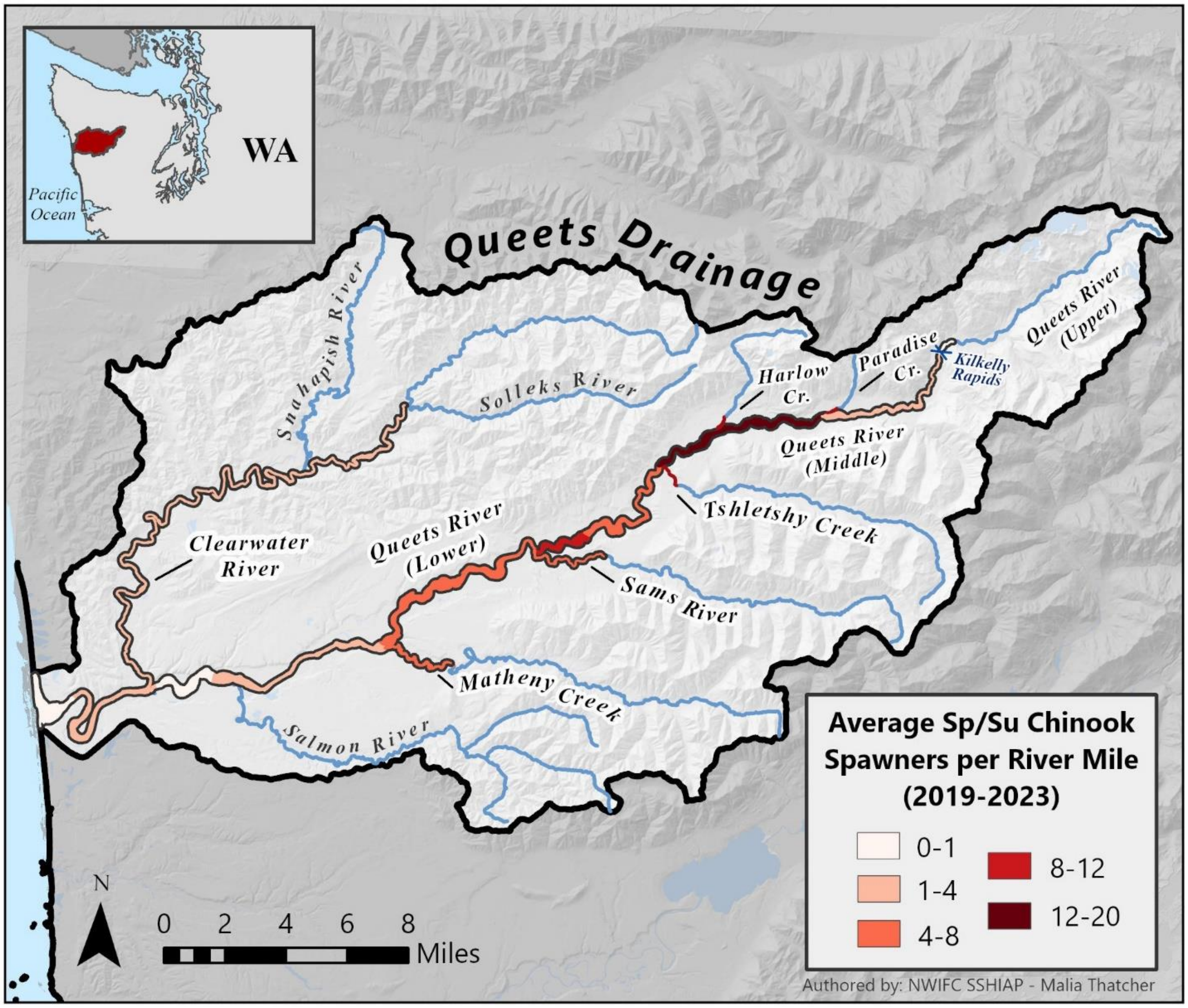

Figure 3.1.1.a. Queets sp/su Chinook spawning habitat utilization as average spawners per river mile from 2019-2023. Surveyed reaches as red hues of National Hydrography Dataset polygons and the remainder of the Queets system as blue lines.

The river regularly experiences low flows during the summer that could affect fish passage, overall survival, and limit smolt production. For the last 20 years, flows on the Queets River most often (i.e., 14/20) reached their lowest in September or later (Table 3.1.1.a). The 20-year median annual low flow from 2001-2020 was 393 cubic feet per second (cfs). Graphically, we see that low flows begin many months earlier than September with few rain events providing relief from June-September (Figure 3.1.1.b). Given run timing presented in Figure 2.3.1.a, adult Queets sp/su Chinook are expected to be holding in the middle to upper portions of the river by the time annual low flows are reached. For this reason, annual minimum flows are generally not believed to limit fish passage to the major spawning reaches displayed in Figure 3.1.1.a in most years. Still, the lowest flows in the 2015 and 2016 water years were recorded at the end of August, slightly earlier than most years, possibly affecting adult fish passage for the later component of the sp/su run in lower portions of the system. The timing of these conditions may also have affected the survival and outmigration of subyearlings from the 2014 and 2015 BYs that did not immediately migrate downstream to the estuary upon emerging. These BYs are significant as their offspring contributed to the low escapement years observed from 2019-2021.

While minimum flows are not thought to limit upriver migration within the main channels in most years, the low river levels that regularly persist through the spring and summer likely still affects their distribution throughout the main channels and access to tributaries. Evaluating stream discharge for May through September back to 1975 reveals a long-term decline in flows experienced in the spring/early-summer (Figure 3.1.1.c). Focusing on the spring and summer flows for the years of concern (2014-2019) shows that flows in 2014, 2015, 2017, and 2018 are below the 20-year (2001-2020) median low flow for these months of 410 cfs (Table 3.1.1.a).

Table 3.1.1.a. Queets River minimum annual and May-Sept. flows, 2001-2020[a/].

	Annual Low Flow		May-Sept. Low Flow	
Water Year	CFS (median = 393.5)	Date	CFS (median = 410.5)	Date
2001	735	08/01/01	735	08/01/01
2002	468	09/29/02	468	09/29/02
2003*	352	11/04/03	401	09/03/03
2004*	386	10/05/04	520	08/20/04
2005	281	09/25/05	281	09/25/05
2006	381	09/16/06	381	09/16/06
2007*	352	10/05/07	421	09/27/07
2008	590	09/23/08	590	09/23/08
2009	365	08/28/09	365	08/28/09
2010	401	08/30/10	401	08/30/10
2011	473	09/21/11	473	09/21/11
2012	405	09/29/12	405	09/29/12
2013*	344	10/09/13	613	08/26/13
2014	376	09/15/14	376	09/15/14
2015	404	08/27/15	404	08/27/15
2016	437	08/30/16	437	08/30/16
2017	372	09/16/17	372	09/16/17
2018	325	09/06/18	325	09/06/18
2019	416	09/06/19	416	09/06/19
2020	439	09/15/20	439	09/15/20

a/ Red font indicates flows less than the 20-year median low flow. Asterisks indicate years when the annual low flow did not occur during May-Sept. Shading indicates critical BYs, and red borders identify below average summer flows and years when low flows were reached slightly earlier than usual.

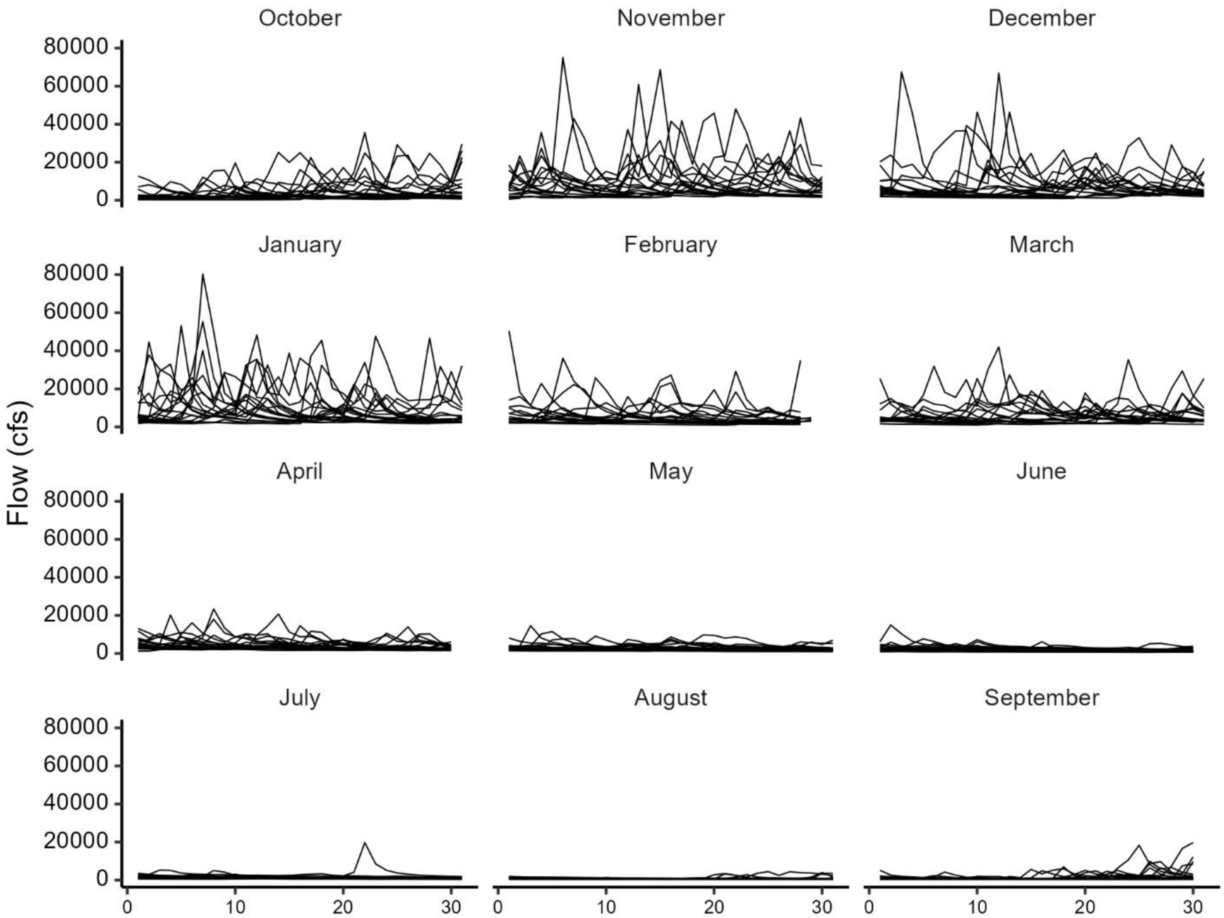

Figure 3.1.1.b. River levels of the Queets River measured daily in cubic feet per second (cfs) for the most recent 20 years from 2004-2023. Months are plotted individually beginning with the start of the water year on October 1.

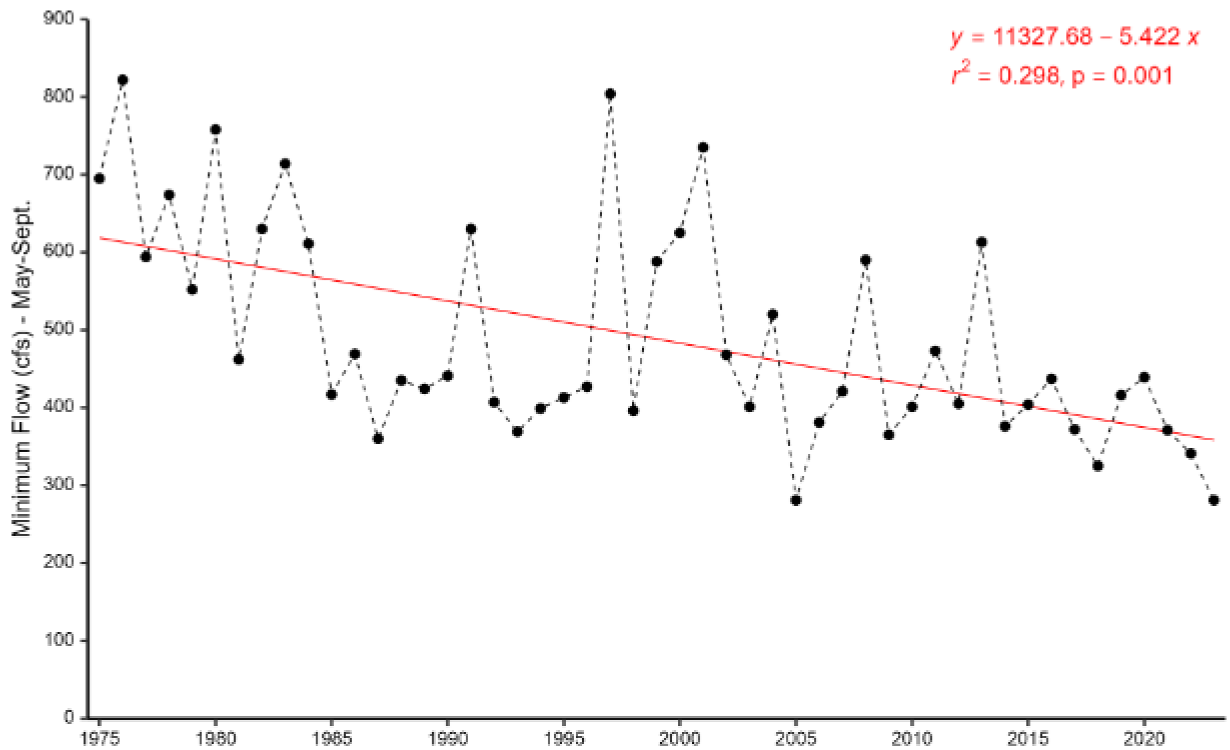

Figure 3.1.1.c. Summer low flows for the months of May-September on the Queets River from 1975 to 2023. Evaluating long-term trends in low flows as they relate to the population status of Queets natural sp/su Chinook.

Periods of low flow often coincide with warming waters, potentially compounding the effects of these multiple stressors. Adult Chinook are sensitive to warm waters and begin experiencing fitness consequences when temperatures exceed 17.8°C (64.0 °F) (Mauger 2022). Core salmonid habitat for adults holding over the summer should maintain temperatures at or below 16°C (60.8 °F). Long-term water temperature data are not available for the Queets River, though water temperature at multiple sites on the Queets River from 2011 to 2015 and air temperature measured at the town of Clearwater, WA from 1949-2009 are available. Measurements at the town of Clearwater show a long-term trend in increasing mean daily maximum air temperature over the months of June through September from ~19.5°C (67.1 °F) in the early-1950's to 20.8°C (69.4 °F) in the late-2010's (47°34′40″N 124°17′35″W; Figure 3.1.1.d). Peak daily water temperature recorded at eight sites demonstrate that, of the surveyed reaches, the middle and upper portions of the mainstem Queets River offer the best cool water refugia as well as mainstem tributaries in the middle section (Figure 3.1.1.e). Paradise Creek is a spring-fed tributary of the middle Queets mainstem that maintains a constant temperature of approximately 8°C (46.4 °F) through the summer months. Maximum daily water temperatures in most sampled sections of the Queets River frequently exceeded 18°C (64.4 °F) in the months of July and August. Maximum daily water temperatures begin dropping in September and first rains draw fall Chinook into the lower portions of the system and trigger peak sp/su Chinook spawning (NWQMC 2015). Water temperature was collected for the 2011 Queets River Watershed Peak Water Temperature project (ProjectIdentifier: QWRIA21P5).

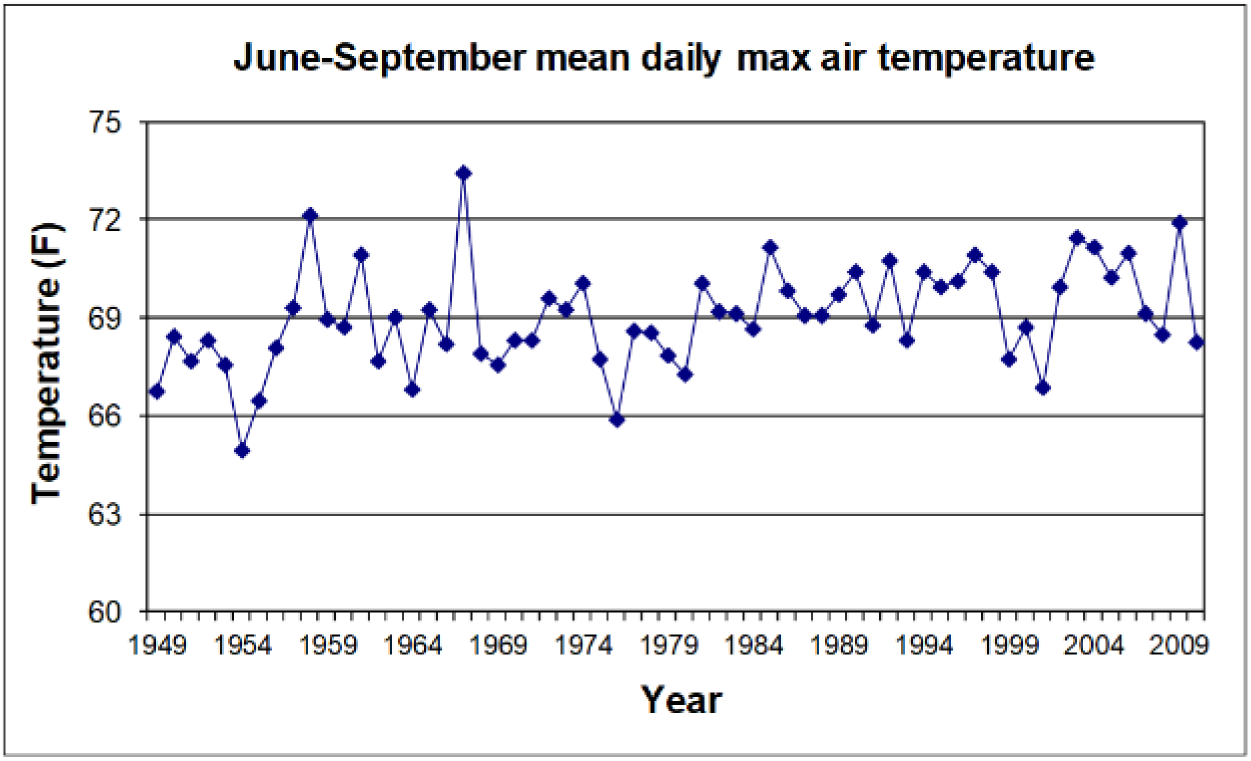

Figure 3.1.1.d. Mean daily maximum air temperature at the town of Clearwater, WA June through September.

