Agenda Item D.2
Attachment 4 **(Electronic Only)**
November 2018

QUEETS RIVER NATURAL COHO

DRAFT 6_OCTOBER 2018

SALMON REBUILDING PLAN, ENVIRONMENTAL ASSESSMENT, MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT ANALYSIS, REGULATORY IMPACT REVIEW, AND INITIAL REGULATORY FLEXIBILITY ANALYSIS

REGULATORY IDENTIFIER NUMBER 0648-BI04

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LIST OF ACRONYMS AND ABBREVIATIONS

ABC	acceptable biological catch
ACL	annual catch limit
BY	brood year
CDFW	California Department of Fish and Wildlife
CoTC	Coho Technical Committee (of the PSC)
Council	Pacific Fishery Management Council
CWT	coded-wire tag
EA	Environmental Assessment
EEZ	exclusive economic zone (from 3-200 miles from shore)
EIS	Environmental Impact Statement
ESA	Endangered Species Act
ESU	evolutionarily significant unit
F_{ABC}	exploitation rate associated with ABC
F_{ACL}	exploitation rate associated with ACL (= F_{ABC})
FMP	fishery management plan
F_{MSY}	maximum sustainable yield exploitation rate
F_{OFL}	exploitation rate associated with the overfishing limit (= F_{MSY}, MFMT)
FONSI	Finding of No Significant Impacts
FRAM	Fishery Regulatory Assessment Model
GAM	generalized additive models
ISBM	individual stock-based management
KMZ	Klamath management zone (ocean zone between Humbug Mountain and Horse Mountain)
KOHM	Klamath Ocean Harvest Model
KRFC	Klamath River fall Chinook
MFMT	maximum fishing mortality threshold
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MSM	mixed stock model
MSST	minimum stock size threshold
MSY	maximum sustainable yield
NA	not available
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NPGO	North Pacific Gyre Oscillation
NS1G	National Standard 1 Guidelines
ODFW	Oregon Department of Fish and Wildlife
OFL	overfishing limit
OY	Optimum Yield
PDO	Pacific Decadal Oscillation
PFMC	Pacific Fishery Management Council (Council)
PSC	Pacific Salmon Commission
PST	Pacific Salmon Treaty
RER	rebuilding exploitation rate
S_{ABC}	spawning escapement associated with ABC
S_{ACL}	spawning escapement associated with ACL (= S_{ABC})
SHM	Sacramento Harvest Model
SI	Sacramento Index
S_{MSY}	MSY spawning escapement
S_{OFL}	spawning escapement associated with the overfishing limit (= S_{MSY})

LIST OF ACRONYMS AND ABBREVIATIONS *(continued)*

SRFC	Sacramento River fall Chinook
SRWC	Sacramento River winter Chinook
STT	Salmon Technical Team (formerly the Salmon Plan Development Team)
VSI	visual stock identification
WDFW	Washington Department of Fish and Wildlife
QIN	Quinault Indian Nation

1.0 EXECUTIVE SUMMARY

To be developed for final Rebuilding Plan.

2.0 INTRODUCTION

In 2018, Queets River natural coho salmon (Queets coho) met the criteria for overfished status as defined in section 3.1 of the Pacific Coast Salmon Fishery Management Plan (FMP; PFMC 2016). In response, the Pacific Fishery Management Council (Council) directed the Salmon Technical Team (STT) to propose a rebuilding plan for Council consideration within one year. The FMP, and the Magnuson-Stevens Fishery Conservation and Management Act (MSA), requires that a rebuilding plan must be developed and implemented within two years of the formal notification from National Marine Fisheries Service (NMFS) to the Council of the overfished status. 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 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 coho, the number of adult spawners expected to produce maximum sustainable yield (MSY) is defined as 5,800 natural-area adult spawners, also known as S_{MSY}. The MSST for Queets coho is defined as 4,350 natural-area adult spawners, with MSST = 0.75 x S_{MSY}. The geometric mean of Queets coho natural-area adult spawners over years 2014-2016 was 4,291, and thus in 2018 the stock met the criteria for overfished status. Figure 2.0.a displays the time series of Queets River coho 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 on a stock exceeds the maximum fishing mortality threshold (MFMT), which for Queets coho is defined as the MSY fishing mortality rate (F_{MSY}) of 0.65. It is possible that this situation 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 coho stock, the physical setting of the Queets river watershed, 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.