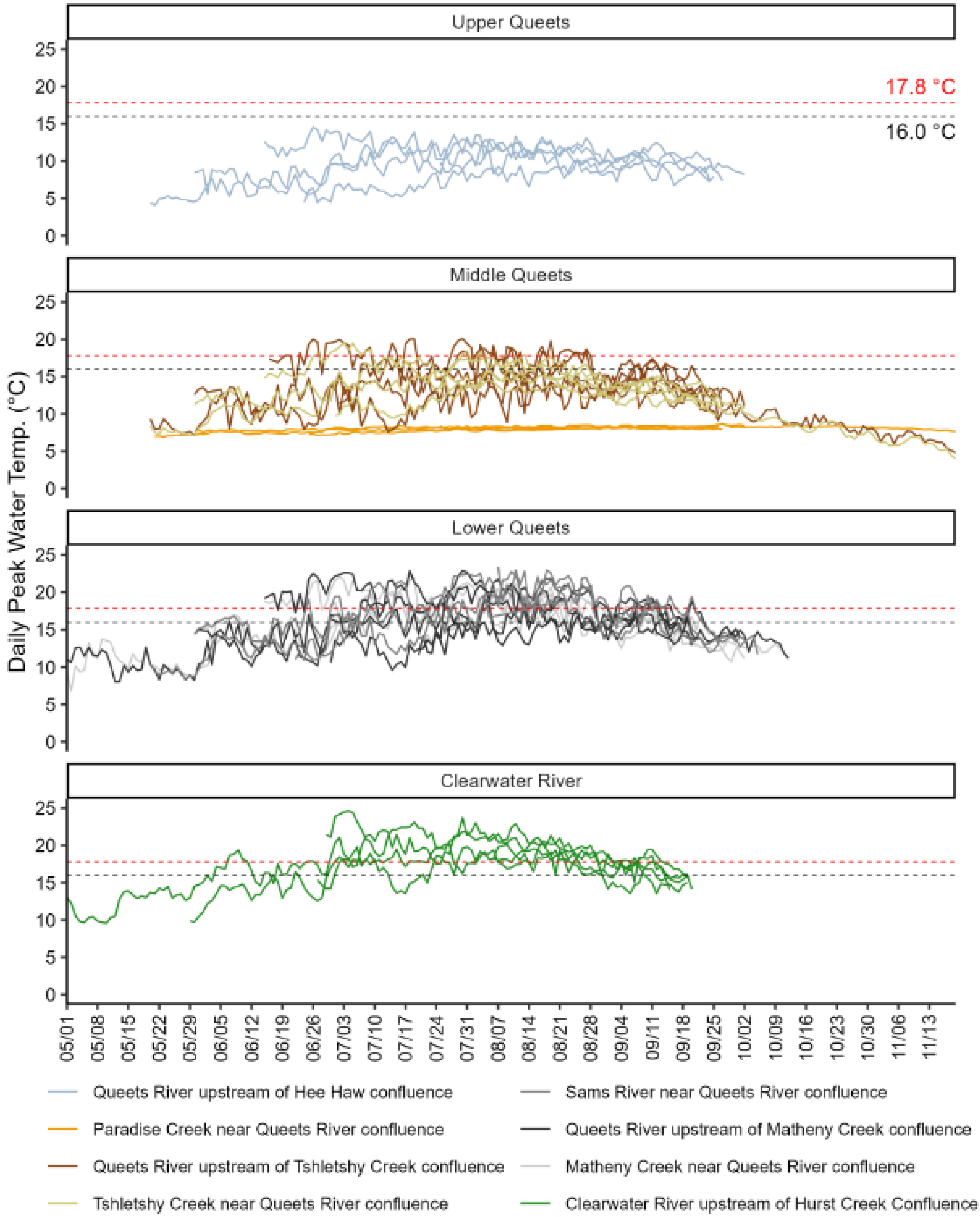

Figure 3.1.1.e. Daily peak water temperature at eight sites within the Queets River watershed from 2011-2015. Upper, middle, and lower Queets River mainstem, Clearwater River, and five middle and lower Queets River mainstem tributaries measured at one site each. Temperatures up to 16°C support spawning while adult Chinook begin experiencing fitness consequences at temperatures as low as 17.8°C (Mauger 2022).

With low flows and high temperatures likely restricting adults to spawning in the main channels, redds will be most susceptible to scour. Peak winter flows are greatest in the main channels and increasingly heavy winter storms have the potential to scour gravel spawning beds, reducing egg to fry survival and diminishing productivity. To evaluate if unusually high winter flows may have significantly affected the spawning success of the 2014-2018 BYs, we evaluated peak flows for the 2015-2019 water years; the effect of peak flows from a given water year would apply to the redds and offspring of the prior BY. For the last 49 water years, peaks flows were highly variable, ranging from 26,100 CFS in 1988 to 91,100 CFS in 1997 with a mean of 52,186 cfs (Figure 3.1.1.f). Peak flows in the 2015-2019 water years were mixed with 2015-2016 being above average and 2017-2019 being below average. No long-term trend in winter storm severity is apparent and relatively moderate flow conditions were seen during the winters of concern. Peak flows likely did not have an abnormally large negative impact on 2014-2018 BY productivity, though redd scour may still be an increasing threat associated with the stocks heightened reliance on mainstem spawning habitat.

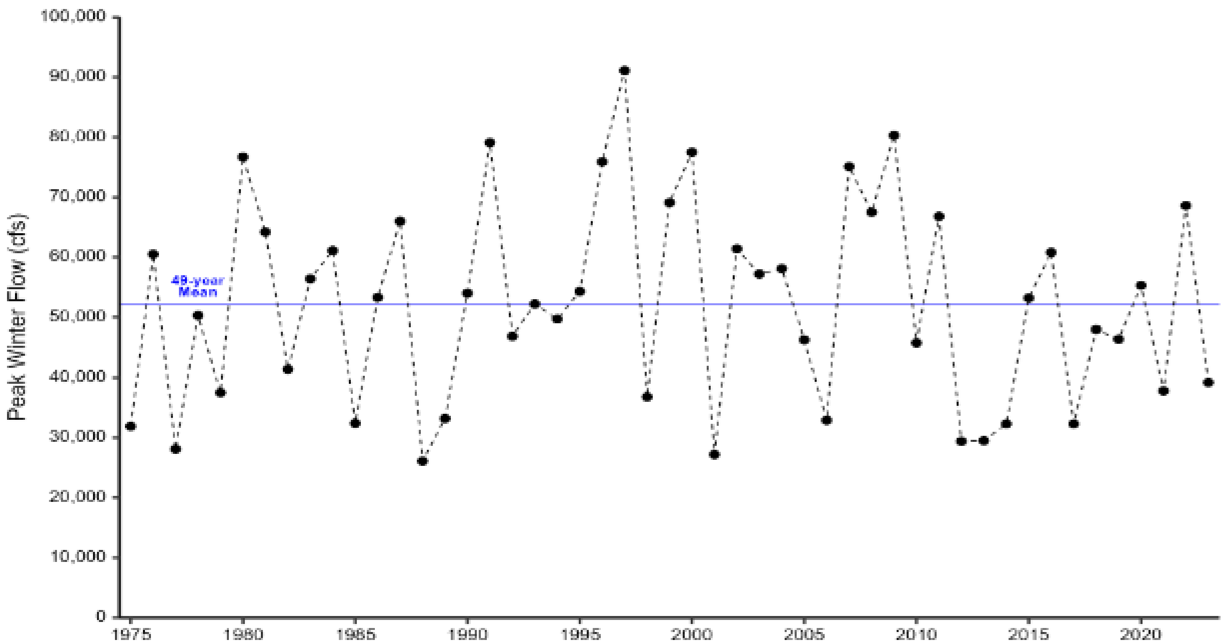

Figure 3.1.1.f. Peak winter flows on the Queets River from 1975 to 2023.

3.2 Marine Survival

3.2.1 Review of Ocean Conditions

Figure 3.2.1.a provides a visual assessment of indicators of ocean conditions in the Northern California Current, the ocean area that Queets sp/su Chinook enter into and spend a significant amount of time. The indicators are split into Climate and Atmospheric, Local Physical, and Local Biological. It is believed that ocean conditions experienced by Chinook salmon when they initially enter the marine system play a large role in determining smolt-to-adult survival rates (Pearcy 1992). In the first 16 rows of Figure 3.2.1.a, Local Biological, Local Physical, and Climate and Atmospheric ecosystem indicators received ranks for their severity in each year relative to measurements of that indicator over all 26 years (1998-2023). Taking the mean of ranks for these

16 indicators for each year and then ranking all 26 means simpifies the matrix of indicator-year ranks seen in Figure 3.2.1.a to a single row (i.e., Rank of the mean rank) where years are ranked in increasing order by the overall graveness of ocean conditions relative to the other 25 years.

Queets sp/su Chinook experienced relatively poor ocean conditions from 2014 to 2020, as measured by these indicators. From 1998 to 2023, the 2nd, 3rd, and 6th poorest ocean conditions were observed consecutively from 2015 to 2017. The year 2018 saw fair ocean conditions but was immediately followed by the 7th poorest ocean conditions from all 26 years seen in 2019. Overall, the last three years, 2021-2023, were mixed – the climate indicators were relatively good, but the physical indicators were relatively poor. Assuming the 2019-2021 broods were composed of ages 3-5 and that ocean conditions typically have the greatest impact on Chinook in their first year of life, affects from poor ocean conditions in 2015 would potentially be most measurable in the 2019 spawning escapement. Furthermore, it is likely that the greatest impact from poor ocean conditions from 2015-2017 would be seen in the age-5 component of the 2019 escapement because this cohort would have endured the most consecutive poor ocean years. Revisiting age compositions of Queets fall Chinook reported in Figure 2.3.1.b substantiate this. While there is a long-term trend in decreasing age-5 contribution, the lowest contribution of age-5 Queets fall Chinook spawners on record occurred in 2019 before returning to a higher baseline abundance for the subsequent four years. The contribution of age-5 fish to Hoh River fall Chinook escapement in 2019 was also reduced relative to recent years. Continuing this logic, we would expect the negative impacts from the 2015-2017 years to compound until 2022 which is the first year where spawners would have experienced three consecutive years of fair to good ocean conditions. Comparing means and ranked means back to spawning escapement in Table 3.2.1.a finds that spawning escapement appeared to respond to trends in ocean conditions in the manner that was expected. Compounding impacts from exceptionally poor ocean conditions from 2015-2021 was potentially the primary driver leading to the unusually depressed spawning escapements of Queets sp/su Chinook from 2019-2021. The poor physical conditions were largely driven by above average sea surface temperatures.

2023 OCEAN CONDITION INDICATORS TREND

good fair poor

	ECOSYSTEM INDICATORS	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
CLIMATE & ATMOSPHERIC	PDO (Sum Dec-March)	23	9	5	17	10	25	16	21	18	13	7	2	20	6	4	11	14	26	24	22	15	19	12	8	3	1
	PDO (Sum May-Sept)	14	5	11	8	13	23	18	21	17	19	7	16	9	4	3	10	24	26	25	20	15	22	12	6	2	1
	ONI (Average Jan-June)	25	1	1	9	17	19	18	21	10	15	3	13	22	6	8	10	12	23	26	16	7	24	20	5	4	14
LOCAL PHYSICAL	SST NDBC buoys (°C; May-Sept)	21	7	9	5	6	13	26	14	2	17	1	12	3	8	10	19	24	23	22	15	18	25	11	4	20	16
	Upper 20 m T (°C; Nov-Mar)	25	14	11	13	8	19	20	16	17	7	1	12	22	6	4	9	3	26	24	23	18	21	2	10	15	5
	Upper 20 m T (°C; May-Sept)	18	12	14	5	1	3	26	21	10	11	2	7	19	9	8	20	24	15	16	13	17	25	23	4	22	6
	Deep Temp (°C; May-Sept)	25	7	10	5	1	12	15	17	13	6	2	9	8	11	4	16	24	21	14	19	20	18	26	3	23	22
	Deep Salinity (May-Sept)	25	4	12	5	7	21	22	13	8	2	3	18	17	15	16	14	26	20	10	9	6	11	24	1	23	19
LOCAL BIOLOGICAL	Copepod richness (May-Sept anom)	24	3	1	11	10	19	18	23	20	14	12	13	22	6	9	4	15	25	26	21	17	16	7	5	2	8
	N copepod biomass (May-Sept anom)	24	19	14	15	6	21	18	25	20	16	9	13	11	3	5	7	8	22	26	23	10	4	2	1	17	12
	S copepod biomass (May-Sept anom)	26	2	7	4	3	18	20	25	17	14	1	9	21	13	10	8	15	23	24	22	16	19	12	5	6	11
	Biological transition	24	13	9	8	11	19	15	23	18	5	1	2	21	3	12	6	6	24	24	22	17	19	14	10	4	16
	Nearshore Ichthyoplankton (Jan-Mar)	21	4	14	8	1	25	26	20	11	22	3	17	2	10	5	13	23	18	19	16	12	24	9	6	15	7
	Near & offshore Ichthyoplankton (community index Jan-Mar)	11	6	4	8	10	13	20	24	1	16	3	12	18	5	2	7	9	22	25	26	21	23	19	15	14	17
	Chinook salmon juvenile catch	23	2	7	20	6	10	18	25	14	12	1	8	5	16	3	4	9	17	22	26	21	15	24	13	11	19
	Coho salmon juvenile catch	24	13	21	5	7	6	23	25	19	2	4	10	11	20	15	1	12	18	17	26	3	16	22	14	9	8
MEANS & RANKS	Mean of ranks	22.1	7.6	9.4	9.1	7.3	16.6	19.9	20.9	13.4	11.9	3.8	10.8	14.4	8.8	7.4	9.9	15.5	21.8	21.5	19.9	14.6	18.8	14.9	6.9	11.9	11.4
	Rank of the mean rank	26	5	8	7	3	19	21	23	14	13	1	10	15	6	4	9	18	25	24	21	16	20	17	2	12	11
NOT INCLUDED IN THE MEAN OF RANKS OR STATISTICAL ANALYSES	Physical Spring Trans (UI based)	4	8	24	21	5	15	18	25	15	1	7	3	10	13	22	11	23	12	6	20	13	15	9	2	26	19
	Physical Spring Trans. Hydrographic	25	4	14	9	6	13	17	26	7	10	1	10	21	4	12	2	19	8	20	24	17	16	22	2	22	15
	Upwelling Anomaly (sum April-May)	12	4	21	8	11	18	16	25	12	6	9	10	19	21	19	14	23	1	3	24	7	5	16	2	26	15
	Length of Upwelling Season (UI based)	6	2	22	14	1	16	12	26	5	3	9	3	18	21	18	17	24	13	8	15	7	10	20	10	24	23
	Copepod Community Index (May-Sept)	25	5	7	10	4	20	18	24	21	13	1	9	17	12	8	6	15	23	26	22	16	19	14	3	2	11

Figure 3.2.1.a. Ocean indicators for years 1998 through 2023. Source: Northwest Fisheries Science Center (https://www.fisheries.noaa.gov/west-coast/science-data/ocean-conditions-indicators-trends). Rectangle box highlights the critical years when the progeny of the 2014-2018 spawners would have entered the marine environment.

Table 3.2.1.a Mean of Ranks and ranks of mean ranks for select ocean conditions, 1998-2023[a].

Year	Mean of Ranks	Rank of Mean Rank	Spawning Escapement
1998	22.1	26	492
1999	7.6	5	373
2000	9.4	8	248
2001	9.1	7	548
2002	7.3	3	738
2003	16.6	19	189
2004	19.9	21	604
2005	20.9	23	298
2006	13.4	14	330
2007	11.9	13	352
2008	3.8	1	305
2009	10.8	10	495
2010	14.4	15	259
2011	8.8	6	373
2012	7.4	4	760
2013	9.9	9	520
2014	15.5	18	377
2015	21.8	25	532
2016	21.5	24	704
2017	19.9	21	825
2018	14.6	16	484
2019	18.8	20	322
2020	14.9	17	342
2021	6.9	2	280
2022	11.9	12	434
2023	11.4	11	540

a/ Ocean conditions based on 16 local biological, local physical, and climate and Atmospheric ecosystem indicators from 1998-2023. Source: Northwest Fisheries Science Center.

3.2.2 Early life survival rates

Without a designated CWT indicator stock, it is not possible to evaluate early marine survival rates of Queets sp/su Chinook directly. As part of their annual exploitation rate analysis (ERA), however, the CTC evaluates early marine survival for the Queets fall run Chinook CWT indicator stock, which exhibits an ocean-type life history similar to Queets sp/su Chinook. These smolt-to-age 2 survival rates are calculated for each BY as the ratio of the age 2 cohort size (before fishing and maturation or escapement mortality processes begin) derived from the CWT cohort reconstruction to the total number of CWT smolts released for that BY. For Queets fall Chinook, smolt-to-age 2 survival estimates are available for BYs 1977-2016 (the last complete brood). Across the time series the survival rates were variable with no clear long-term trend, ranging from a low of 0.59 percent to a high of 5.65 percent, with a median of 2.55 percent (CTC 2023). Of the five BYs that predominantly contributed to the 2019-2021 escapements which led to the overfished designation (2014-2018) all but one year (2016) appear to have survival rate estimates that were below the long term mean of 2.55 percent, although the 2017 and 2018 estimates are based on information for brood years that had not fully returned (CTC 2023).

3.3 Harvest Impacts

3.3.1 Ocean Fisheries

North of Falcon Council-managed fisheries typically allow for the retention of Chinook during the late-spring and early-summer months. Adult sp/su Chinook are returning to the Queets River during this time and potentially migrating from the north into Council managed ocean areas earlier than fall Chinook. The earlier-timed and prolonged nature of their run may mean that Council area ocean fishery impacts during the Chinook-directed spring season and all-species summer season are greater than those estimated for WA coast fall stocks. Recoveries of tagged spring, summer, and fall Chinook stocks of the WA coast, of which ocean impacts are better documented, offer support for this. A cursory evaluation of CWT recoveries suggests that Council area ocean impacts account for a greater proportion of total impacts for Hoh spring and Quillayute summer Chinook than that seen for Queets fall Chinook. Still, the overall impact of southern U.S. (SUS) fisheries, including Council area Indian and non-Indian commercial ocean troll and non-Indian sport fisheries appear to be relatively low for the FNMCCSC in most comparisons. Instead, the northern distribution of these stocks corresponds to greater total impacts in marine areas off the coast of BC and SEAK.

Impacts on adult Queets sp/su Chinook are believed to be greatest in fisheries off the coasts of northern BC and SEAK where other spring, summer, and fall Chinook stocks from the WA coast are harvested in greater numbers. These fisheries are managed under the PST and primarily fall under the aggregate abundance-based management (AABM) regime. Between 2017 and 2021, the fishing years most likely to have impacted Chinook that would otherwise have returned to spawn in 2019 – 2021, both the SEAK and northern BC AABM fisheries operated within their pre-season catch limits, catching on average 94 percent and 67 percent of their quotas, respectively (CTC 2024).

The treaty Indian ocean troll fishery was open for Chinook retention from May 1 through mid-September in 2017-2021. During the same time-period, the non-Indian commercial troll fishery was typically open from early May through mid-to-late September with occasional intermittent closures, and recreational fisheries were typically open from late-June through mid-September with intermittent closures within specific subareas. Since it is not possible to evaluate the actual impacts of these fisheries in the absence of a designated CWT indicator stock, harvest impacts are unknown. Recoveries from summer Chinook released into the Queets River in 1979 show that age-4 fish made up the majority of harvest and most recoveries were made from June through August (Figure 3.3.1.a). In recent years, retention of Queets fall and Quillayute summer Chinook differ in proportions but overall show that recoveries peak during mid-summer. For Queets fall Chinook recoveries in Council-managed fisheries were almost negligible (Figure 3.3.1.b), whereas for Quillayute summer Chinook., Council area fisheries account for a much larger portion of the total ocean fishery recoveries (Figure 3.3.1.c). Hoh River spring Chinook CWT recoveries from two BYs have a similar composition and distribution as the other stocks (Figure 3.3.1.d). From the limited range of years and Chinook runs that were evaluated here, total impacts from Council area fisheries on Washington coastal Chinook stocks are thought to be minimal. As one of the far north migrating stocks, Queets sp/su Chinook likely experience similar ocean fishing pressures as those listed below. Council-area ocean fisheries were therefore not likely a leading factor in the stocks overfished declaration.

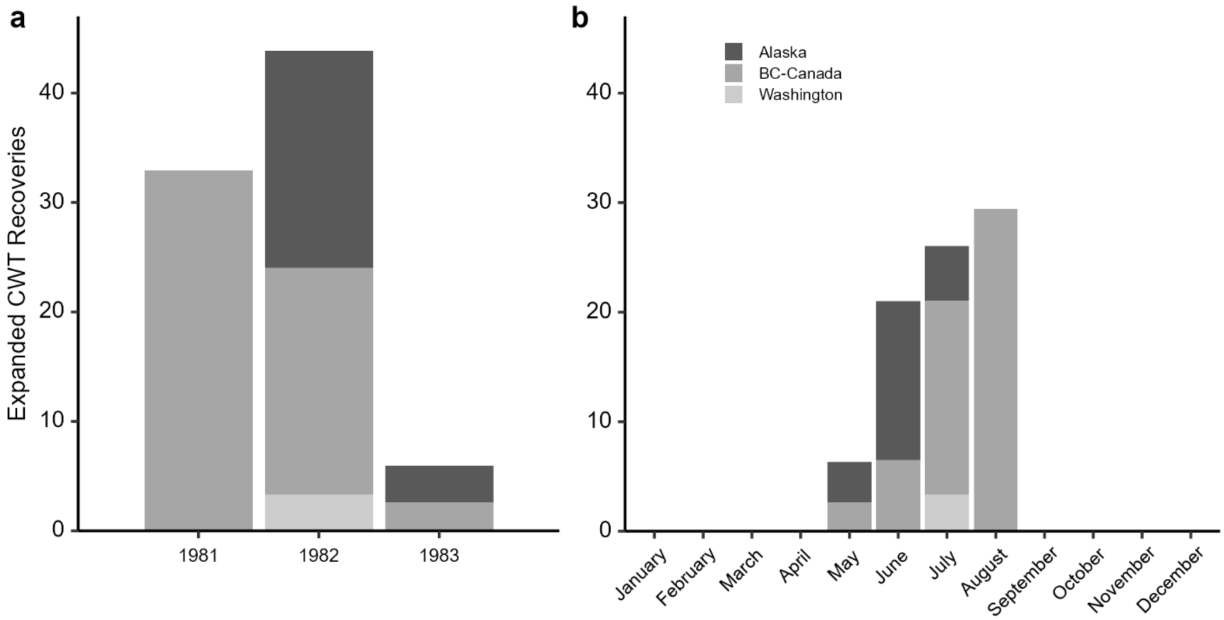

Figure 3.3.1.a. Expanded CWT recoveries by year (left) and month (right) from ocean fisheries in Alaska, BC, and Washington for Queets sp/su Chinook. Adipose clipped Quillayute River summer Chinook reared at Quinault Lake Hatchery and released at SAMS R 21.0205 in the Queets watershed in 1979.

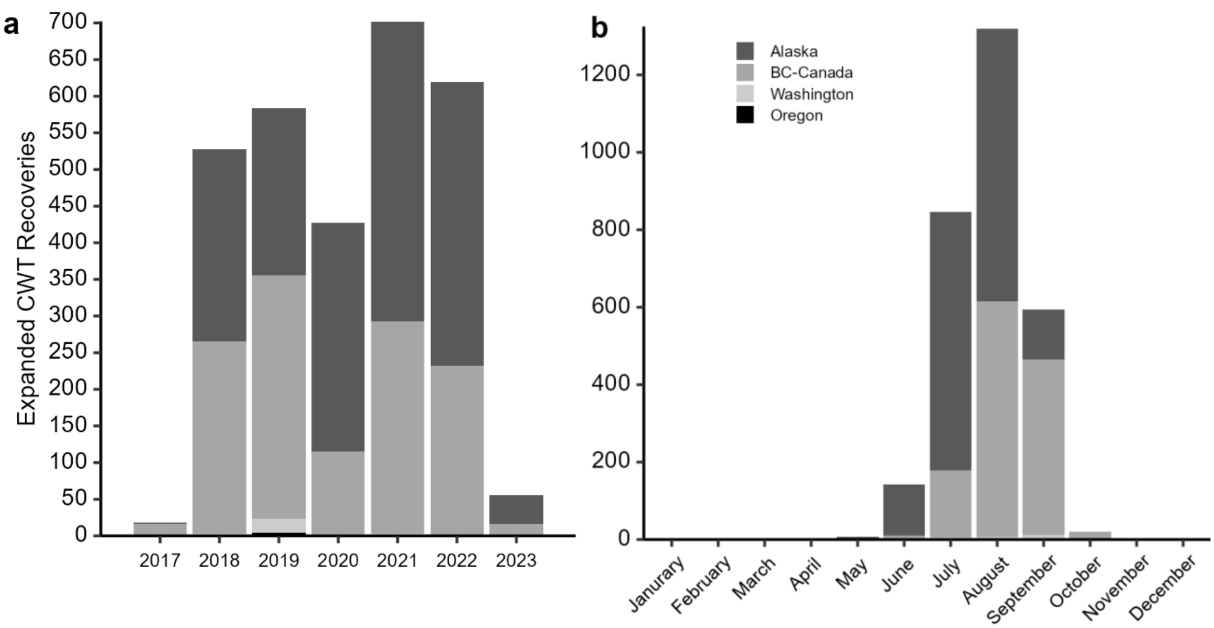

Figure 3.3.1.b. Expanded CWT recoveries by year (left) and month (right) from ocean fisheries in Alaska, BC, Washington, and Oregon for Queets fall Chinook. Adipose clipped Queets River fall Chinook reared at the Salmon River Fish Culture facility and released into the Queets watershed from 2014 – 2018.

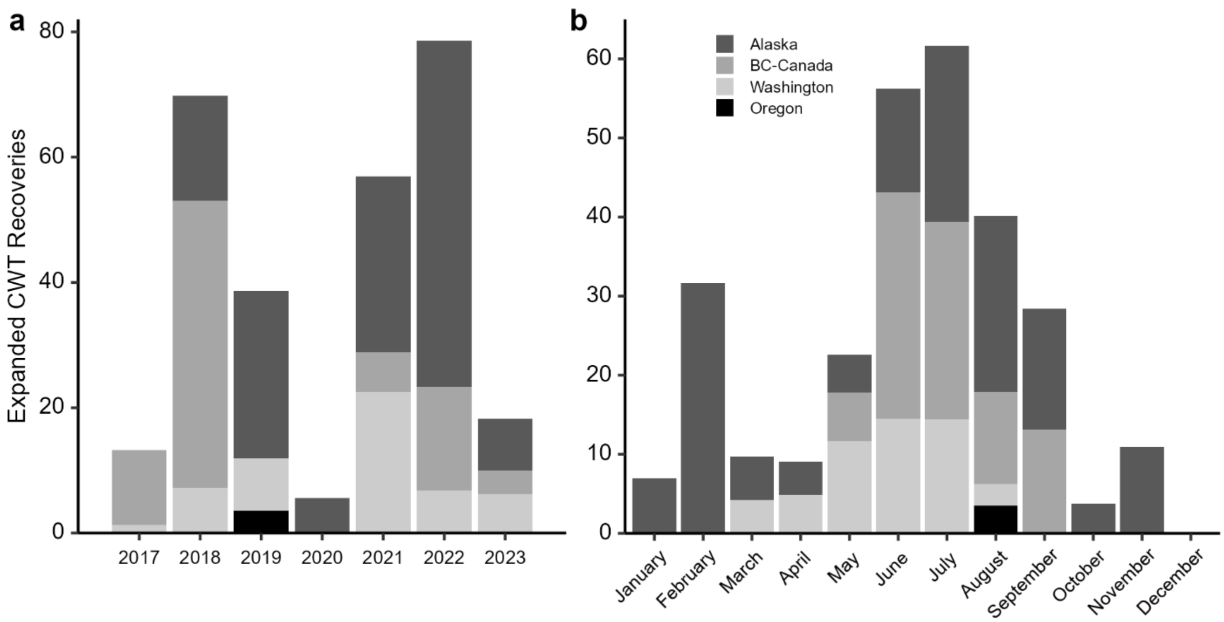

Figure 3.3.1.c. Expanded CWT recoveries by year (left) and month (right) from ocean fisheries in Alaska, BC, Washington, and Oregon for Quillayute summer Chinook. Adipose clipped Quillayute River summer Chinook reared at the Lonesome Creek and Sol Duc Fish Hatcheries and released into the Quillayute watershed from 2016, 2017, 2019, and 2020.

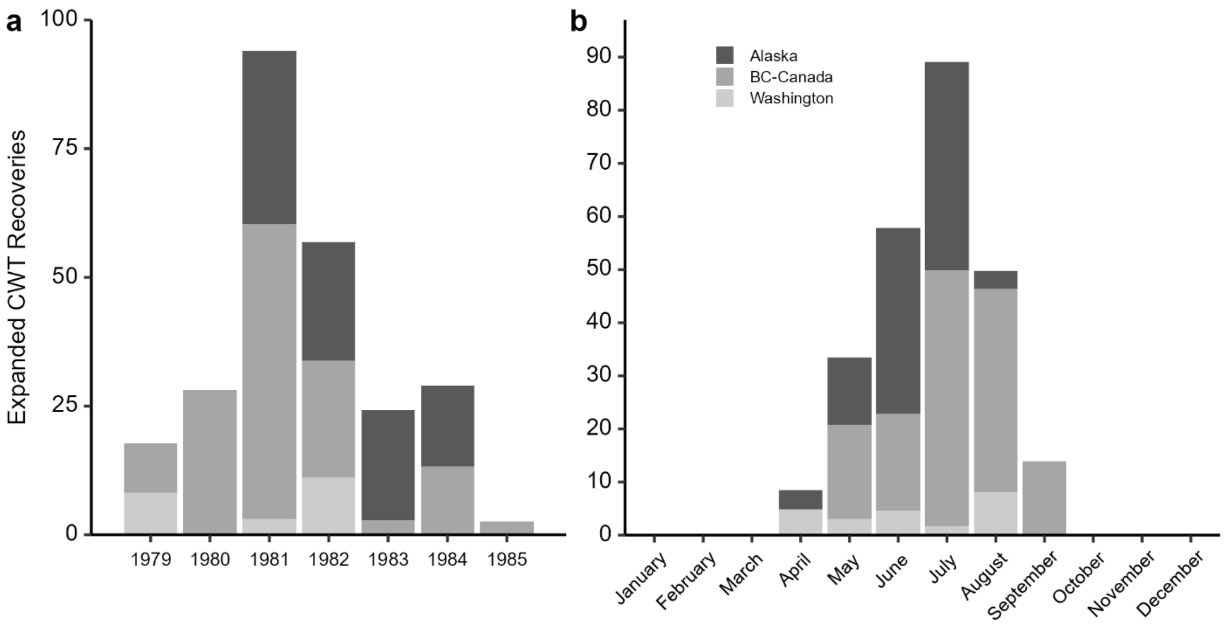

Figure 3.3.1.d. Expanded CWT recoveries by year (left) and month (right) from ocean fisheries in Alaska, BC, and Washington for Hoh spring Chinook. Adipose clipped Hoh River spring Chinook reared at the Sol Duc Fish Hatchery and released into the Hoh watershed in 1978 and 1980.

3.3.2 In-river fisheries

Freshwater fisheries occurring from May through September are of particular interest as they coincide with the stock's run timing and may lead to in-river reductions in spawning escapement. Upon review, freshwater fisheries have not heavily impacted Queets sp/su Chinook for more than 20 years and were likely not a primary factor leading to their overfished status. Still, the stock may remain vulnerable to fall fisheries throughout September and early October during their spawning period, particularly when low flow conditions persist late into the fall season and prevent sp/su Chinook from migrating to upstream spawning habitats. While freshwater fisheries are not expected to significantly inhibit the stock's rebuilding in the near-term, more definitive discernment of Queets sp/su from fall Chinook may become more important for estimating freshwater impacts on the stocks in the future.

Quinault Indian Reservation

A Tribal gillnet fishery targets the early-timed and compressed hatchery coho run returning to the Salmon River Fish Culture Facility on the Salmon River (river mile 4). The retention of Chinook is permitted, though the fishery has opened on week 36 in recent years to limit impacts on the sp/su Chinook stock. From 2014-2019 the fishery typically opened from mid- to late-August, leading to the incidental harvest of sp/su Chinook. Beginning in 2019 the fishery remained closed through the spring/summer management period to limit these impacts, though low level of sp/su Chinook harvest are recorded at the start of week 36. An estimated 117 sp/su Chinook were harvested from 2014-2020 from this fishery (Figure 3.3.2.a). In 2019-2021, the fishery opened week 36 from which sp/su Chinook harvest was 1, 24, and 0, respectively.

Fewer than 10 sp/su Chinook annually from 2013-2018 and fewer than five annually from 2019-2021 were harvested during the Tribal sp/su sockeye subsistence fisheries. Two sp/su sockeye subsistence fisheries are typically open weeks 19-24; a set net fishery is open in the lower six grounds at the mouth of the Queets River and a hook and line fishery is open from the mouth to the Highway 101 bridge. These fisheries harvest roughly 50-100 sockeye each year from which fewer than 10 sp/su Chinook are harvested as bycatch.

A fall recreational salmon fishery within the Quinault Indian Reservation typically operates from September 1 through November 30. It targets multiple species, including fall run Chinook, with an adult (≥24-inches, 60.96 cm) Chinook bag limit of 1 and a combined species jack limit of 12 (Chinook <24-inches (60.96 cm), coho <20 inches (50.80 cm)). This fishery is timed later to allow the sp/su Chinook spawning run to safely migrate into the middle and upper portions of the system without fishing pressure. Likewise, a fall treaty gillnet fishery opens week 36. While Chinook caught after August 31 are reported as fall Chinook, there has been no pedigree analysis determining to what degree sp/su Chinook are harvested in early-September.

Historically, Queets sp/su Chinook were harvested in the lower river by the Tribal commercial fishery, though the fishery has been closed since 2000. Commercial catch reported in PFMC documents and archived catch records from 1981-1999 show that impacts from the historical Tribal commercial in-river fishery varied with terminal runsize and was minimal for the nine years previous to its closure. The low level of harvest in the fishery from 1991 to 1999 came after the stock saw substantial growth followed by immediate collapse in the late-1980's (Figure 3.3.2.a).

Olympic National Park
Most of the Queets River system resides within the U.S. National Park system, specifically, the Olympic National Park (ONP). Therefore, the majority of freshwater, non-tribal, recreational impacts on Queets sp/su Chinook occurred within this management system. While ONP has exclusive jurisdiction over recreational fisheries in the park, park managers and biologists work cooperatively with Washington Department of Fish & Wildlife (WDFW) and Washington Treaty Tribes to establish harvest and gear regulations. Annual regulations for ONP are implemented each year from May1 through April 30.

To meet National Park System management objectives of protecting and perpetuating native aquatic species, the park generally promotes catch-and-release of wild fish and harvest of non-native and hatchery fish. There has not been a directed fishery for Queets sp/su Chinook in the park system since the 1980's. Review of reported catch from the WDFW CRC database of years 1981 – 2001 and 2001 – 2018 showed very few Chinook released during the spring and summer timeframe when retention of Queets sp/su Chinook were not allowed.

An online archive of emergency rule changes within the park for the Queets system is not currently available, however, documentation of previous rule changes exists and can be obtained through request of the ONP which was done for the purpose of this report. When fisheries are active within the state park, the Park Service hosts rules and regulation changes on their website.

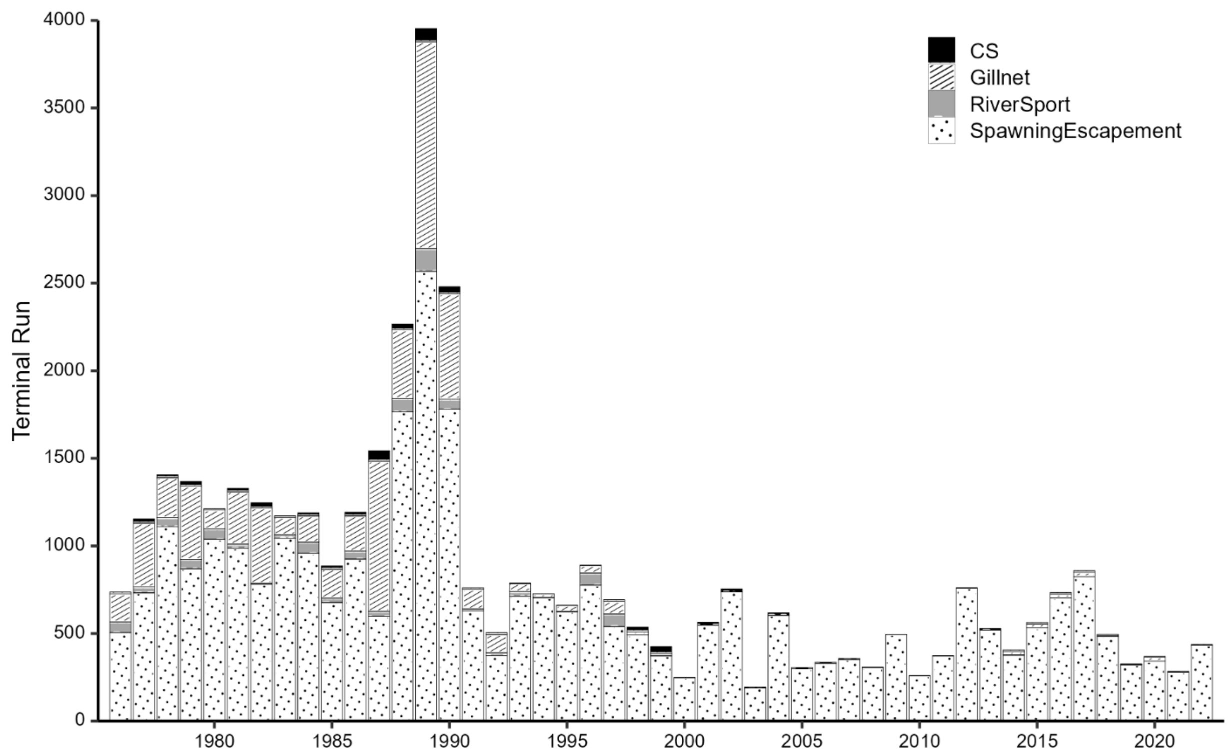

Figure 3.3.2.a. Total terminal run size and freshwater fishery impacts on Queets River sp/su Chinook from 1976-2022.