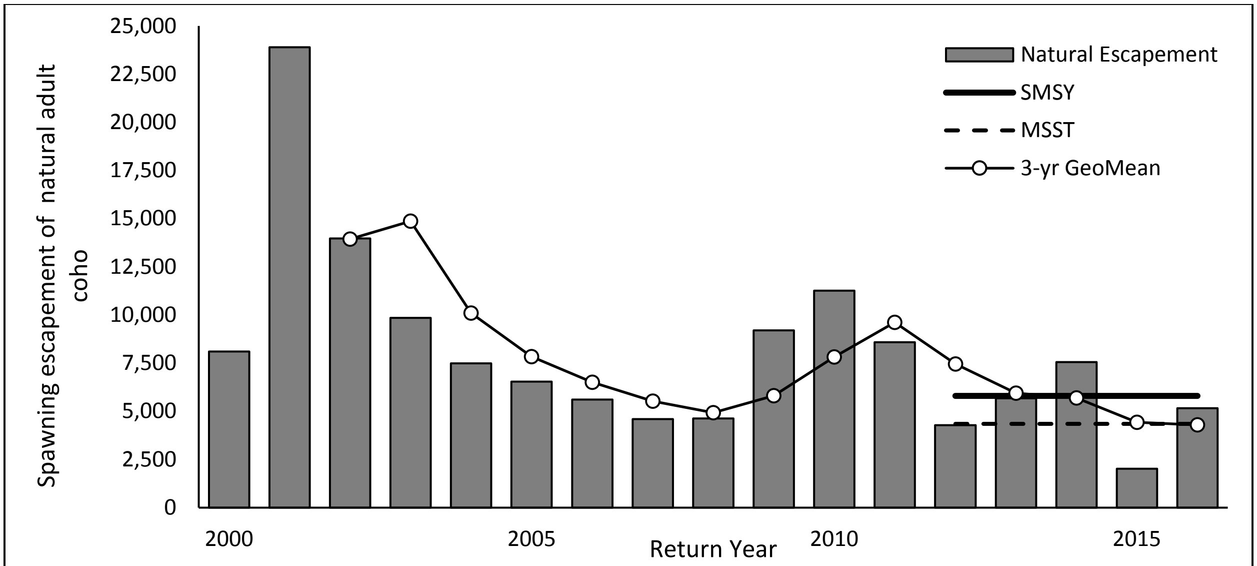

Figure 2.0.a. Spawning escapement of adult natural Queets coho

2.1 2.1 National Environmental Policy Act

In addition to addressing the requirements of the FMP and MSA, this rebuilding plan document integrates the environmental assessment required under the National Environmental Policy Act (NEPA).

2.1.1 Proposed Action

The Proposed Action is for the Council to adopt and NMFS to approve a rebuilding plan for the Queets coho salmon stock, which has been determined by NMFS to be overfished under the MSA. The rebuilding plan must be consistent with the MSA and the provisions of the FMP; therefore, the plan shall include a control rule and a specified rebuilding period. The specified rebuilding period shall be as short as possible, taking into consideration the needs of the commercial, recreational and tribal fishing interests and coastal communities.

2.1.2 Purpose and Need

The purpose of the proposed action is to develop and implement a harvest control rule that will be applied to setting annual ocean salmon fishery management measures that impact Queets coho. This harvest control rule will be designed to attain a three-year geometric mean spawning escapement that meets the SMSY specified for that stock in the FMP in the least amount of time possible while taking into account the biology of the stock, international agreements, and the needs of fishing communities, but not to exceed 10 years. The need for the proposed action is to rebuild Queets coho, which the National Marine Fisheries Service determined, in 2018, to be overfished under the MSA.

2.2 Stock overview

The Pacific Salmon Treaty (PST), between the governments of the United States of America and Canada, calls for the conservation and rational management of Pacific salmon stocks shared by both countries (PSC 2009). Under the treaty, the joint Coho Technical Committee (CoTC) was formed to aid in the internationally coordinated abundance-based management of coho salmon

(*Oncorhynchus kisutch*). The PST named Queets River as one of thirteen key management units (MU) of naturally spawning coho stocks.

Coho salmon mature and migrate to freshwater in the fall and spawn in the late fall and early winter. Fry emerging from the gravel in the following spring and migrate to the saltwater as yearling smolts in the spring of their second year of life. A small fraction of the males mature as and spawn as 2-year-old "jacks" the following year, but the majority spend another year in the ocean and mature and spawn three years following their brood year.

The number of adult spawners returning in years 2014, 2015, and 2016 led to the geometric mean of Queets coho natural-area adult spawners to fall below the MSST. These return years correspond with brood years 2011, 2012, and 2013.

Natural coho production in the Queets River system has been extensively studied since the 1970s. Research indicates that the dynamics of coho populations in the Queets River are quite complex; the dependence of the species upon different habitat types during different life history stages makes the stock susceptible to a variety of factors that affect environmental conditions at certain times of the year.

The capacity of various tributaries of the Queets River to support coho populations varies depending upon their positions within the watershed and geomorphologies that result in different types of habitat. Naturally-produced coho are dependent on a variety of habitat types within the Queets River Basin: (1) lower mainstem, (2) low gradient tributaries, (3) off-channel ponds, (4) upper mainstem, and (5) high gradient tributaries (Lestelle et. al. 1993). Utilization of these habitat types varies, depending upon life history stage. Low and high gradient tributaries and the upper mainstem are the primary spawning areas, although some spawning also occurs in the lower mainstem and the outlet channels of off-channel rearing habitats. The lower mainstem and lower gradient tributaries are the primary areas used for summer rearing with other habitat types occupied to a lesser degree. Lower gradient tributaries and off-channel ponds are most heavily utilized during the overwintering period, while juvenile coho rarely occupy upper mainstem and high gradient tributaries during this life history stage (STT 2001).

2.2.1 Stock composition

There are three components to the run: (1) natural, (2) supplemental, and (3) hatchery.

Located on a tributary to the Queets River and operated by the Quinault Tribe, the Salmon River Hatchery is the primary adult coho broodstock collection, incubation, and juvenile rearing program in the MU (Haymes 2008). Coho juveniles reared at the hatchery were also periodically coded wire tagged (CWT) and released at several other locations in the basin as part of a long-term natural production enhancement program using juveniles produced from wild origin adult coho collected with wild broodstock capture programs (CoTC draft report 2012, unpublished data)

2.2.2 Location and geography

The Queets River MU encompasses the Queets River Basin. 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 (Figure 2.2.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. This western Washington river system is 82.7 km long and drains a watershed of 1,152 square km.

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 (DNR) and private timber companies. The Salmon River is contained almost entirely within the boundaries of the Quinault Indian Reservation. In addition, Sams River and Matheny Creek run mostly through land managed by the United States Forest Service (USFS). Lands on and off the Quinault Indian Reservation are subject to various logging practices, both contemporary and historical (STT 2001).