3.4 Summary of potential contributing factors

Freshwater conditions were generally poor during critical years leading to the overfished status. Summer low flows occurring from May-September have been in long-term decline since at least the 1970s. Low flows were average for the broods that returned in 2019-2021, but below the recent 20-year average for BY 2013, 2014, 2016, and 2017. Additionally, flows were experienced slightly earlier in the summers of 2015 and 2016. Peak winter flows have high interannual variability, but do not show any clear trend for the last 40 years. However, redds and fry of BY 2014 and 2015 saw slightly higher than usual winter flows.

A summary of indicators suggests that ocean conditions in 2015 – 2017 were extremely poor and comprised three of the worst five years over the most recent 26-year period. Ocean conditions were also below average to poor in 2014 and 2018 – 2020. All of these are years that would have affected fish escaping in 2019 – 2021. Conditions have improved recently, however, and were above average to good between 2021 – 2023.

As a result of the poor ocean conditions from 2014 – 2020, early marine survival of Queets sp/su Chinook is assumed to be low for the BYs that contributed to 2019 – 2021 escapements. While there are no direct early marine survival estimates for Queets sp/su Chinook, this assumption is supported by smolt-to-age 2 survival estimates of Queets fall Chinook, which were below the long-term median survival rate in four of the five BYs that predominantly contributed to 2019 – 2021 escapements.

Because this stock is data poor, it is difficult to say with certainty that ocean harvest played a role in the overfished status. Ocean fishery impacts are unknown for Queets sp/su Chinook, but total ocean harvest impacts on other WA coast Chinook stocks suggest that ERs are greatest in SEAK and northern BC ocean salmon fisheries, and that SUS fisheries represent a small proportion of the total ER. During 2000-2021, the average total ocean ER on Queets fall Chinook was 42 percent in the most recent CTC ERA (CTC 2023), but CWT recoveries for Quillayute summer Chinook suggest an average total ocean ER of roughly half of that (see Appendix B, Figure B-2). It is more likely that the actual ocean harvest impacts on Queets sp/su Chinook are closer to that of Quillayute summer Chinook, which, overall, appear to be lower than those seen for Queets fall Chinook.

Freshwater fisheries were not a primary factor leading to the stock's overfished status and are not expected to significantly inhibit the stock's rebuilding. There has not been a Queets sp/su Chinook directed fishery on the Quinault Indian Reservation (QIR) since 1999 or in the Olympic National Park since the 1980's. Impacts in freshwater fisheries are limited to low levels of Chinook that are assumed to be sp/su run, of which most impacts are the result of incidental harvest by freshwater fisheries targeting sockeye and early timed hatchery coho within the QIR.

The spawning escapement of Queets sp/su Chinook in 2021 was the third lowest in the last 20 years, and together the three depressed BYs from 2019-2021 correspond closely with three consecutive years of exceptionally poor ocean conditions from 2015-2017. With higher-than-average spawning escapements in 2022 and 2023, and especially favorable ocean conditions from 2021-2023, the 3-yr geometric mean of spawning escapements may continue to trend upwards for the next two years. However, the Queets sp/su Chinook spawning escapement has not achieved a 3-year geometric mean that meets the S_{MSY} of 700 since 1992.

4.0 RECOMMENDATIONS FOR ACTION

4.1 Recommendation 1: Rebuilt criterion

Consider the stock to be rebuilt when the 3-year geometric mean of natural-area adult escapement meets or exceeds S_{MSY}. This is the default rebuilt criterion in the FMP.

4.2 Recommendation 2: Management strategy alternatives

Recommend the Council to adopt a management strategy that will be used to guide management of fisheries under Council authority that impact Queets sp/su Chinook until rebuilt status is achieved. Because this stock is data poor, it is difficult to say with certainty that ocean harvest played a role in the overfished status and equally difficult to measure if changes in harvest strategies could contribute to rebuilding the stock. Here we offer for consideration two alternative management strategies with rebuilding time frames that exceed the ideal rebuilding time (T_{max}) of 10 years, largely due to the limited impacts to Queets sp/su Chinook that are assumed to occur in Council-area fisheries.

The description of alternatives may include references intended to meet NEPA or MSA criteria. Guidelines suggest that alternatives are identified as either an 'action' or a 'no-action' alternative, and that the minimum time (T_{min}) and the time estimated to achieve rebuilt status (T_{target}) are acknowledged within the suite of alternatives. See Section 2.1 for a more complete description on the guidance and factors considered in selecting an Alternative.

<u>**Alternative I**</u> **(Preliminary Preferred Alternative, PPA**)
Status Quo. During the rebuilding period, continue to use the current management framework and reference points, as defined in the FMP and the PST, to develop annual fishery regulations. This is considered a 'no-action' alternative. Under this scenario, the results of the rebuilding time analysis suggest that the probability of achieving rebuilt status stabilizes at a maximum of approximately one percent in year-four. This is below the 50 percent threshold, suggesting rebuilt status may never be achieved under current conditions and that the rebuilding time, T_{target}, is projected to exceed the ideal T_{max} of 10 years. See Section 4.4 for the rebuilding analysis.

<u>Alternative II</u>:
Suspend non-treaty NOF Council-area ocean salmon fisheries to minimize impacts within Council jurisdiction to the extent feasible on Queets sp/su Chinook until the stock meets the criteria for rebuilt status. This is considered an 'action' alternative. Under this Alternative, we evaluate the rebuilding time under two different scenarios: a low assumed ER scenario and a high assumed ER scenario. See Appendix B for a description of how these assumed ERs were derived. Under this Alternative, the probabilities of achieving rebuilt status stabilize at a maximum of one percent for the low ER scenario and two percent for the high ER scenario. This is below the 50 percent threshold, suggesting that rebuilt status may never be achieved and that the rebuilding time, T_{target}, is projected to exceed the ideal T_{max} of 10 years. See Section 4.4 for the rebuilding analysis.

For the two alternatives, the estimated time to rebuild is greater than 10-years. Although the estimated economic impacts of the alternatives are expected to be provided in a supplemental document; under the 'action' alternative (Alternative II), it is likely that a closure of the non-treaty NOF Council-area ocean salmon fisheries would negatively impact the needs of the fishing communities due to the loss of revenue generated from the fisheries (both sport and troll). Therefore, the action Alternative II may not be well-suited to meet the purpose and need of the action as described in section 2.2, since the (negative) economic impact will likely be great and there is no benefit of a decreased estimated rebuild time (T_{max}).

For the two Alternatives and the T_{min} scenario, year-1 for the T_{min} and T_{target} calculations is defined as 2024. This convention was adopted for Queets sp/su Chinook due to the overfished designation occurring in 2023. Rebuilding times projected here used observed escapement through 2023 and modeled escapements beginning in 2024 when calculating 3-year geometric means. As a result, this assumes the relevant fishery modifications were first implemented in 2024 and maintained in each year thereafter. However, an adopted rebuilding plan will likely be first implemented in 2025.

4.3 Recommendation 3: Comanager recommendations

Habitat topics

If chronic under escapement or low smolt production is indicated, then as comanagers, the Quinault Indian Nation (QIN) and WDFW should prioritize actions in the Queets and Clearwater basins to improve productivity of habitat.

Suggested recommendations for habitat restoration include the following priorities:

1) Improve habitat quality in low gradient tributaries primarily by increasing large wood structure and connectivity among deep pools which provide cold water refugia when over summering.
2) Evaluate and address potential barriers to migration in the lower sections of the mainstem Queets River during periods of low flows.
3) Facilitate rapid improvements in accessibility and availability of floodplain habitats in the Clearwater and Lower Queets rivers by implementing periodic maintenance of egress to all major off-channel ponds and enlarging or diversifying structure in off-channel habitats.
4) Restore old-growth characteristics to riparian forests within stream corridors through negotiating conservation set-asides and alternative forestry practices (i.e. replacement of conifer in riparian areas)

As comanagers, QIN and WDFW should seek funding to initiate and sustain long-term programs to provide information on environmental conditions in the Queets and Clearwater mainstem and tributaries. Land management practices in these systems differ markedly, most notably regarding activities relating to logging. Baseline environmental data would contribute to evaluating impacts of climate change and help identify causes for production failures. The monitoring system should at minimum include stations to record stream flow, water temperature, turbidity, and dissolved oxygen. Other monitoring activities could include significant developments in riparian and land habitats, such as logging activity, road construction, wildfires, road and slope failures, chemical spills, and fish passage culvert conditions. In addition to providing a source of information to support future investigation and analyses, the monitoring system would also serve as an alert system to identify problem areas that may be addressed proactively through cooperative action.

Supplementation

Should chronic under escapement persist, the comanagers should assess the validity of supplementation strategies for recovering the stock to a point of self-sufficiency where genetic viability is secured. An evaluation of the effective population size and genetic viability of the stock may require considerable resources but provide crucial information about the long-term outlook of the stock and need for artificial propagation. In addition to surveying available resources and timeline for carrying out a supplementation program, the risks and benefits of different supplementation strategies, including adult supplementation, juvenile supplementation, and outplanting of eyed eggs, should be compared with the potential for natural colonization of improved habitat.

Precautionary measures for inseason management

If a preponderance of inseason evidence indicates Chinook abundance is significantly less than anticipated during preseason planning or Chinook physical condition is poor, immediate precautionary steps could be taken to reduce ERs including, if necessary, emergency modifications to or closures of Chinook-directed non-treaty NOF ocean fisheries. Treaty troll fisheries would be minimized, and complimentary management of terminal fisheries would be recommended as an auxiliary action.

External outreach through PSC

The Council and co-managers should initiate discussions with fishery managers outside of PFMC (i.e., the Pacific Salmon Commission and North Pacific Fishery Management Council) to further resolve uncertainty around the spatial and temporal distribution of ocean exploitation rates on Queets sp/su Chinook and other Washington coast Chinook stocks. Given that negative trends in ocean and Queets River freshwater conditions are likely to persist, the potential effects of northern ocean fisheries to the stock's long-term outlook should be communicated to all relevant fishery managers.

4.4 Recommendation 4: STT recommendations

Developing the rebuilding plan for this stock came with its challenges mainly due to the lack of data for this stock and how Council-area fisheries may impact it. It also appears that the abundance of this stock has been low for many years, which brings into question the current capacity of habitat and conservation goals used to manage it.

The STT recommends that the reference points and other criteria in place for this stock be reviewed including:

A. Investigate the feasibility of improving data on this stock, so that additional analysis can be conducted.
B. Investigate the feasibility of re-evaluating the current reference points for this stock, and update as needed.

It is likely that the work needed to address these recommendations would require expertise outside of the STT.

4.5 Analysis of rebuilding scenarios

Here we use a similar but simplified approach to that developed by O'Farrell and Satterthwaite (2021) to estimate rebuilding times for Queets sp/su Chinook. The rebuilding time model assesses the probability of a stock achieving rebuilt status in the years following an overfished declaration. In this model, future abundance is based on a distribution fit to past estimated abundances (2000 – 2021). Replicate simulations are performed to allow for projecting of the probability of achieving rebuilt status by year. The model framework allows for evaluation of alternative management strategies by estimating the escapement that would occur under the various fishing scenarios.

The approach used here is simplified because, unlike the prior stocks for which rebuilding plans were developed and rebuilding times were estimated (PFMC 2019a, 2019b, 2019c, 2019d, 2019e), Queets sp/su Chinook are not a target stock under the FMP and they have no associated harvest control rule. Annual abundance forecasts do not factor into preseason fishery planning and preseason estimates of ER are not produced. As a result, abundance forecast error and ER implementation error were not accounted for in this analysis.

The projected rebuilding time is defined as the number of years needed for the probability of achieving rebuilt status to meet or exceed 50 percent, with year-1 representing 2024. Here we use a probability of 50 percent to define rebuilding times, as this is the acceptable value described in NS1; however, the Council has the discretion to recommend a higher threshold to be used for this purpose.

Due to the uncertainty in the estimated ERs from ocean fisheries, the rebuilding time analysis included using both a low and high assumed ER for Alternative II and the T_{min} scenario as a way to measure sensitivity to the range of possible ERs experienced by the stock. The analysis shows that in all but one configuration, the projected rebuilding time is expected to exceed 10 years. For both Alternatives I (status-quo) and II (suspend non-treaty NOF fisheries), the probability of achieving rebuilt status stabilized at a maximum of one or two percent (Table 4.5.a). This is well below the 50 percent threshold for determining rebuilding times, suggesting that rebuilt status may never be achieved under these Alternatives and that the rebuilding time (T_{target}) is expected to exceed the ideal T_{max} of 10 years. This indicates that Council action alone is unlikely to be able to achieve rebuilt status for Queets sp/su Chinook.

Under the T_{min} scenario (minimum rebuilding time where all fisheries that impact Queets sp/su Chinook are closed) an estimate of rebuilding time could only be calculated under the assumption of high ERs (i.e., using Queets fall Chinook as the proxy); in this case the estimated rebuilding time was five years (Table 4.5.a). When assuming low ocean ERs (i.e., using Quillayute summer Chinook as the proxy), however, the probability of achieving rebuilt status did not reach the 50 percent threshold and instead stabilized at a maximum of approximately 15 percent, suggesting that rebuilt status would difficult to achieve, even under a scenario with zero fishing impacts. The rebuilding probabilities in Table 4.5.a are displayed graphically in Figure 4.5.a. For additional data, methods, and results, see Appendix B.

As indicated above, there is considerable uncertainty surrounding the estimate of T_{min}, which ranges widely from 5 years under the assumption of high ocean ERs to potentially never achieving rebuilt status under the assumption of low ocean ERs. Given this uncertainty, we express T_{max} as a range here as well. Section 2.1 above details the potential methods specified in NS1 that could be used to determine T_{max} in the event that T_{min} exceeds 10 years. In this case, the generation time may not accurately reflect the productivity of the stock, and fishing at a rate that is 75 percent of MFMT would reflect an unrealistically high ER. As a result, we recommend method 3 (T_{min} multiplied by two), which would define T_{max} as a range from 10 years if high ERs are assumed, to potentially never achieving rebuilt status if low ERs are assumed.

Table 4.5.a. Projected rebuilding probabilities by year for each Alternative and the T_{min} Scenario. The projected rebuilding time is indicated in bold as the year in which the rebuilding probability first exceeds 0.50

	Year									
Alternative	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Alternative I	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Alternative II_LowER	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02
Alternative II_HighER	0.00	0.00	0.00	0.02	0.02	0.02	0.02	0.02	0.02	0.02
T_{MIN}_LowER	0.00	0.00	0.01	0.10	0.15	0.14	0.15	0.15	0.15	0.14
T_{MIN}_HighER	0.00	0.00	0.08	0.45	**0.62**	0.61	0.61	0.61	0.61	0.62

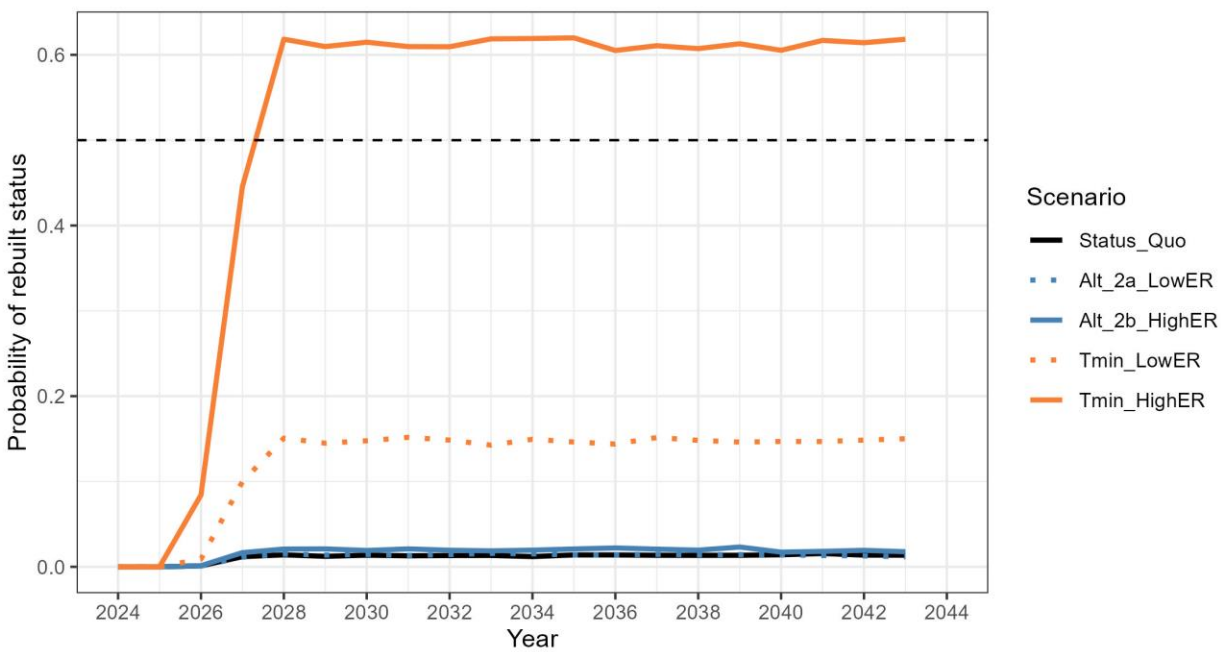

Figure 4.5.a. Projected probability of achieving rebuilt status by year under the three alternatives and the T_{min} scenario. The rebuilding time (T) for each scenario is defined as the first year in which the probability of achieving rebuild status exceeds 0.50 minus 2023 (the year in which the stock was designated as overfished).

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APPENDIX A. STATUS DETERMINATION CRITERIA

The following is an excerpt from the Salmon Fishery Management Plan

3.1 STATUS DETERMINATION CRITERIA

"Overfished. A stock or stock complex is considered ''overfished'' when its biomass has declined below a level that jeopardizes the capacity of the stock or stock complex to produce MSY on a continuing basis."

NS1Gs (600.310 (e)(2)(i)(E))

In establishing criteria by which to determine the status of salmon stocks, the Council must consider the uncertainty and theoretical aspects of MSY as well as the complexity and variability unique to naturally producing salmon populations. These unique aspects include the interaction of a short-lived species with frequent, sometimes protracted, and often major variations in both the freshwater and marine environments. These variations may act in unison or in opposition to affect salmon productivity in both positive and negative ways. In addition, variations in natural populations may sometimes be difficult to measure due to masking by hatchery produced salmon.

3.1.1 General Application to Salmon Fisheries

In establishing criteria from which to judge the conservation status of salmon stocks, the unique life history of salmon must be considered. Chinook, coho, and pink salmon are short-lived species (generally two to six years) that reproduce only once shortly before dying. Spawning escapements of coho and pink salmon are dominated by a single year-class and Chinook spawning escapements may be dominated by no more than one or two year-classes. The abundance of year-classes can fluctuate dramatically with combinations of natural and human-caused environmental variation. Therefore, it is not unusual for a healthy and relatively abundant salmon stock to produce occasional spawning escapements which, even with little or no fishing impacts, may be significantly below the long-term average associated with the production of MSY.

Numerous West Coast salmon stocks have suffered, and continue to suffer, from nonfishing activities that severely reduce natural survival by such actions as the elimination or degradation of freshwater spawning and rearing habitat. The consequence of this man-caused, habitat-based variation is twofold. First, these habitat changes increase large scale variations in stock productivity and associated stock abundances, which in turn complicate the overall determination of MSY and the specific assessment of whether a stock is producing at or below that level. Second, as the productivity of the freshwater habitat is diminished, the benefit of further reductions in fishing mortality to improve stock abundance decreases. Clearly, the failure of several stocks managed under this FMP to produce at an historical or consistent MSY level has little to do with current fishing impacts and often cannot be rectified with the cessation of all fishing.

To address the requirements of the MSA, the Council has established criteria based on biological reference points associated with MSY exploitation rate and MSY spawning escapement. The criteria are based on the unique life history of salmon and the large variations in annual stock abundance due to numerous environmental variables. They also take into account the uncertainty and imprecision surrounding the estimates of MSY, fishery impacts, and spawner escapements. In recognition of the unique salmon life history, the criteria differ somewhat from the general guidance in the NS1 Guidelines (§600.310).

3.1.4 Overfished

"For a fishery that is overfished, any fishery management plan, amendment, or proposed regulations… for such fishery shall (A) specify a time period for ending overfishing and rebuilding the fishery that shall:(i) be as short as possible, taking into account the status and biology of any overfished stocks of fish, the needs of the fishing communities, recommendations by international organizations in which the United States participates, and the interaction of the overfished stock within the marine ecosystem; and (ii) not exceed 10 years, except in cases where the biology of the stock of fish, other environmental conditions, or management measures under an international agreement in which the United States participates dictate otherwise…."

Magnuson-Stevens Act, §304(e)(4)

A stock will be considered overfished if the 3-year geometric mean of annual spawning escapements falls below the MSST, where MSST is generally defined as 0.5*S_{MSY} or 0.75*S_{MSY}, although there are some exceptions (Table 3-1). Overfished determinations will be made annually using the three most recently available postseason estimates of spawning escapement.

3.1.4.1 Council Action

When the overfished status determination criteria set forth in this FMP have been triggered, the Council shall:

1) notify the NMFS NWR administrator of this situation;
2) notify pertinent management entities;
3) structure Council area fisheries to reduce the likelihood of the stock remaining overfished and to mitigate the effects on stock status;
4) direct the STT to propose a rebuilding plan for Council consideration within one year.

Upon formal notification from NMFS to the Council of the overfished status of a stock, a rebuilding plan must be developed and implemented within two years.

The STT's proposed rebuilding plan shall include:

1) an evaluation of the roles of fishing, marine and freshwater survival in the overfished determination;
2) any modifications to the criteria set forth in section 3.1.6 below for determining when the stock has rebuilt,
3) recommendations for actions the Council could take to rebuild the stock to S_{MSY}, including modification of control rules if appropriate, and;
4) a specified rebuilding period.

In addition, the STT may consider and make recommendations to the Council or other management entities for reevaluating the current estimate of S_{MSY}, modifying methods used to forecast stock abundance or fishing impacts, improving sampling and monitoring programs, or changing hatchery practices.

Based on the results of the STT's recommended rebuilding plan, the Council will adopt a rebuilding plan for recommendation to the Secretary. Adoption of a rebuilding plan will require implementation either through an FMP amendment or notice and comment rule-making process. Subject to Secretarial approval, the Council will implement the rebuilding plan with appropriate actions to ensure the stock is rebuilt in as short a time as possible based on the biology of the stock but not to exceed ten years, while taking into consideration the needs of the commercial, recreational and tribal fishing interests and coastal communities. The existing control rules provide a default rebuilding plan that targets spawning escapement at or above MSY, provided sufficient recruits are available, and targets a rebuilding period of one generation (two years for pink salmon, three years for coho, and five years for Chinook). If sufficient recruits are not available to achieve spawning escapement at or above MSY in a particular year, the control rules provide for the potential use of *de minimis* exploitation rates that allow continued participation of fishing communities while minimizing risk of overfishing. However, the Council should consider the specific circumstances surrounding an overfished determination and ensure that the adopted rebuilding plan addresses all relevant issues.

Even if fishing is not the primary factor in the depression of the stock, the Council must act to limit the exploitation rate of fisheries within its jurisdiction so as not to limit rebuilding of the stock or fisheries. In cases where no action within Council authority can be identified which has a reasonable expectation of contributing to the rebuilding of the stock in question, the Council will identify the actions required by other entities to recover the depressed stock. Due to a lack of data for some stocks, environmental variation, economic and social impacts, and habitat losses or problems beyond the control or management authority of the Council, it is possible that rebuilding of depressed stocks in some cases could take much longer than ten years. The Council may change analytical or procedural methodologies to improve the accuracy of estimates for abundance, harvest impacts, and MSY escapement levels, and/or reduce ocean harvest impacts when it may be effective in stock recovery. For those causes beyond Council control or expertise, the Council may make recommendations to those entities which have the authority and expertise to change preseason prediction methodology, improve habitat, modify enhancement activities, and re-evaluate management and conservation objectives for potential modification through the appropriate Council process.

In addition to the STT assessment, the Council may direct its Habitat Committee (HC) to work with federal, state, local, and tribal habitat experts to review the status of the essential fish habitat affecting the overfished stock and, as appropriate, provide recommendations to the Council for restoration and enhancement measures within a suitable time frame. However, this action would be a priority only if the STT evaluation concluded that freshwater survival was a significant factor leading to the overfished determination. Upon review of the report from the HC, the Council will consider appropriate actions to promote any solutions to the identified habitat problems.

3.1.5 Not Overfished-Rebuilding

After an overfished status determination has been triggered, once the stock's 3-year geometric mean of spawning escapement exceeds the MSST, but remains below S_{MSY}, or other identified rebuilding criteria, the stock status will be recognized as "not overfished-rebuilding". This status level requires no Council action, but rather is used to indicate that stock's status has improved from the overfished level but the stock has not yet rebuilt.

3.1.6 Rebuilt

The default criterion for determining that an overfished stock is rebuilt is when the 3-year geometric mean spawning escapement exceeds S_{MSY}; the Council may consider additional criteria for rebuilt status when developing a rebuilding plan and recommend such criteria, to be implemented subject to Secretarial approval.

Because abundance of salmon populations can be highly variable, it is possible for a stock to rebuild from an overfished condition to the default rebuilding criterion in as little as one year, before a proposed rebuilding plan could be brought before the Council.

In some cases it may be important to consider other factors in determining rebuilt status, such as population structure within the stock designation. The Council may also want to specify particular strategies or priorities to achieve rebuilding objectives. Specific objectives, priorities, and implementation strategies should be detailed in the rebuilding plan.

3.1.6.1 Council Action

When a stock is determined to be rebuilt, the Council shall:

- notify the NMFS NWR administrator of its finding, and;
- notify pertinent management entities.

3.1.7 Changes or Additions to Status Determination Criteria

Status determination criteria are defined in terms of quantifiable, biologically-based reference points, or population parameters, specifically, S_{MSY}, MFMT (F_{MSY}), and MSST. These reference points are generally regarded as fixed quantities and are also the basis for the harvest control rules, which provide the operative guidance for the annual preseason planning process used to establish salmon fishing seasons that achieve OY and are used for status determinations as described above. Changes to how these status determination criteria are defined, such as MSST = $0.50*S_{MSY}$, must be made through a plan amendment. However, if a comprehensive technical review of the best scientific information available provides evidence that, in the view of the STT, SSC, and the Council, justifies a modification of the estimated values of these reference points, changes to the values may be made without a plan amendment. Insofar as possible, proposed reference point changes for natural stocks will only be reviewed and approved within the schedule established for salmon methodology reviews and completed at the November meeting prior to the year in which the proposed changes would be effective and apart from the preseason planning process. SDC reference points that may be changed without an FMP amendment include: reference point objectives for hatchery stocks upon the recommendation of the pertinent federal, state, and tribal management entities; and Federal court-ordered changes. All modifications would be documented through the salmon methodology review process, and/or the Council's preseason planning process.

APPENDIX B. MODEL DESCRIPTION

Introduction

In 2023 the recent three-year geometric mean (2019 – 2021) of Queets sp/su Chinook spawning escapement fell below its MSST value of 350, resulting in the stock being designated as overfished. Per the FMP, when a stock is designated as overfished, the STT is required to prepare a proposed rebuilding plan within one year. There are a number of required components of the proposed rebuilding plan (FMP Section 3.1.4.1), one of which is to provide a specified rebuilding period. Unless decided otherwise, the criterion for an overfished stock to achieve rebuilt status is a geometric mean of the three most recent years of spawning escapement that meets or exceeds S_{MSY}, which for Queets sp/su Chinook is set at 700. In addition, the NEPA analysis of rebuilding plans requires the development of rebuilding plan alternatives.

In 2018, five Pacific salmon stocks met the criteria for overfished status, requiring the STT to develop five proposed rebuilding plans (PFMC 2019a, 2019b, 2019c, 2019d, 2019e). As part of this, a model was developed and used to project rebuilding times across a variety of alternative rebuilding strategies for each of the five stocks (O'Farrell and Satterthwaite 2021). The model was created to allow for a quantitative assessment of rebuilding scenarios which include recommendations for action and their associated alternatives. The tool has some elements of a management strategy evaluation (MSE) but lacks an explicit biological operating model. It relies on draws from an abundance distribution informed by past abundance levels. As such, no explicit population dynamics are included in the model. Data limitations and the short time frame for development of the rebuilding plan did not allow for constructing a more detailed operating model. Here we describe this model and its inputs in further detail and provide additional results for the Queets sp/su Chinook stock.

For this analysis we use a similar but simplified approach to that developed by O'Farrell and Satterthwaite (2021) to estimate rebuilding times for Queets sp/su Chinook. The approach is simplified because, unlike the prior stocks for which rebuilding plans were developed and rebuilding times were estimated, Queets sp/su Chinook are not a target stock under the FMP and they have no associated harvest control rule. Abundance forecasts do not factor into preseason fishery planning and preseason estimates of ER are not produced. As a result, abundance forecast error and ER implementation error were not accounted for in this analysis.

Data

Terminal returns and escapements

Terminal run size (TRS) and spawner escapement estimates for Queets sp/su Chinook were obtained from Appendix B8 of the CTC's most recent annual report of catch and escapement (CTC 2024), available electronically, here. Terminal harvest rates in each year were also calculated as (TRS - Esc)/TRS (Table B-1).

Table B-1. Terminal run size, escapement, and terminal harvest rates for Queets sp/su Chinook; 2000 – 2023 (CTC 2024).

Year	Terminal Run	Escapement	Terminal Harvest Rate
2000	250	248	0.008
2001	565	548	0.030
2002	755	738	0.023
2003	195	189	0.031
2004	619	604	0.024
2005	306	298	0.026
2006	336	330	0.018
2007	358	352	0.017
2008	305	305	0.000
2009	501	495	0.012
2010	262	259	0.011
2011	378	373	0.013
2012	769	760	0.012
2013	526	520	0.011
2014	402	377	0.062
2015	561	532	0.052
2016	733	704	0.040
2017	860	825	0.041
2018	497	484	0.026
2019	328	322	0.018
2020	371	342	0.078
2021	285	280	0.018
2022	439	434	0.011
2023	550	540	0.018

Exploitation rates

For Queets sp/su Chinook, ER estimates are not available due to lack of a representative CWT indicator stock. Spring and summer run Chinook stocks originating from coastal Washington are believed to have far north migration patterns similar to those of the fall run Chinook stocks that also originate from the Washington coast. For this exercise, we first evaluated ERs for Queets fall Chinook to represent a suitable surrogate for Queets sp/su Chinook and then evaluated other possibilities. Geographically, Queets fall Chinook are the nearest CWT indicator stock with suitable data for conducting a cohort reconstruction and estimating ERs. The CTC conducts a CWT-based cohort analysis for Queets fall Chinook as part of their annual ERA; here we used ERs resulting from the CTC's most recently published ERA (CTC 2023), which can be found electronically, here (Table B-2; Figure B-1). These are calendar year exploitation rates in units of adult equivalent (AEQ) total mortality.

Table B-2. Ocean fishery AEQ total mortality calendar year exploitation rates for Queets fall Chinook by fishery region (CTC 2023).

Year	SEAK	BC	PFMC	Other SUS	Ocean ER
2000	0.259	0.096	0.000	0.000	0.355
2001	0.146	0.023	0.007	0.000	0.176
2002	0.248	0.067	0.002	0.000	0.317
2003	0.172	0.113	0.004	0.000	0.289
2004	0.166	0.149	0.003	0.000	0.318
2005	0.169	0.114	0.003	0.000	0.286
2006	0.224	0.166	0.004	0.000	0.394
2007	0.367	0.236	0.024	0.003	0.630
2008	0.197	0.145	0.000	0.000	0.342
2009	0.329	0.146	0.000	0.000	0.475
2010	0.254	0.097	0.005	0.000	0.356
2011	0.268	0.111	0.004	0.000	0.383
2012	0.405	0.176	0.008	0.000	0.589
2013	0.260	0.266	0.011	0.000	0.537
2014	0.297	0.153	0.006	0.004	0.460
2015	0.247	0.166	0.009	0.000	0.422
2016	0.312	0.201	0.000	0.000	0.513
2017	0.167	0.143	0.000	0.000	0.310
2018	0.260	0.261	0.002	0.000	0.523
2019	0.227	0.299	0.019	0.000	0.545
2020	0.353	0.130	0.002	0.000	0.485
2021	0.356	0.254	0.003	0.000	0.613

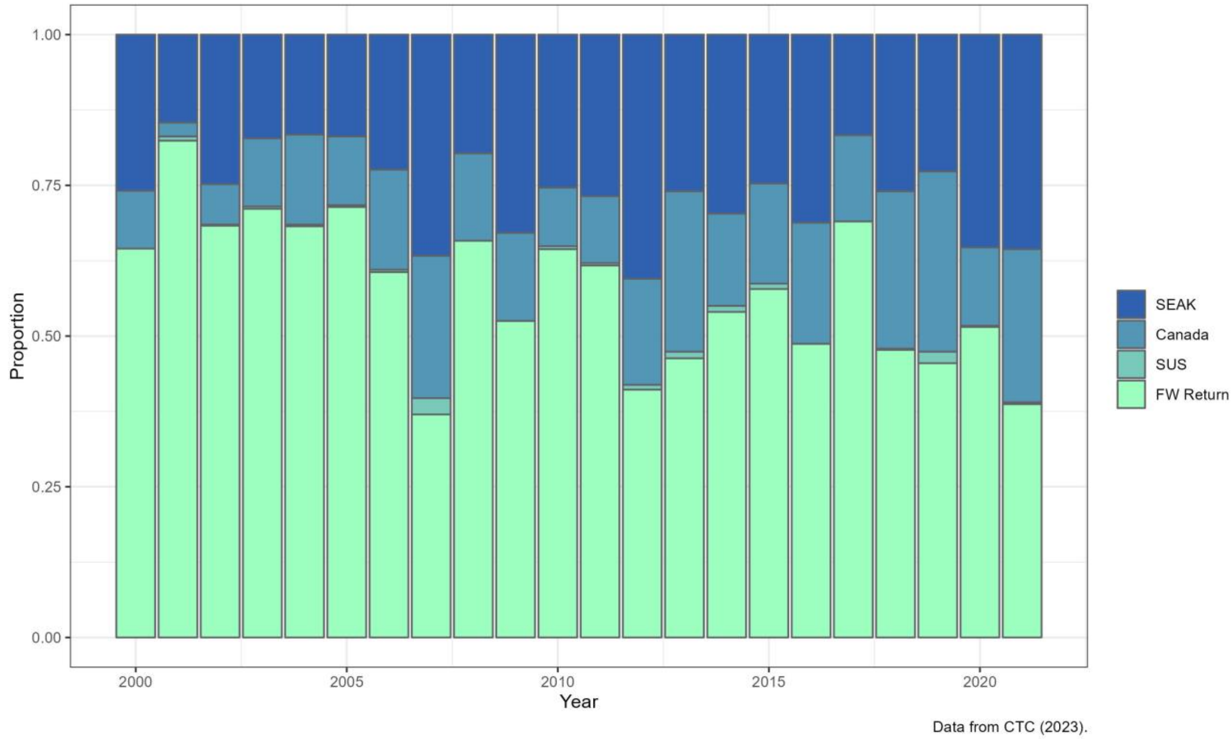

Figure B-1. Distribution of AEQ total mortality across ocean fishery regions and freshwater return for the Queets fall Chinook CWT indicator stock; 2000 – 2021.

We limited these data series to 2000 – present to align with the start of the 1999 PST Agreement and the significant restrictions to freshwater fishery harvest rates that began in 2000. The 1999 PST Agreement established the AABM and individual stock-based management (ISBM) fishing regimes that are still in place today, however, since the 1999 PST Agreement there have been two additional ten year Agreements (2009 – 2018 and 2019 – 2028), both of which have included negotiated reductions in catches and associated harvest rates for the SEAK and West Coast Vancouver Island AABM fisheries (see CTC (2024) for additional details).

While alternatives are limited, there might be shortcomings in using Queets fall Chinook ERs as a surrogate for Queets sp/su Chinook, as differences in run timing could be expected to result in differences in ocean ERs between the two. For example, impacts in ocean fisheries off the coast of Washington could be higher for sp/su run fish than fall fish due to more temporal overlap in migration timing with the fisheries. Ocean fisheries off the coast of Washington typically occur between May and September, which is when sp/su fish returning to Washington coastal rivers are expected to be migrating through the area. Fall run fish, however, return later in the season and may not migrate through Washington coastal waters until after the majority of the fisheries have already occurred.

Since BY 2008, there has been a consistent annual release of approximately 160k adipose-clipped summer run CWTs from the Quillayute River system (see **Error! Reference source not found.** f or tag codes). While not as geographically close as Queets fall Chinook, these fish still originate from the Washington coast and may better represent Queets sp/su Chinook based on similarities in run timing. Since a formal cohort analysis does not exist for these CWTs, estimates of ocean

ERs are not available. We can, however, compare the distribution of recoveries across fisheries and escapement for these CWTs with the landed catch mortality distribution of the Queets fall Chinook indicator stock from CTC (2023). Figure B-2 displays the annual and average distribution of CWT recoveries for these two stocks across ocean fishery regions and returns to the river for 2013 through 2021.

A visual comparison suggests that the impacts on Quillayute summer Chinook in SEAK and BC appear to be approximately one third of those on Queets fall Chinook. For fisheries in the SUS, while the overall magnitude remains small, the proportion of recoveries occurring in SUS ocean fisheries is approximately 6.5 times larger for Quillayute summer than for Queets fall. Overall, this comparison suggests that ocean ERs on Washington coastal fall Chinook may be greater than those on Washington coastal sp/su Chinook. Thus, using Queets fall Chinook ERs in a rebuilding time analysis for Queets sp/su Chinook may result in an underestimation of the true ERs experienced by the stock in Council fisheries but an overestimation of the total ocean ERs, and in turn, rebuilding probabilities that are biased high. It is important to note that the proportions in Figure B-2 only represent the distribution of CWT recoveries (expanded for sampling rates) and not ERs, as they do not incorporate incidental mortality (i.e., drop off and release mortality). They should, however, be roughly similar to ERs. Additionally, minimal QA/QC was performed on the Quillayute summer CWT recoveries.