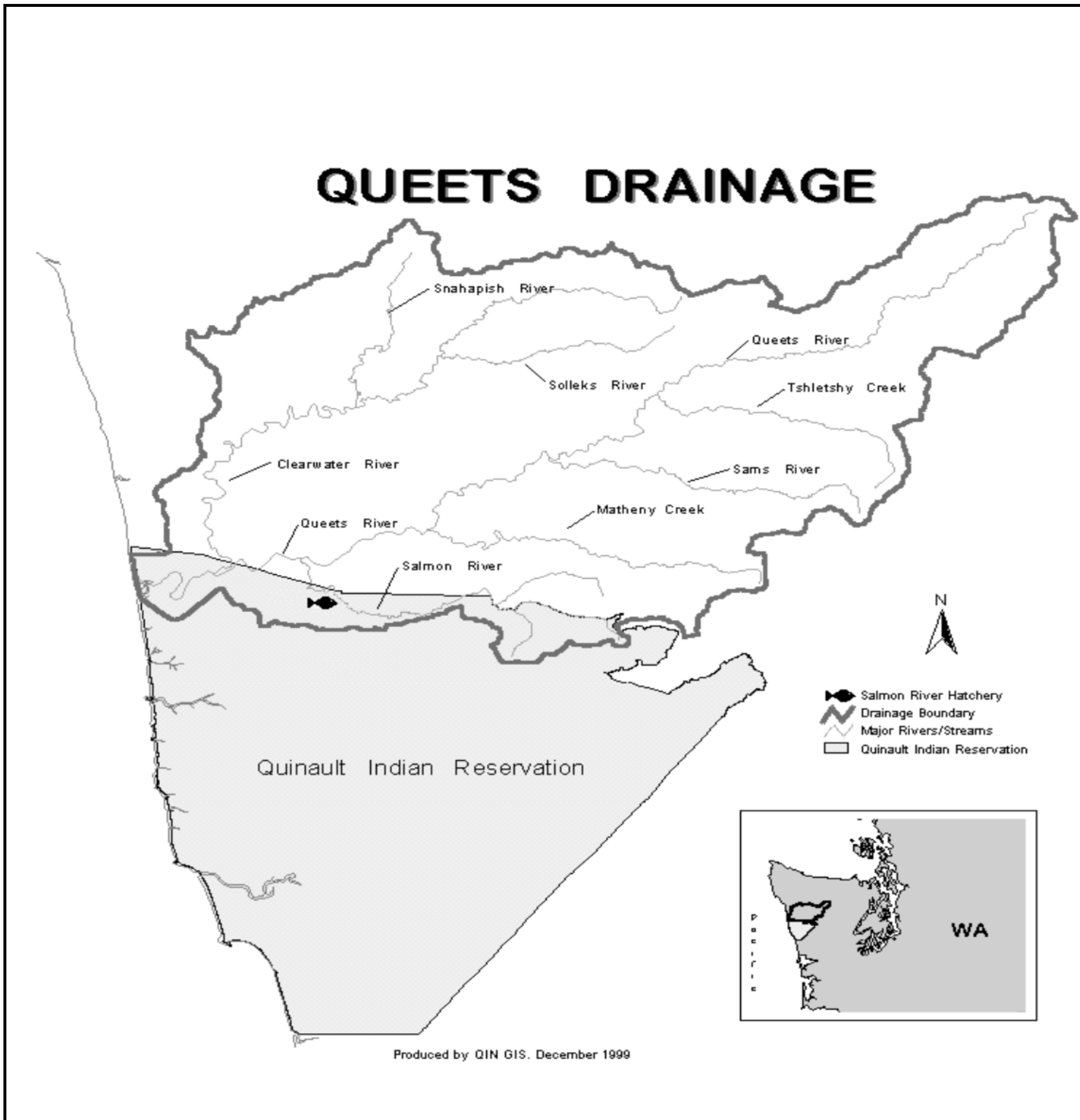

Figure 2.2.a Location of the Queets River Basin

2.3 Management Overview

Queets River coho are one of four coastal coho MU's included in the coho chapter of the PST. Under the PST, coastal coho MU's are managed under an abundance-based management regime. Each year, the MU's are classified as "low" abundance, "moderate" abundance, or "abundant" based on the forecast ocean abundance of age-3 fish. Washington coastal coho stocks are managed for an escapement goal (or range), and the abundance category is determined by the maximum allowable exploitation rate that would meet the escapement goal given the current year's abundance (CoTC, 2013). The abundance category of Washington coast coho MU's is used to determine the maximum allowable total exploitation rate in ocean fisheries from Southeast Alaska, British Columbia and Washington, and in-river fisheries (Table 2.3.a).

Table 2.3.a. Pacific Salmon Treaty-defined total exploitation rate ceilings by PSC status categories.

Queets River natural coho		
Status (PSC/Council)	Ocean Age-3 Abundance Reference Point	Total Exploitation Rate
Low	< 7,250	Up to 20%
Moderate	7,250 - 9,667	21% – 40%
Abundant	> 9,667	41% – 65%

2.3.1 Conservation objectives

The Queets River coho MU is managed together with other Washington coastal coho populations, which include all natural and hatchery stocks originating in Washington coastal streams north of the Columbia River to the western Strait of Juan de Fuca. Management goals for Washington coastal coho stocks include achieving natural spawning escapement objectives and treaty allocation requirements.

The Council's conservation objectives for stocks managed for natural production were based on MSY spawner escapements established pursuant to the U.S. District Court order in *Hoh v Baldrige*. The conservation objectives for the Queets, Hoh, and Quillayute Rivers were developed as ranges intended to bracket estimates of MSY escapement. The range reflects inherent uncertainty by using the high estimate of recruits-per-spawner and the low estimate of carrying capacity for the lower bound, and the low estimate of recruits-per-spawner and the high estimate of smolt carrying capacity for the upper end of the range. The ranges were further adjusted upward by 26-184 percent for risk aversion and habitat considerations. For Queets River Natural coho, the escapement goal range is 5,800 – 14,500 natural adult spawners. However, annual natural spawning escapement targets may vary from the FMP conservation objectives if agreed to by Washington Department of Fish and Wildlife (WDFW) and the treaty tribes under the provisions of *Hoh v Baldrige* and subsequent U.S. District Court orders. After an annual agreement is reached, ocean fishery escapement objectives are established for each river, or region of origin. The agreement includes provisions for treaty allocation requirements and non-ocean fisheries. Agreements on annual spawning targets for Washington coastal coho other than those in the FMP are not made every year (Draft CoTC report 2012, unpublished data).