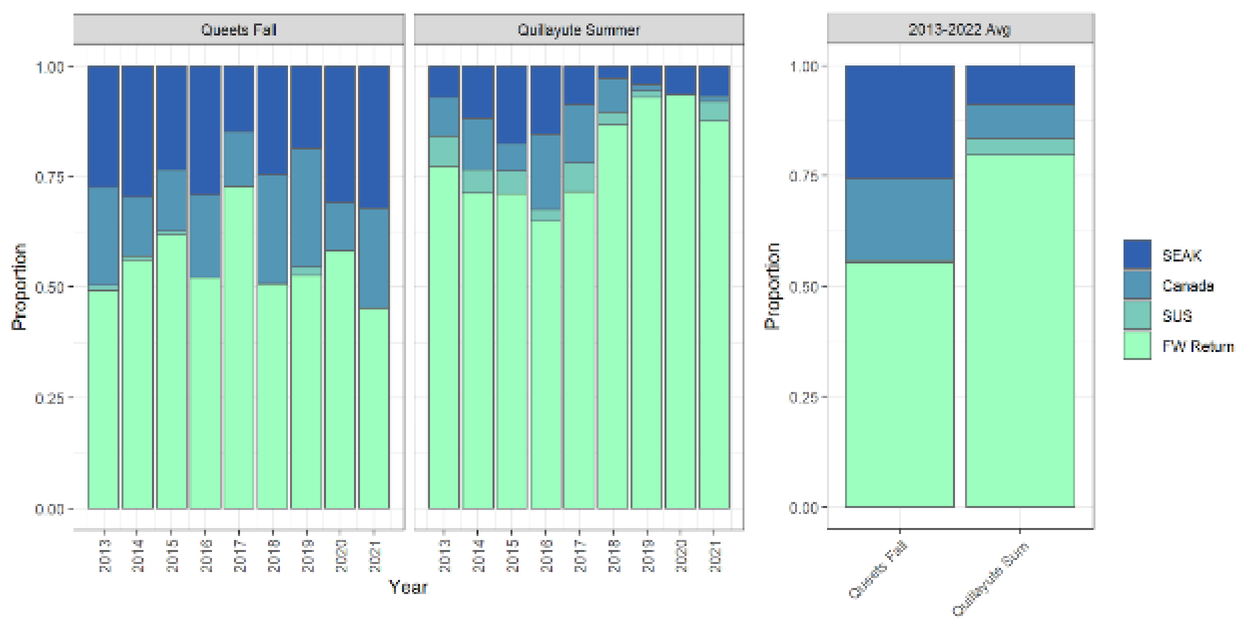

Figure B-2. Annual and mean distributions of CWT recoveries across ocean fishery regions and freshwater return for Queets fall and Quillayute summer Chinook; 2013 – 2021.

Rebuilding time scenarios assessed

For this assessment we evaluated three different scenarios:

- ***Alternative 1 - Status Quo:*** For this scenario we assume fisheries coastwide are maintained at existing levels.

- ***Alternative 2 - Close Non-Treaty NOF Council Fisheries:*** For this scenario we assume closure of all non-treaty NOF Council area fisheries. Given the uncertainties regarding ocean ERs for Queets sp/su Chinook, we evaluate two scenarios for this Alternative:
    - ***Alternative 2a - Low ER scenario:*** For this scenario we assume Queets fall ERs in Council area fisheries are a suitable surrogate for Queets sp/su Chinook. Between 2000 and 2021, Queets fall ERs in Council area fisheries averaged approximately 0.5% (Table B-2). While some of this harvest is likely to have occurred in Treaty Indian fisheries, here we make the conservative assumption that all exploitation occurred in non-treaty NOF fisheries.
    - ***Alternative 2b - High ER scenario:*** For reasons explained above, there may be reason to expect that using Queets fall Chinook ERs in Council area fisheries could underestimate the actual ERs on Queets sp/su Chinook. Based on the distribution of CWT recoveries for Quillayute summer Chinook (Figure B-2), the proportion occurring in SUS fisheries (predominantly NOF Council area Fisheries) is approximately 6.5 times higher than for Queets fall Chinook. For this scenario, we use the ERs from Alternative 2a multiplied by a factor of 6.5.
- ***T_{min} Scenario - Close Fishing Coastwide:*** For this scenario we assume complete closure of all fisheries (marine and freshwater) that impact Queets sp/su Chinook. Note that this scenario involves the closure of numerous fisheries that are outside Council jurisdiction, including those in SEAK, BC, and Washington Tribal freshwater fisheries. As such, this is not being presented as an Alternative for Council action; rather, it is intended to provide insight into T_{min}. Given the uncertainties regarding ocean ERs for Queets sp/su Chinook, we evaluate two scenarios here:
    - ***T_{min} Scenario A - High Ocean ER:*** Here we assume that the level of ocean ER experienced by Queets sp/su Chinook is equivalent to that of Queets fall Chinook, averaging approximately 42 percent annually (Table B-2).
    - ***T_{min} Scenario B - Low Ocean ER:*** For reasons explained above, there may be reason to expect that using Queets fall Chinook total ocean fishery ERs could overestimate the actual ocean ERs experienced by Queets sp/su Chinook. Looking at the distribution of CWT recoveries for Quillayute summer Chinook (Figure B-2), the proportion occurring in ocean fisheries is approximately half that of Queets fall Chinook. For this scenario, we assume that the level of ocean ER experienced by the Queets sp/su Chinook is equivalent to half of the Queets fall Chinook ERs, averaging approximately 21 percent annually (Table B-2).

Alternative 1: Status Quo Fisheries

To estimate a rebuilding time under the status quo scenario we can use prior year spawner escapements to inform future year escapements based on the assumption that future fishery impact rates and survival rates will be similar to those in the past, thus producing similar escapements.

First, we evaluate the prior year escapements. Figure B-3 below shows Queets sp/su Chinook escapements between 2000 and 2023.

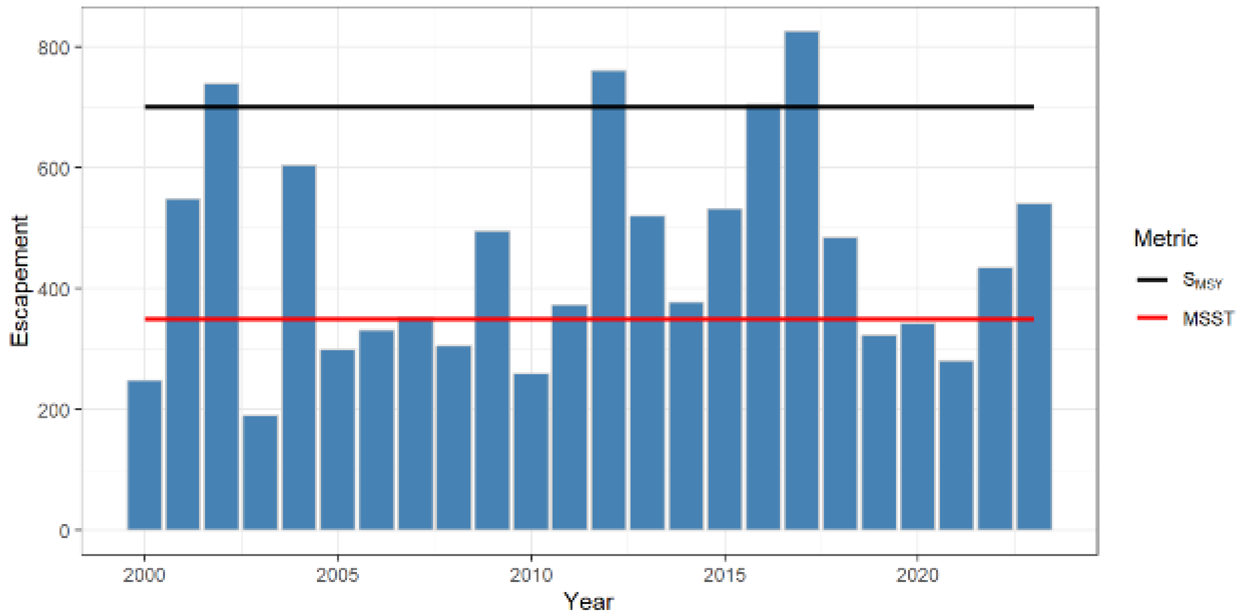

Figure B-3. Spawner escapement estimates for Queets sp/su Chinook with S_{MSY} and MSST reference points; 2000 – 2023.

Next, we evaluate the escapement estimates to verify that they fit a log-normal distribution, as is typically the case with escapement time series. This is done through visual interpretation, of the below histogram, density plot, and Q-Q plots (Figure B-4).

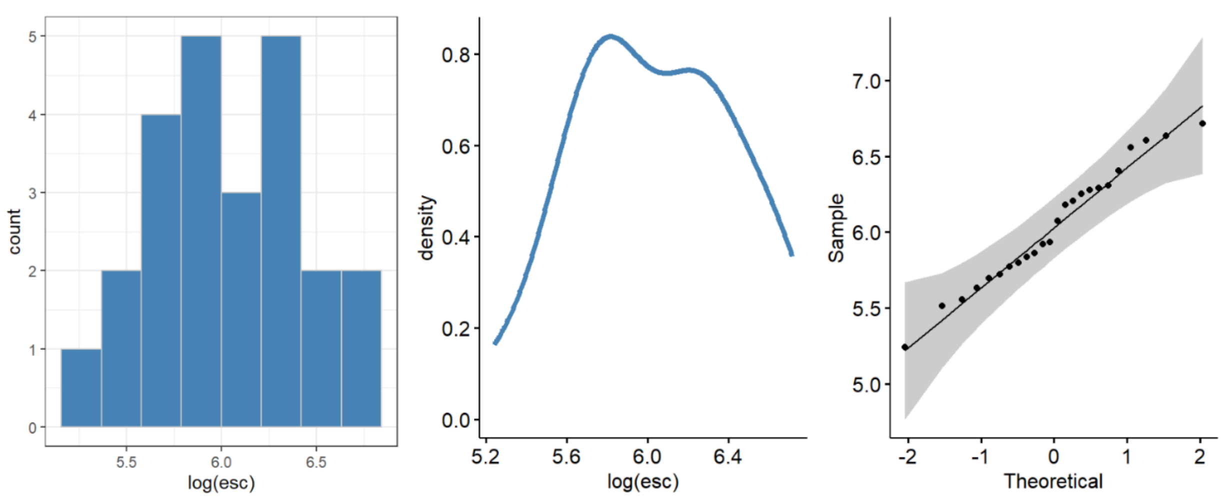

Figure B-4. Histogram, probability density plot, and Q-Q plot of log-transformed spawner escapement estimates for Queets sp/su Chinook.

The results of a Shapiro-Wilk's test also suggest that the escapement estimates are not significantly different from a log-normal distribution (p-value = 0.73).

There was not strong evidence of autocorrelation in the escapement time series, as displayed in the following ACF plot (Figure B-5).

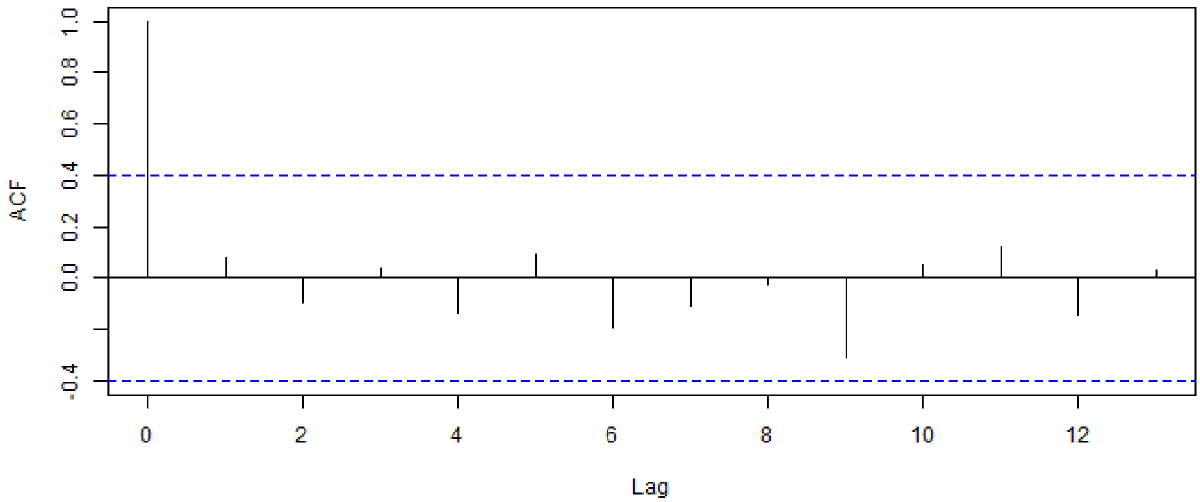

Figure B-5. ACF plot of spawner escapement estimates for Queets sp/su Chinook.

To estimate the time necessary to achieve rebuilt status (3-yr geometric mean of spawning escapement > S_{MSY} of 700) under the status quo scenario, we randomly draw escapements for each year 20 years into the future over a series of 10,000 replicates for each year. At the time of this analysis, observed escapements were available through 2023, so 2024 was the first year for which escapement estimates were randomly drawn. Escapements are drawn from a log-normal distribution defined by the mean and standard deviation of log transformed Queets sp/su Chinook escapement values from 2000 through 2021 (the most recent year available at the time of overfished designation; Table B-1, Figure B-3). Autocorrelation was not accounted for in these random draws due to the lack of evidence of its existence in the Queets sp/su escapement time series (Figure B-5). For each replicate within each year the three-year geometric mean of spawning escapement was calculated using the most recent escapement estimates that would have been available (e.g., in 2024 the geometric mean was calculated using spawning escapements for 2020 – 2022). Then for each year we calculated the probability of achieving rebuilt status as the proportion of the 10,000 replicates where the three-year geometric mean was greater than or equal to S_{MSY}. We also calculated the probability of falling back into overfished status as the proportion of replicates in each year where the three-year geometric mean fell below the MSST. Similar to O'Farrell and Satterthwaite (2021), we defined the projected rebuilding time as the number of years needed for the probability of achieving rebuilt status to meet or exceed 0.50.

Table B-3. Projected probabilities of achieving rebuilt status or falling back into overfished status by year under the status quo scenario

Year	Probability Rebuilt	Probability Overfished
2024	0.000	1.000
2025	0.000	0.000
2026	0.001	0.023
2027	0.012	0.091
2028	0.014	0.232
2029	0.012	0.236
2030	0.014	0.238
2031	0.013	0.238
2032	0.013	0.234
2033	0.013	0.230
2034	0.012	0.234
2035	0.014	0.229
2036	0.014	0.235
2037	0.014	0.237
2038	0.013	0.239
2039	0.014	0.229
2040	0.014	0.236
2041	0.016	0.239
2042	0.014	0.236
2043	0.014	0.236

Alternative 2: Close Non-Treaty NOF Council Fisheries

For this scenario we assume closure of all NOF Council area non-Indian commercial troll and recreational fisheries. Given the uncertainties regarding ocean ERs for Queets sp/su Chinook, we evaluate two scenarios for this Alternative: a low ER scenario and a high ER scenario. For each of these scenarios, we take a simplified approach to estimating the aggregate-age adult escapement that would occur in the absence of NOF non-treaty fisheries. This is accomplished by calculating a time series of estimated terminal returns that would be expected in the absence of the fisheries that were closed simply by dividing the observed terminal run in each year by one minus the assumed ER in non-treaty NOF fisheries in that same year. Since freshwater fisheries were not being closed in this scenario, we estimated the annual escapement by multiplying the resulting estimated terminal returns by one minus the terminal harvest rate for each year (Tables B-4 and B-6). Future year escapements for each replicate are then drawn from a log-normal distribution defined by the mean and standard deviation of log transformed values of these resulting estimated escapement estimates.

A shortcoming of this approach is that it would tend to overestimate the escapement in the first few years, as the AEQ metric represents the probability that a fish would return to spawn at any point in the future in the absence of fisheries and not all unharvested fish would return to spawn in that first year. Some younger fish may remain in the ocean and not mature until one or more years in the future. After a few years, however, this would no longer be an issue, as all of the broods affected by the last year of fishing before the closure would have fully returned and all remaining broods in the ocean would be free of harvest.

<u>Alternative 2a: Low ER scenario</u>

For this scenario we assume Queets fall ERs in Council area fisheries are a suitable surrogate for Queets sp/su Chinook. Between 2000 and 2021, Queets fall ERs in Council area fisheries averaged approximately 0.5 percent (Table B-2). While some of this harvest is likely to have occurred in Treaty Indian fisheries, here we make the conservative assumption that all exploitation occurred in non-treaty North of Falcon fisheries. Table B-4 shows the estimated escapements of Queets sp/su Chinook under Alternative 2a. Table B-5 displays the probability of achieving rebuilt status and the probability of falling back into overfished status for each year under Alternative 2a.

Table B-4. Estimated Queets sp/su escapement under Alternative 2a (low ER)

Year	Observed Terminal Run	NT NOF ER	Estimated Terminal Run	Terminal Harvest Rate	Estimated Escapement
2000	250	0.000	250	0.008	248
2001	565	0.007	569	0.030	552
2002	755	0.002	757	0.023	739
2003	195	0.004	196	0.031	190
2004	619	0.003	621	0.024	606
2005	306	0.003	307	0.026	299
2006	336	0.004	337	0.018	331
2007	358	0.024	367	0.017	361
2008	305	0.000	305	0.000	305
2009	501	0.000	501	0.012	495
2010	262	0.005	263	0.011	260
2011	378	0.004	380	0.013	375
2012	769	0.008	775	0.012	766
2013	526	0.011	532	0.011	526
2014	402	0.006	404	0.062	379
2015	561	0.009	566	0.052	537
2016	733	0.000	733	0.040	704
2017	860	0.000	860	0.041	825
2018	497	0.002	498	0.026	485
2019	328	0.019	334	0.018	328
2020	371	0.002	372	0.078	343
2021	285	0.003	286	0.018	281

Table B-5. Projected probabilities of achieving rebuilt status or falling back into overfished status by year under Alternative 2a (low ER).

Year	Probability Rebuilt	Probability Overfished
2024	0.000	1.000
2025	0.000	0.000
2026	0.001	0.020
2027	0.011	0.089
2028	0.015	0.239
2029	0.014	0.234
2030	0.015	0.220
2031	0.013	0.218
2032	0.014	0.218
2033	0.016	0.219
2034	0.015	0.227
2035	0.014	0.228
2036	0.014	0.229
2037	0.015	0.236
2038	0.014	0.232
2039	0.014	0.227
2040	0.014	0.220
2041	0.013	0.225
2042	0.013	0.228
2043	0.012	0.230

Alternative 2b: High ER scenario

As noted above, there may be reason to expect that using Queets fall Chinook ERs in Council area fisheries could underestimate the actual ERs on Queets sp/su Chinook. Looking at the distribution of CWT recoveries for Quillayute summer Chinook (Figure B-2), the proportion occurring in SUS fisheries (predominantly North of Falcon Council area Fisheries) is approximately 6.5 times higher than for Queets fall Chinook. For this scenario, we use the ERs from Alternative 2a multiplied by a factor of 6.5. Table B-6 shows the estimated escapements of Queets sp/su Chinook under Alternative 2b. Table B-7 displays the probability of achieving rebuilt status and the probability of falling back into overfished status for each year under Alternative 2b.