2.3.2 Management strategy

The Queets River coho stock is managed as a unit under the determinations of the U.S. District Court in *U.S. v. Washington*, and *Hoh Indian Tribe v. Baldrige*. Each year the abundance of the Queets River coho MU is forecast and the abundance category is determined. The fishery impacts of different management alternatives are modeled during the preseason planning process using the Fishery Regulation Assessment Model (FRAM), which contains a specific model stock for Queets coho called Queets River Fall Natural with separate marked and unmarked components. Management measures adopted by the Council are consistent with the conservation objectives of the FMP or annual natural spawning escapement targets agreed to by WDFW and the treaty tribes (see section above).

3.0 REVIEW OF POTENTIAL FACTORS LEADING TO OVERFISHED STATUS

3.1 Freshwater survival

3.1.1 Review of freshwater conditions

Adult and juvenile coho salmon of the 2011, 2012, 2013 and 2014 brood years were present in the Queets River Basin from the fall of 2011 through the spring of 2016. Brood years 2011-2013 are of particular interest since those are the brood years that produced the three years of adult returns (2014-2016) that led to the overfished status.

River flows (USGS gage 12040500; Queets River Near Clearwater, WA) during this period followed normal patterns with a majority of the annual discharge occurring in October through March, and the lowest flows occurring in August through September of each year. However, some extremes during this period may have affected overall survival and limited smolt production, especially from the 2013 and 2014 brood year. Water temperatures in the Queets River during the summer rearing months in 2014 and 2015 also reached levels that may have reduced overall survival (Quinault Division of Natural Resources, unpublished data). Prolonged periods of low flows and high water temperatures likely limited suitable cold water refugia, altered feeding behavior and increased juvenile coho susceptibility to disease and stress-induced mortality.

Parent spawners, eggs, alevin and emergent fry of the 2011 brood year experienced moderate flows in the fall and winter of 2011/2012 (Figure 3.1.1.a). Flows remained moderate, above 50-percentile levels, through the summer months and reached low flow conditions near the 5-percentile levels for only a brief period in late September and early October 2012. Fry and pre-smolt juveniles experienced moderate flows through the fall and winter of 2012/2013. Flow conditions for freshwater residence of 2011 brood year juveniles were generally moderate and presumably favorable except for the brief low flow period in late summer of 2012. Water temperatures during the summer were moderate with only 17 days exceeding 16 degrees Celsius and zero days exceeding 20 degrees (Figure 3.1.1.f). An estimated productivity of 32.7 smolts/spawner for the freshwater stage is in the upper range for similar escapement levels and suggests relatively good freshwater survival for the 2011 brood year (Figure 3.1.1.b).

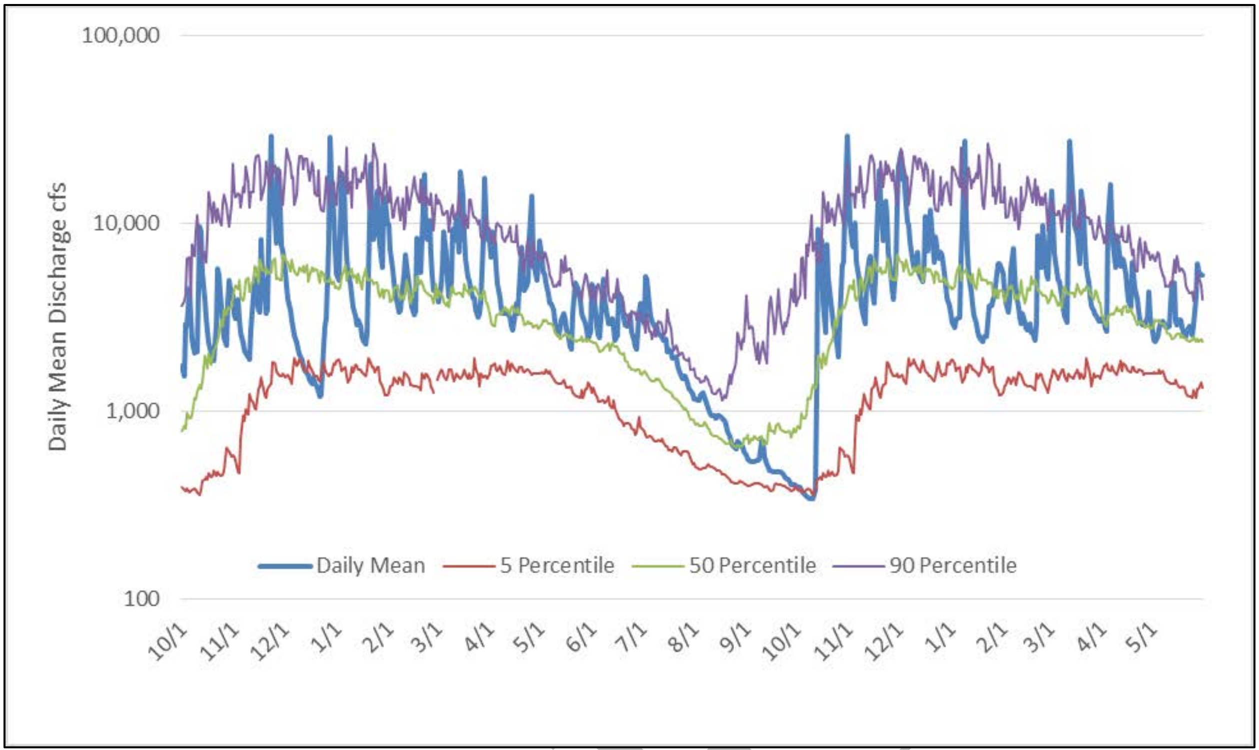

Figure 3.1.1.a: Daily mean discharge measurements for the Queets River for October 2011 through May 2013. Values for the 5, 50 and 90 percentile flow levels derived from approximately 63 years of record are also shown. For example, the 5-percentile flow is the level at which 5 percent of flows are equal to or less than the estimated value.