Table B-6. Estimated Queets sp/su escapement under Alternative 2b (high ER)

Year	Observed Terminal Run	NT NOF ER	Estimated Terminal Run	Terminal Harvest Rate	Estimated Escapement
2000	250	0.000	250	0.008	248
2001	565	0.046	592	0.030	574
2002	755	0.013	765	0.023	747
2003	195	0.026	200	0.031	194
2004	619	0.020	631	0.024	616
2005	306	0.020	312	0.026	304
2006	336	0.026	345	0.018	339
2007	358	0.156	424	0.017	417
2008	305	0.000	305	0.000	305
2009	501	0.000	501	0.012	495
2010	262	0.033	271	0.011	268
2011	378	0.026	388	0.013	383
2012	769	0.052	811	0.012	801
2013	526	0.072	567	0.011	560
2014	402	0.039	418	0.062	392
2015	561	0.059	596	0.052	565
2016	733	0.000	733	0.040	704
2017	860	0.000	860	0.041	825
2018	497	0.013	504	0.026	490
2019	328	0.124	374	0.018	367
2020	371	0.013	376	0.078	347
2021	285	0.020	291	0.018	285

Table B-7. Projected probabilities of achieving rebuilt status or falling back into overfished status by year under Alternative 2b (high ER)

Year	Probability Rebuilt	Probability Overfished
2024	0.000	1.000
2025	0.000	0.000
2026	0.001	0.017
2027	0.017	0.065
2028	0.021	0.181
2029	0.021	0.186
2030	0.019	0.187
2031	0.021	0.193
2032	0.019	0.195
2033	0.019	0.188
2034	0.020	0.193
2035	0.021	0.192
2036	0.022	0.188
2037	0.021	0.182
2038	0.020	0.182
2039	0.023	0.186
2040	0.017	0.190
2041	0.018	0.192
2042	0.019	0.193
2043	0.018	0.192

T_{min} Scenario: Close Fisheries Coastwide

In this scenario we assume complete closure of all fisheries that impact Queets sp/su Chinook. Note that this scenario involves the closure of numerous fisheries that are outside Council jurisdiction, including state and tribal freshwater fisheries in addition to ocean fisheries that occur in SEAK and BC. As such, it is not being presented as an Alternative for Council action; rather, it is intended to provide insight into T_{min}. Given the uncertainties regarding ocean ERs for Queets sp/su Chinook, we evaluate two scenarios here: a high ER scenario and a low ER scenario. We took a similar approach here as we did for Alternative 2, where the observed terminal run in each year was expanded by one minus the estimated ER in the fisheries being closed. In this case, however, no adjustment was needed to account for terminal harvest rates, as those fisheries were also being closed.

T_{min} Scenario A: High Ocean ERs

Here we assume that the level of ocean ER experienced by Queets sp/su Chinook is equivalent to that of Queets fall Chinook, averaging approximately 42 percent annually (**Error! Reference source not found.**). **Error! Reference source not found.** shows the estimated escapements of

Queets sp/su Chinook under the high ER T_{MIN} scenario. To calculate the rebuilding probabilities under this scenario, we followed the same approach outlined above, except used the 2000 – 2021 estimated escapements from **Error! Reference source not found.** in place of observed e scapement estimates to inform the log-normal distribution from which the random escapements were drawn. **Error! Reference source not found.** displays the probability of achieving rebuilt s tatus and the probability of falling back into overfished status for each year under the high ER T_{MIN} scenario.

Table B-8. Estimated Queets sp/su escapement under the high ER Tmin scenario

Year	Observed Terminal Run	Ocean ER	Estimated Escapement
2000	250	0.355	388
2001	565	0.176	686
2002	755	0.317	1105
2003	195	0.289	274
2004	619	0.318	908
2005	306	0.286	429
2006	336	0.394	554
2007	358	0.630	968
2008	305	0.342	464
2009	501	0.475	954
2010	262	0.356	407
2011	378	0.383	613
2012	769	0.589	1871
2013	526	0.537	1136
2014	402	0.460	744
2015	561	0.422	971
2016	733	0.513	1505
2017	860	0.310	1246
2018	497	0.523	1042
2019	328	0.545	721
2020	371	0.485	720
2021	285	0.613	736

Table B-9. Projected probabilities of achieving rebuilt status or falling back into overfished status by year under the high ER T_{min} scenario

Year	Probability Rebuilt	Probability Overfished
2024	0.000	1.000
2025	0.000	0.000
2026	0.084	0.001
2027	0.446	0.002
2028	0.618	0.003
2029	0.610	0.003
2030	0.615	0.003
2031	0.610	0.002
2032	0.610	0.003
2033	0.619	0.003
2034	0.619	0.003
2035	0.620	0.002
2036	0.605	0.003
2037	0.611	0.002
2038	0.607	0.002
2039	0.613	0.002
2040	0.605	0.002
2041	0.617	0.003
2042	0.614	0.004
2043	0.618	0.003

T_{min} Scenario B: Low Ocean ERs

As noted above, there may be reason to expect that using Queets fall Chinook total ocean fishery ERs could overestimate the actual ocean ERs experienced by Queets sp/su Chinook. Looking at the distribution of CWT recoveries for Quillayute summer Chinook (Figure B-2), the proportion occurring in ocean fisheries is approximately half that of Queets fall Chinook. For this scenario, we assume that the level of ocean ER experienced by the Queets sp/su Chinook is equivalent to half of the Queets fall Chinook ERs, averaging approximately 21 percent annually (**Error! R eference source not found.**). **Error! Reference source not found.** shows the estimated escapements of Queets sp/su Chinook under the low ER T_{MIN} scenario. To calculate the rebuilding probabilities under this scenario, we followed the same approach outlined above, except used the 2000 – 2021 estimated escapements from **Error! Reference source not found.** in place of o bserved escapement estimates to inform the log-normal distribution from which the random escapements were drawn. **Error! Reference source not found.** displays the probability of a chieving rebuilt status and the probability of falling back into overfished status for each year under the low ER T_{min} scenario.

Table B-10. Estimated Queets sp/su escapement under the low ER T_{min} scenario

Year	Observed Terminal Run	Ocean ER	Estimated Escapement
2000	250	0.178	304
2001	565	0.088	620
2002	755	0.159	897
2003	195	0.145	228
2004	619	0.159	736
2005	306	0.143	357
2006	336	0.197	418
2007	358	0.315	523
2008	305	0.171	368
2009	501	0.238	657
2010	262	0.178	319
2011	378	0.192	468
2012	769	0.295	1090
2013	526	0.269	719
2014	402	0.230	522
2015	561	0.211	711
2016	733	0.257	986
2017	860	0.155	1018
2018	497	0.262	673
2019	328	0.273	451
2020	371	0.243	490
2021	285	0.307	411

Table B-11. Projected probabilities of achieving rebuilt status or falling back into overfished status by year under the low ER T_{min} scenario.

Year	Probability Rebuilt	Probability Overfished
2024	0.000	1.000
2025	0.000	0.000
2026	0.009	0.005
2027	0.100	0.015
2028	0.151	0.038
2029	0.145	0.036
2030	0.148	0.034
2031	0.152	0.037
2032	0.149	0.036
2033	0.143	0.036
2034	0.150	0.035
2035	0.146	0.038
2036	0.144	0.038
2037	0.152	0.034
2038	0.148	0.038
2039	0.146	0.037
2040	0.147	0.035
2041	0.147	0.035
2042	0.149	0.032
2043	0.150	0.037

Conclusion

The results of this assessment indicate that achieving rebuilt status for Queets sp/su Chinook will be difficult and potentially impossible with the current S_{MSY} value of 700. Of the scenarios evaluated, only one exceeded a 0.50 probability of achieving rebuilt status; the T_{min} scenario with high assumed ERs has a >0.50 probability of achieving rebuilt status in 2028, a projected rebuilding time of 5 years following the overfished designation in 2023 (**Error! Reference source not found.**, Figure B-). For the remaining scenarios, the probability of achieving rebuilt status never exceeds 0.50, indicating that under these conditions rebuilt status is unlikely to occur. For Alternative 1 (status quo), the probability of achieving rebuilt status levels off at around 0.01. This outlook remains similar under Alternative 2 (Close non-treaty NOF fisheries), where the probability of achieving rebuilt status levels off around 0.01 and 0.02 for the low and high ER scenarios, respectively. Lastly, for the T_{MIN} scenario (close fisheries coastwide) with low assumed ERs, the probability of achieving rebuilt status leveled off around 0.15 (**Error! Reference source not found.**, Figure B-).

Table B-12. Projected probabilities of achieving rebuilt status by year for each of the Alternatives and the T_{min} scenario.

Alternative	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Alternative I	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Alternative II_LowER	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02
Alternative II_HighER	0.00	0.00	0.00	0.02	0.02	0.02	0.02	0.02	0.02	0.02
T_{MIN}_LowER	0.00	0.00	0.01	0.10	0.15	0.14	0.15	0.15	0.15	0.14
T_{MIN}_HighER	0.00	0.00	0.08	0.45	0.62	0.61	0.61	0.61	0.61	0.62

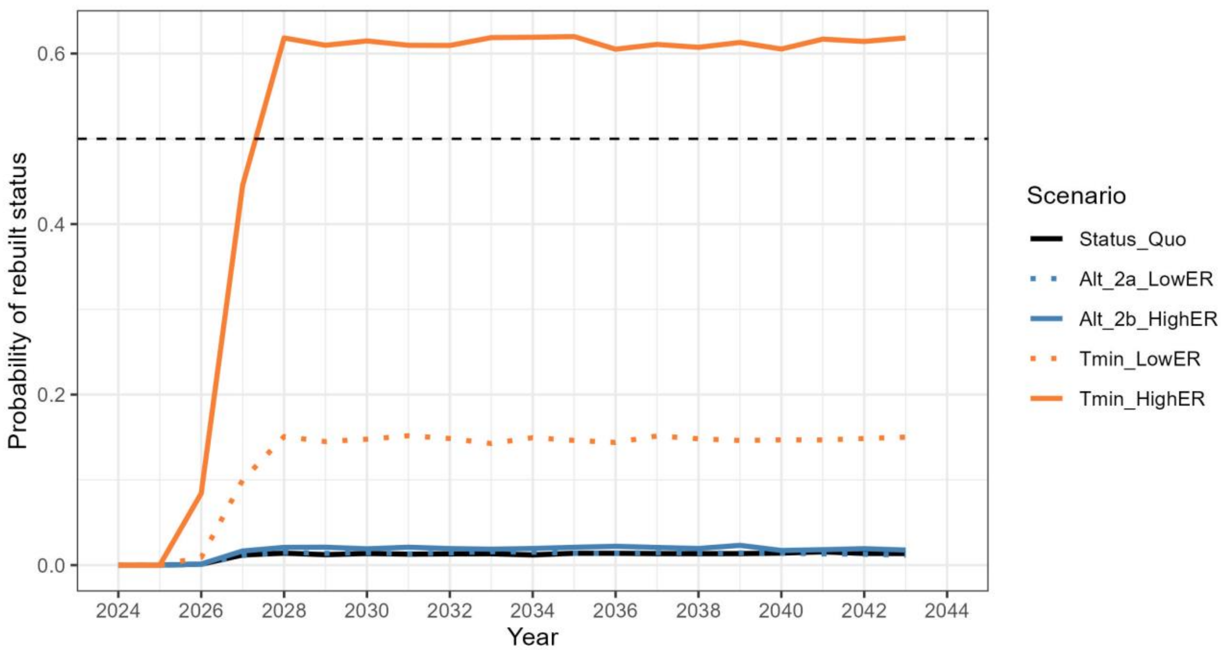

Figure B-6. Projected probabilities of achieving rebuilt status by year for each of the Alternatives and the T_{min} scenario.

Based on recent estimates of escapement for Queets sp/su Chinook, we can be quite confident that if these levels persist into the future, it is unlikely that the stock will achieve rebuilt status anytime soon, if ever. While considering the results of other scenarios, however, it is important to remain cognizant of the numerous assumptions made in this analysis. This simplified model does not account for population dynamics or any increased production that might result from increased escapement that occurs in the fishery closure scenarios. Additionally, there are uncertainties surrounding the appropriate levels of ER to assume for Queets sp/su Chinook in ocean fisheries. We attempt to address this uncertainty by evaluating low and high ER assumption scenarios in order to provide a range of possible outcomes.

Table B-13. Coded-wire tag codes used to represent Quillayute summer Chinook.

Brood Year	Tag Code	cwt_1st_mark
2008	210826	5000
2008	210827	5000
2009	210917	5000
2009	210920	5000
2010	210978	5000
2010	210980	5000
2011	210992	5000
2011	210994	5000
2012	211058	5000
2012	211059	5000
2013	211102	5000
2013	211103	5000
2014	211140	5000
2014	211141	5000
2015	211184	5000
2015	211186	5000
2016	211237	5000
2016	211238	5000
2017	211262	5000
2017	211264	5000
2017	211265	5000
2018	211309	5000
2018	211310	5000
2019	211396	5000
2019	211397	5000

APPENDIX C. SOCIOECONOMIC IMPACTS OF MANAGEMENT STRATEGY ALTERNATIVES

Domestic ocean fisheries impacting Queets River natural spring/summer Chinook (Queets sp/su Chinook) occur mainly off the coast of Washington state and in Oregon north of Cape Falcon. Fisheries analyzed for this purpose include nontribal commercial and sport fisheries. The focus of this analysis is impacts on ocean fisheries and related economic activity. Therefore, the economic benchmark is impacts for port areas in Oregon and Washington north of Cape Falcon during 2004 to 2023. The year 2023 was selected as the last year of the period because it was the most recent year for which data were available when the analytical models were developed. A 20-year time span was used since the years within that timeframe include recent history and describe a range of harvest and escapement levels that could reasonably be expected to occur in future years, although due to ocean, climate, and other conditions, the actual distribution may tend more toward one end of this spectrum than the other or exhibit increased variability.

Salmon Fishery Income Impacts and Community Dependance

Coastal community income impacts provide information on the effects of fluctuations in annual salmon harvest on local economies and small businesses. Income impacts are based on commercial landings and recreational fishing days (angler-trips) and were estimated using the IO-PAC fisheries economic impact model[1].

Estimated local community income impacts of commercial and recreational ocean salmon fisheries are shown in Table C-1. Income impact measures are most relevant to those participants and stakeholders dependent on an income stream from the fishery, including individuals, businesses, and state and local governments. These impacts represent estimates of total personal income associated with harvesting and processing activities in commercial salmon fisheries and trip-related expenditures made by recreational salmon anglers, expressed at the local community (county or multi-county) levels.[2] Income impacts reported in this document consist of the sum of personal income earned by those directly participating in the fishery (e.g. vessel owners, crew members, processing workers, recreational charter operators), income indirectly associated with the fishery that is earned by those providing inputs to harvesting, processing and recreational sectors (e.g., fuel, gear, packaging, bait, and ice suppliers; and hotel, restaurant, and campground operators), and income earned by those whose goods and services are purchased when direct and indirect income is re-spent in the community (e.g., grocery store owners and employees, local manufacturers, auto mechanics, restaurants, health care, and legal professionals). This latter category of impacts is sometimes called ‘induced income.’

[1] Prior to 2014, income impacts were estimated using the Fisheries Economic Assessment Model (FEAM). When IO-PAC was adopted, it was applied retrospectively back to 2010. The change in methodology means that income impacts estimated using IO-PAC for years beginning with 2010 are not completely comparable with historical values for years prior to 2010, which were estimated using FEAM. Appendix E to the *Review of 2014 Ocean Salmon Fisheries* contains a more detailed explanation of the change in income modeling methodology, including comparisons of IO-PAC with FEAM-based estimates for overlapping years.

2 Because income impact refers to income “associated with” a given level of economic activity, the term impact in this context should not be confused with the term impact as frequently employed in policy analyses such as those required by the National Environmental Policy Act. Such policy analyses refer to impact as the effect (the difference) which results from taking an action (as compared to not taking the action). Income impacts are one of a number of different but related measures of total economic activity (e.g., income impacts, gross receipts, total jobs, etc.).

When the commercial or recreational fishery is reduced or absent, the net impact on local communities will depend on the economic base of the community and on how people respond to the reduced fishery. For example, if a recreational angler is unable to make a planned coastal salmon trip and instead travels inland to fish in a river or at a mountain lake, then the impact associated with the lost salmon trip represents a net loss to the members of the coastal community. On the other hand, if the recreational fisher instead took part in another form of recreational activity in the same coastal community, then there may be little or no net loss to the community as a whole. However, at least some of those whose livelihood involves the salmon fishery would experience an income reduction, as if the angler's money had been spent elsewhere (or not at all). Similarly, for those involved in the commercial fishery, whether or not reduced income impacts associated with a reduction in salmon harvest represent a net loss to the community depends on the degree to which opportunities exist in the community to engage in some other economic activity to compensate for the loss of income from commercial salmon harvesting and processing.

Income impacts are presented at the local, port area level. Estimates of changes in income impacts may represent a disruption due to redistribution of activity within the local economy or a net loss from activity leaving the local economy. At higher levels, such as for the state, it is more likely that an indicated change represents a disruption due to redistribution of activity within the economy rather than a net loss to the greater state economy.

Income impacts are estimated based on several data components, including reported commercial fishery landings and exvessel prices by port or area, an inventory of local harvesters and processors, estimates of operational expenditures by harvesters and processors, estimates of the number of angler trips and expenditure patterns of recreational anglers, and local total income impact coefficients generated by IO-PAC using IMPLAN® models constructed for each port or area. Commercial ocean harvests that are landed outside of coastal areas (e.g., ocean troll caught salmon landed in Puget Sound ports) are not included in these estimates of coastal community impacts.

The income impacts presented below are estimates of annual trends and are intended to indicate the possible redirection of economic activity between fishing-dependent and non-fishing sectors. As such, they represent likely upper bounds on the local community and state-level income impacts generated by West Coast salmon fisheries. All income impact estimates reported in this document are in terms of inflation-adjusted 2023 dollars.

Economic Data

Estimates of total coastal community personal impacts during 2004-2023 in affected port areas north of Cape Falcon (Neah Bay, La Push, Westport, Ilwaco and Astoria) for the non-tribal commercial ocean troll salmon fishery and recreational ocean salmon fishery are shown in Figures C-1 and C-2 and Table C-1, below. Personal income impacts from non-tribal commercial ocean troll salmon fishing averaged approximately $3.8 million per year (in inflation-adjusted 2023 dollars), ranging from $1.7 million (in 2020) to $6.8 million (in 2010). Estimates of in the ocean recreational salmon fishery averaged $9.7 million, ranging from $4.1 million (in 2020) to $16.1 million (in 2014) (Figures C-1 and C-2, Table C-1).