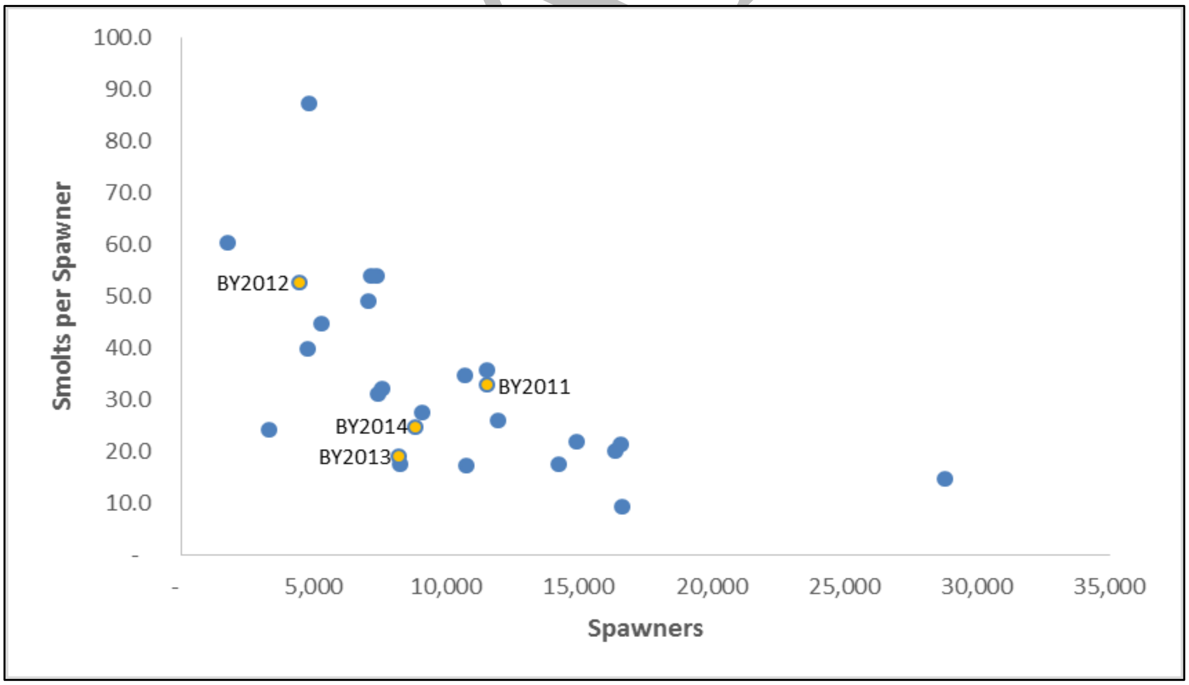

Figure 3.1.1.b Coho smolts-per-spawner as a function of natural spawning escapement of Queets River coho salmon for brood years 1989 through 2014. Note: the estimates of spawning escapement include all natural spawners including hatchery origin returning fish. The brood years 2011-2014 are highlighted in orange.

The 2012 brood year fish experienced moderate flows, infrequently exceeding 90-percentile levels, through the fall and winter of 2012/2013 (Figure 3.1.1.c). These fish experienced good flows, generally around the 50-percentile level, through the summer of 2013 and then relatively low flows during the fall and early winter of 2013/2014. Flows returned to moderate in the late winter through spring of 2014. Flow conditions for freshwater residence of the 2012 brood year juveniles were generally moderate. Water temperatures during the summer rearing months were higher than the previous year with 62 days exceeding 16 degrees Celsius, but there were still zero days that exceeded 20 degrees (Figure 3.1.1.f). Brood year 2012 experienced a relatively good productivity of 52.6 smolts/spawner, which is well within the range of productivity for similar spawning escapements (Figure 3.1.1.b).

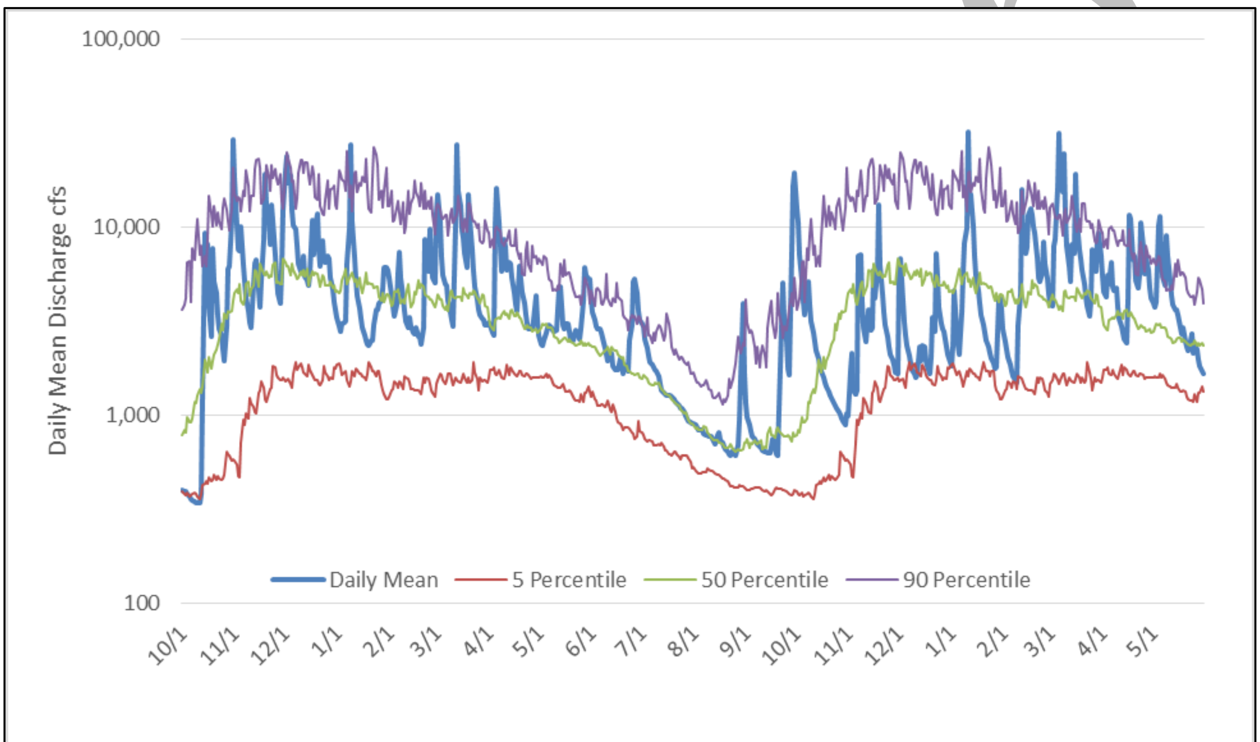

Figure 3.1.1.c: Daily mean discharge measurements for the Queets River for October 2012 through May 2014. Values for the 5, 50 and 90 percentile flow levels derived from approximately 63 years of record are also shown. For example, the 5-percentile flow is the level at which 5 percent of flows are equal to or less than the estimated value.

For brood year 2013, flows were relatively low, generally less than 50-percentile levels, during the parent-spawning phase (Figure 3.1.1.d). These low flows could limit access to stable, peripheral locations and expose redds to greater risk of loss from scour during subsequent high flow events. Flows did increase to generally greater than the 50-percentile levels during late winter and spring of 2014. Summer flows were very low in 2014, falling to near the 5-percentile level in August and September. Flows in the fall and winter of 2014/2015 were moderate to high with several flood events exceeding 90-percentile levels. Flow conditions for freshwater residence of the 2013 brood year juveniles were more challenging than those for the 2011 and 2012 brood years. The relatively low flows during spawning, extreme low flows during summer and the frequent floods during the overwintering period may have reduced survival. Water temperatures during the summer rearing period exceeded 16 degrees Celsius for 68 days and extreme temperatures exceeding 20 degrees Celsius were observed for 20 days (figure 3.1.1.f). This is reflected in the poor productivity of 18.9 smolts/spawner, which is low productivity for spawning escapements of similar magnitude (Figure 3.1.1.b).

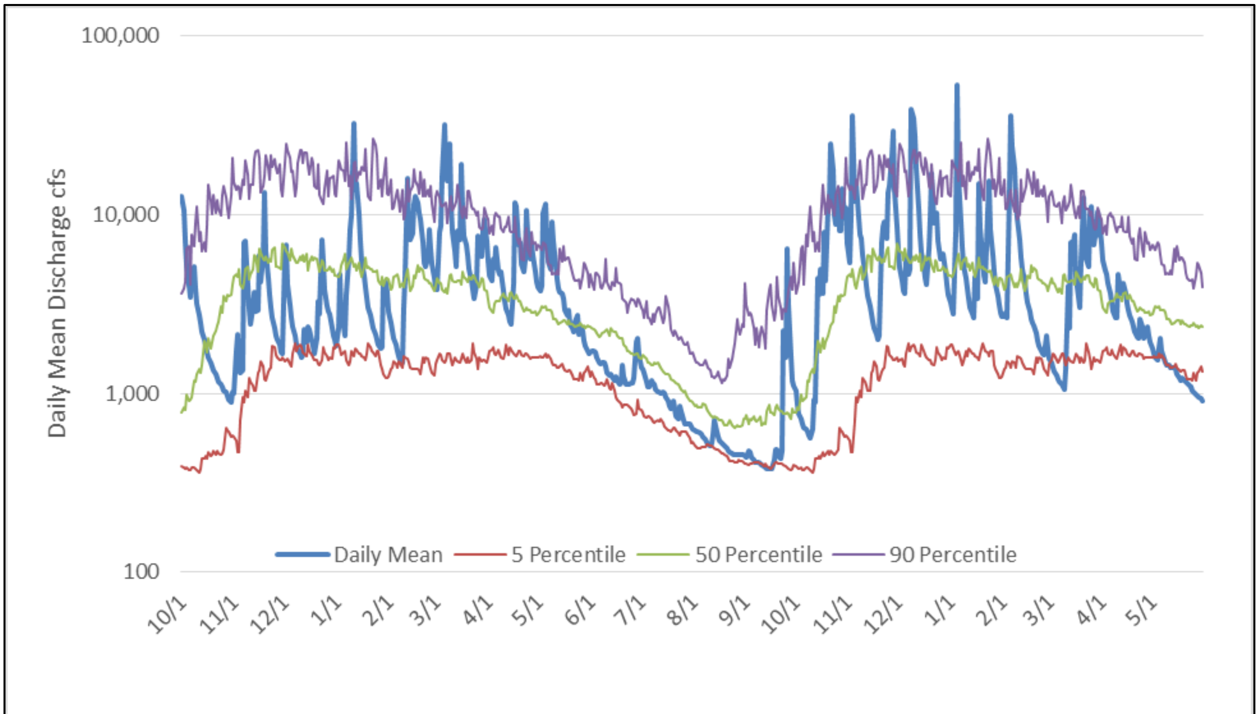

Figure 3.1.1.d: Daily mean discharge measurements for the Queets River for October 2013 through May 2015. Values for the 5, 50 and 90 percentile flow levels derived from approximately 63 years of record are also shown. For example, the 5-percentile flow is the level at which 5 percent of flows are equal to or less than the estimated value.

The 2014 brood year is outside the production years (brood years 2011-2013) that led to the current overfished condition. However, juveniles from the 2014 brood year are included in this section because the relatively poor conditions and low freshwater survival help illustrate the relationships described for the focus brood years. Flows during the brood year 2014 parent spawning period were moderate to high with some flood events greater than 90-percentile levels (Figure 3.1.1.e). Flows at these levels have potentially positive (e.g. habitat access, greater distribution) and negative (redd scour) effects for egg and alevin survival. A period of extreme low flows occurred in mid-March of 2015 that could have caused some losses due to redd dewatering. Summer flows in 2015 were extremely low, falling below 5-percentile levels from mid-May to late August. Fall 2015 and winter 2016 flows were moderate to high with several flood events greater than the 90-percentile level. Flow conditions during the freshwater residency of 2014 brood year juveniles were again more challenging than those for the 2012 brood year. Summer water temperatures in 2015 were extremely high exceeding 16 degrees Celsius for 73 days and exceeding 20 degrees for 63 days. Peak summer water temperatures occurred approximately a month earlier than normal in the first week of July. The relatively poor productivity of 24.7 smolts/spawner supports this inference (Figure 3.1.1.b).