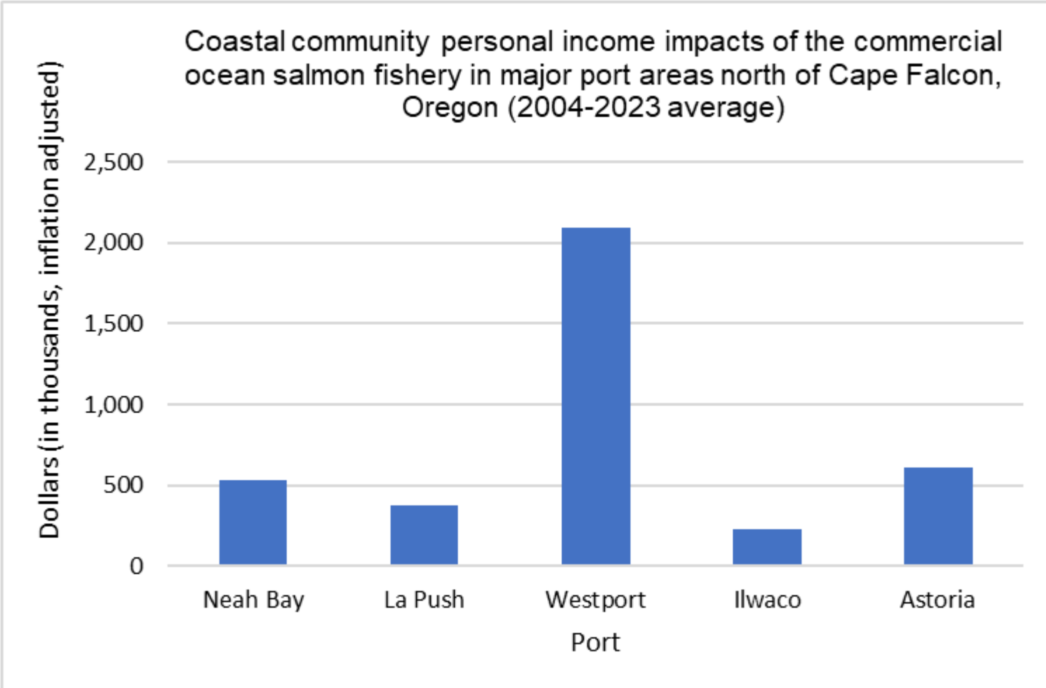

Figure C-1. Coastal community personal income impacts of the commercial ocean salmon fishery in major port areas north of Cape Falcon, Oregon (2004-2023 average)

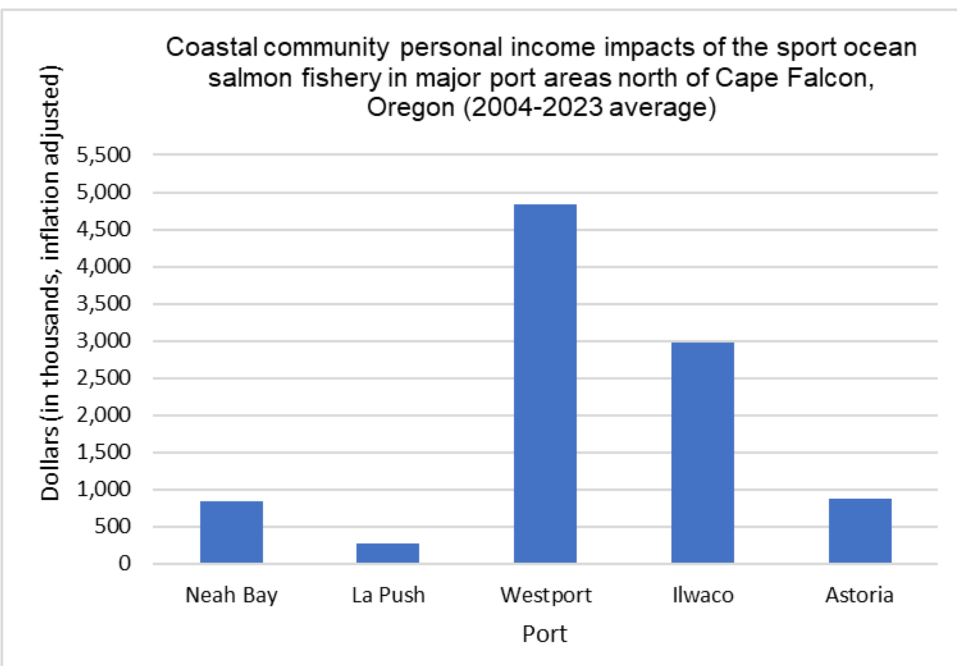

Figure C-2. Coastal community personal income impacts of the sport ocean salmon fishery in major port areas north of Cape Falcon, Oregon (2004-2023 average)

Management Strategy Alternatives

In the rebuilding plan analysis, two alternatives were provided for Council consideration: status quo (no action) and closure of the non-tribal ocean salmon fisheries in Council managed areas north of Cape Falcon (NOF), Oregon (action).

Alternative I:
Status Quo. During the rebuilding period, continue to use the current management framework and reference points, as defined in the Pacific Salmon Fishery Management Plan (FMP) and the Pacific Salmon Treaty (PST), to develop annual fishery regulations. This is considered a 'no-action' alternative. Under this scenario, the probability of achieving rebuilt status stabilizes at a maximum of approximately one percent in year-four. The rebuilding time, T_{target}, is projected to exceed the ideal T_{max} of 10 years (see Section 4.5).

Alternative II:
Suspend non-tribal NOF Council-area ocean salmon fisheries to minimize impacts within Council jurisdiction to the extent feasible on Queets sp/su Chinook until the stock meets the criteria for rebuilt status. Under this Alternative, the probabilities of achieving rebuilt status stabilize at a maximum of one percent for the low ER scenario and two percent for the high ER scenario. The rebuilding time, T_{target}, is projected to exceed the ideal T_{max} of 10 years (see Section 4.5).

Economic Impacts

The data provided in the following section is specific to the non-tribal Council-area ocean salmon fisheries north of Cape Falcon and focuses on salmon harvests in commercial (troll) and recreational or sport fisheries[3].

The data for the commercial fishery in Figure C-1 and Table C-1 are based on reported annual harvest by catch area combined with average Chinook and coho weights per fish caught and exvessel prices at ports of landing. If future average weights per fish or exvessel prices diverge significantly from what was observed in recent years, then projected income impacts reported in this document for the non-tribal commercial salmon fishery may prove to be correspondingly biased.

The data for the sport fishery in Figure C-2 and Table C-1 are based on reported angler trips (effort) and the estimated average dollars spent for both charter and private trips. Effort and economic impacts were then estimated by summing weighted average coho and Chinook angler success rates multiplied by projected coho and Chinook recreational catch. If future average angler success rates or trip expenditures diverge significantly from what was observed in recent years, then projected

[3] Salmon that remain unharvested in the ocean do not necessarily represent a total economic loss, as they may augment inside harvest or provide additional spawning escapement that contributes to ocean abundance in subsequent years. Restricting ocean harvests may increase opportunities for inside harvesters (e.g., higher commercial revenue or more angler trips) or contribute to higher inside catch per unit effort (CPUE) representing lower costs for commercial harvesters and/or higher success rates for recreational fishers. Salmon that remain unharvested by both ocean fisheries and inside fisheries may impact future production, although the magnitude and direction of this effect varies depending on the biology of the affected stocks, habitat, and environmental factors.

income impacts reported in this document for the recreational ocean salmon fishery may prove to be correspondingly biased.

Alternative I: Status quo management strategies would be employed consistent with the FMP, and regulations set annually resulting from the preseason salmon process. The sum of coastal community personal income impacts from port areas within the NOF area (Astoria, Ilwaco, Westport, La Push, and Neah Bay) were analyzed over the past 20 years (2004-2023), and were inflation adjusted based on 2023 prices. The results showed that the non-tribal commercial troll fishery averaged an estimated $3.8 million personal income impacts, ranging from $1.7 million to $6.8 million. During the same period, the sport fishery averaged an estimated $9.7 million in personal income impacts, ranging from $4.1 million to $16.1 million. It seems reasonable to assume that the average annual economic impact generated by these fisheries during the rebuilding period would fall within the range observed over the past 20 years given the trends in salmon abundance and environmental conditions, although it is also possible that values may fall outside the range.

During the rebuilding period, which is estimated to be at least ten years, Alternative I would result in no economic impact on port areas in the NOF region.

Alternative II: NOF non-tribal ocean fisheries would be suspended until the stock reached rebuilt status, which is projected to take longer than the ideal maximum rebuilding time (T_{max}) of ten years. While economic impacts across the individual port areas vary, all ports would be negatively impacted by a complete closure of the non-tribal commercial ocean troll salmon fishery and recreational ocean salmon fishery north of Cape Falcon. The impact of this alternative for the non-tribal commercial (troll) fishery is estimated at an annual reduction, on average, of at least $3.8 million. If the stock is rebuilt in ten years (which projections show would likely take longer than 10 years), then the sum of the economic impact during those ten years would be estimated at $38.0 million. The impact of Alternative II on the sport fishery is estimated to be an annual reduction, on average, of $9.6 million. If the stock is rebuilt in ten years (which projections show would likely take longer than 10 years), then the sum of the economic impact during those ten years would be estimated at $96.0 million. Of course, these estimates do not take into account how fishery participants may shift their effort onto other fisheries, which could result in lowering the negative impact of a closure of the NOF ocean salmon fishery. Additionally, with a suspension of harvest, future broods of salmon may increase in abundance, which may result in increased harvest opportunity in the future and thereby may help mitigate some of the estimated economic losses.

In summary, during the rebuilding period, which is estimated to be more than ten years, this Alternative could result in an economic (negative) impact to annual personal income of $3.8 million on the commercial troll fishery and $9.6 million on the sport fishery. Given the magnitude of the potential negative economic impact of Alternative II, it may not be a viable option when considering the impact to communities as described under NS1 of the MSA.

Social and Community Impacts
The effect of a proposed action on other indicators of community social welfare (e.g., poverty, divorce rates, graduation/dropout rates, incidents of domestic violence, etc.) cannot be directly measured. Change in personal income in communities may be used as a rough proxy for other

socioeconomic effects. However, changes in the broader regional economy ("cumulative effects") and long-term trends in fishery-related employment are more likely to drive these indicators of social wellbeing than the short-term economic effects of an action alternative.

To the extent practicable, social impacts are considered when tribal and non-tribal commercial and recreational salmon fishery seasons are shaped. Efforts are made to accommodate important cultural events such as Memorial Day, Independence Day, and Labor Day holidays as well as traditional fishing derby events. Commercial fisheries often include vessel limits per trip or per open period to stretch quota attainment over a longer period of time. Doing so can provide greater access for smaller vessels, increase safety at sea by limiting the incentive to fish in inclement weather, improve marketing opportunities, and extend the period during which consumers have access to fresh, wild caught salmon. That being said, closure of all commercial and recreational salmon fisheries could be expected to have significantly adverse social impacts on fishing communities and economically linked businesses in the affected areas.

Salmon are also an important part of tribal culture and have been since time immemorial. Salmon provide economic, cultural, ceremonial, and subsistence benefits to west coast tribal communities.

<u>Alternative I:</u> Under no-action, the salmon seasons would continue to be managed consistent with the FMP and other policy and regulatory guidelines. Social and community impacts from utilizing a status quo management strategy are expected to be within the range seen in previous years, which are typically based on salmon abundance and harvest opportunity. The estimated rebuilding time of at least ten years is not expected to result in a shift from the social and community impacts seen in previous years and analyzed in this document.

<u>Alternative II</u>: The action of suspending Council-area NOF non-tribal ocean salmon seasons until the stock is rebuilt would likely have pronounced impacts on salmon fishing communities in the NOF area. The NOF area includes port communities along the Washington coast and Astoria, Oregon with historical importance to salmon fishing. Reductions in salmon fishery opportunities in many of these ports could be financially detrimental and socially disruptive. Fishery participants could shift focus to other fishing opportunities or other income sources to maintain their livelihood, and it is uncertain if participants who leave the fishery would return once the stock is rebuilt and the fishery reopened. Small businesses directly or indirectly reliant on salmon fisheries may see reduced income because of the closure which could result in fewer employment opportunities and reduced business growth potential.

Environmental Justice

Environmental Justice (EJ) Populations: Executive Order 12898 and the Council for Environmental Quality (CEQ) guidance on Environmental Justice under NEPA identifies Environmental Justice (EJ) populations as low income, minority, or those relying on subsistence fishing or farming including Indian tribes. National Oceanic and Atmospheric Administration (NOAA) Fisheries has recently published their West Coast Equity and Environmental Justice (EEJ) Implementation Plan, which identifies tribal communities and minority fishing communities as potentially underserved, although this list may be updated over time. Additionally, there may be communities that are limited by access to information, geographic isolation, or low income which could also be considered EJ communities. Based on this information there are likely EJ communities within the action area.

Alternative I: Under no-action, the salmon seasons would continue to be managed consistent with the FMP and other policy and regulatory guidelines, and therefore this Alternative would not be expected to have a disproportionate effect on EJ communities.

Alternative II: The action of suspending Council-area NOF non-tribal ocean salmon seasons would likely have a negative impact on salmon fishing EJ communities in the NOF area. While Alternative II (action Alternative) could result in adverse economic effects through closure of the non-tribal ocean NOF salmon fisheries, the data cannot identify specific communities, e.g., by census block, which may be affected by reductions in commercial or recreational fishing. Commercial and recreational fishers that capture fish may reside in different geographic areas than where the fish is landed. In addition, based on available data, it is not possible to distinguish differences in impacts between EJ and reference populations. Economic models apply the overall harvest management framework and historical landings patterns to estimate effects of harvest reductions. Based on available data, further subdividing the projections to the county or sub-county level would simply result in a proportional distribution of effects among areas in that region. Therefore, if the study area includes EJ communities (based on low income or minority thresholds), it is not possible to determine whether the economic effects of this alternative result in a disproportionate effect on specific low-income or minority communities using available data.

Table C-1. Estimates of coastal community personal income impacts of the troll and recreational ocean salmon fishery for major port areas north of Cape Falcon, Oregon, in thousands of real (inflation adjusted, 2023) dollars.[a/]

Year or Avg.	Neah Bay	La Push	Westport	Ilwaco	Astoria	Coastal Community Total[c/]
			OCEAN TROLL[d/e/]			
2004	1,129	356	1,403	137	1,178	4,203
2005	926	553	1,424	176	977	4,056
2006	689	558	536	359	1,277	3,420
2007	304	309	1,263	157	377	2,409
2008	198	262	750	200	537	1,948
2009	404	416	1,453	101	220	2,593
2010	306	491	4,682	116	1,184	6,778
2011	701	278	1,715	117	298	3,108
2012	1,035	602	1,716	274	857	4,484
2013	591	546	3,261	91	432	4,921
2014	471	544	1,866	1,354	2,247	6,482
2015	344	700	3,443	479	1,194	6,159
2016	225	224	1,639	259	319	2,666
2017	625	195	3,647	91	401	4,959
2018	489	513	2,602	25	65	3,694
2019	1,021	460	1,199	53	58	2,792
2020[f/]	-	154	1,419	112	32	1,717
2021[g/]	312	93	2,621	67	92	3,185
2022	220	150	2,218	101	246	2,935
2023	189	169	3,060	347	252	4,017
2004-2023 ave.	**536**	**379**	**2,096**	**231**	**612**	**3,826**
			RECREATIONAL			
	Neah Bay	La Push	Westport	Ilwaco[b/]	Astoria	**NOF Total**
2004	1,444	306	6,269	4,109	1,354	13,482
2005	990	310	5,722	3,327	982	11,331
2006	649	272	4,225	2,587	705	8,438
2007	662	211	4,335	3,381	990	9,579
2008	287	127	2,851	1,204	284	4,754
2009	773	339	5,440	3,723	997	11,272
2010	775	341	6,408	3,404	1,025	11,952
2011	758	371	5,236	3,033	780	10,177
2012	946	352	5,917	2,863	597	10,676
2013	1,093	377	5,750	2,995	694	10,909
2014	1,197	499	8,404	4,708	1,284	16,093
2015	1,065	345	7,294	3,793	931	13,428
2016	-	117	2,775	2,592	386	5,870
2017	771	183	3,974	2,432	751	8,112
2018	643	201	3,457	1,933	659	6,893
2019	746	241	3,826	3,443	1,264	9,520
2020[h/]	-	-	2,722	1,072	279	4,072
2021[h/]	-	158	3,878	2,827	1,046	7,909
2022	613	234	4,289	3,637	1,356	10,128
2023	955	258	4,004	2,430	1,259	8,905
2004-2023 ave.	**845**	**276**	**4,839**	**2,975**	**881**	**9,675**

a/ Estimates of income impacts are provided from output of the Fishery Economic Assessment Model (FEAM) and IOPAC. These are the income impacts associated with expenditures in the troll and/or recreational sectors. There is no differentiation between money that may be new to the area versus money that may otherwise have been expended in other sectors. Values from 2001 through 2009 are based on a run of the FEAM using 2000 PacFIN landings and 1998 IMPLAN data. Beginning with the 2010 data year, income impact estimates are based on the NWFSC's IOPAC model, which uses updated IMPLAN and landings data, and survey-based industry cost data. A description of the transition from FEAM-based to IOPAC-based impact multipliers and comparisons of results from the two models are found in Appendix E of the Review of 2014 Ocean Salmon Fisheries: https://www.pcouncil.org/documents/2015/02/review-of-2014-ocean-salmon-fisheries.pdf/

b/ For the Ilwaco port area, recreational values exclude recreational shorebased effort from the Columbia River north jetty.

c/ Total personal income impacts on coastal areas. Totals do not include impacts of one coastal area on another.

d/ Excluding pink salmon.

e/ All commercial values in this table are based on preliminary information available at the start of each year's Review of Ocean Salmon Fisheries.

f/ The port of Neah Bay was closed to public access and the port of La Push was restricted to local access only in 2020 due to the COVID-19 pandemic. Vessels were allowed to land in the Puget Sound ports of Sekiu and Port Angeles by emergency rule. Totals include revenue from ocean troll-caught landings (36,000 pounds of Chinook, 800 pounds of coho) in Puget Sound ports authorized by emergency rule

g/ The port of Neah Bay was partially closed and restricted to limited local access only in 2021 due to the COVID-19 pandemic. Vessels were allowed to land in the Puget Sound ports of Sekiu and Port Angeles by emergency rule. Totals include revenue from ocean troll-caught landings (9,100 pounds of Chinook, 1,300 pounds of coho) in Puget Sound ports authorized by emergency rule.

h/ Neah Bay and La Push were closed to public access in 2020 and Neah Bay again in 2021 due to the COVID-19 pandemic. 2020 Values for Washington include catch and effort from 7,016 ocean salmon angler trips (276 charter and 6,740 private) from Sekiu. 2021 Values for Washington include catch and effort from 10,899 ocean salmon angler trips (345 charter and 10,554 private) from Sekiu.