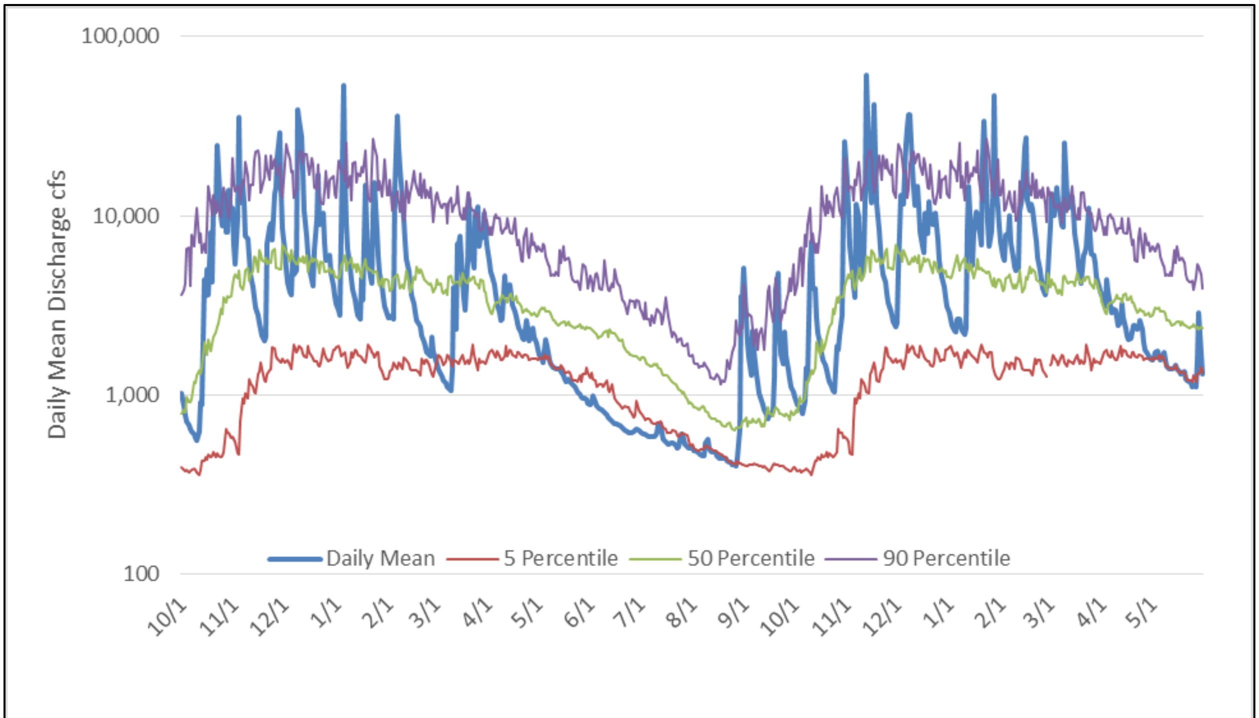

Figure 3.1.1.e: Daily mean discharge measurements for the Queets River for October 2014 through May 2016. Values for the 5, 50 and 90 percentile flow levels derived from approximately 63 years of record are also shown. For example, the 5-percentile flow is the level at which 5 percent of flows are equal to or less than the estimated value.

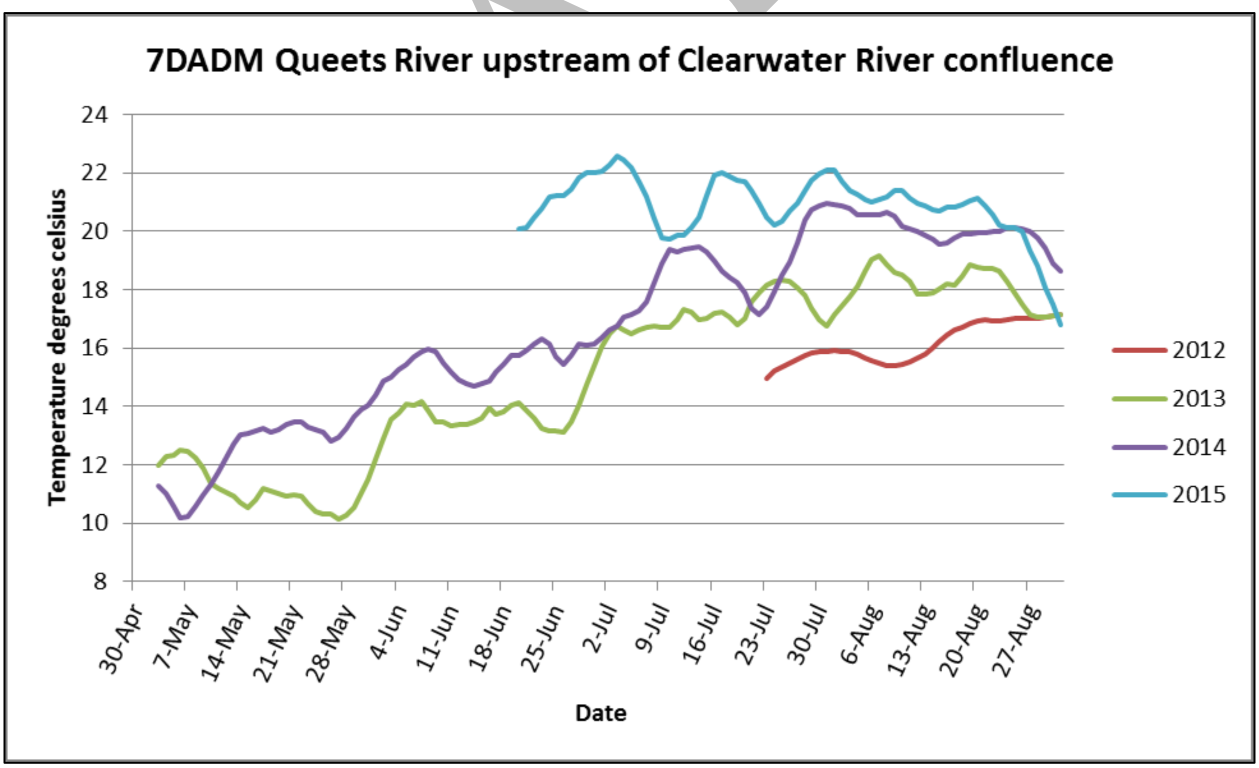

Figure 3.1.1.f: Seven Day Average Daily Maximum Water Temperatures (Degrees Celsius) measured from 4/30-8/31 for years 2012-2015.

3.1.2 Juvenile Production Estimates

Coho salmon in Washington, Oregon, and California enter the ocean as yearling smolts, and contribute to fisheries and spawning escapement as 3-year-olds the following calendar year. Year classes contributing to the spawning escapements in 2014-2016 were from brood years 2011-2013, and migrated to sea as smolts in 2013, 2014, and 2015 (Figure 3.1.2.a).

Since 1991, juvenile production has averaged 275,400 smolts per emigration year through 2016. More recently (2004-2016), smolt production averaged 297,300, ranging from 155,900 to 420,500. During the immigration years 2013-2015, which produced the returns in years 2014-2016, smolt production averaged 256,800, ranging from 155,900 (2015) to 379,100 (2013). Smolt production estimates in 2016 and 2017 were both below average.

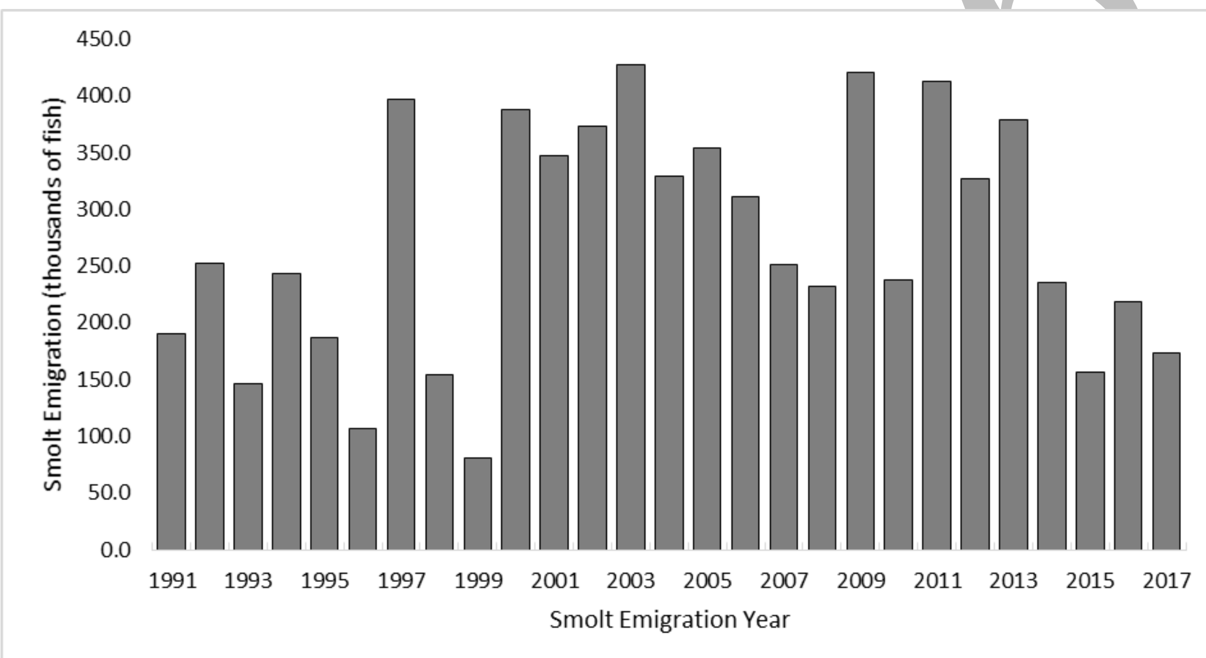

Figure 3.1.2.a. Natural smolt production of Queets River coho salmon by smolt year (data from QIN).

3.2 Marine Survival

3.2.1 Review of Ocean Conditions

Ecosystem indicators associated with early marine survival of Chinook and coho salmon are displayed in Figure 3.2.1.a (Peterson et al 2017). These indicators were selected based primarily on correlations with survival of Columbia River stocks, but are generally indicative of coast-wide marine conditions. Indicators related to the early marine survival of coho are generally related to adult coho abundance in the following year; so, early marine survival rates from 2013-2015 are associated with adult returns in 2014-2016. The mean ranks of indicators were generally neutral, but declined in 2013 and 2014 and have been negative since then. One noteworthy indicator is the catches of juvenile coho in the September surveys. These were highly correlated with coho returns in the following year, but the September surveys were discontinued in 2013, and are thus omitted from the mean ranks.

Ecosystem Indicators	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
	Year																		
PDO (Sum Dec-March)	16	6	3	12	7	18	11	15	13	9	5	1	14	4	2	8	10	19	17
PDO (Sum May-Sept)	10	4	6	5	11	15	14	16	12	13	2	9	7	3	1	8	17	19	18
ONI (Average Jan-June)	18	1	1	6	12	14	13	15	8	11	3	10	16	4	5	7	9	17	19
46050 SST (°C; May-Sept)	15	8	3	4	1	7	19	14	5	16	2	9	6	10	11	12	13	18	17
Upper 20 m T (°C; Nov-Mar)	18	11	8	10	6	14	15	12	13	5	1	9	16	4	3	7	2	19	17
Upper 20 m T (°C; May-Sept)	15	11	13	4	1	3	19	17	7	8	2	5	12	10	6	16	18	9	14
Deep temperature (°C; May-Sept)	19	6	8	4	1	10	12	16	11	5	2	7	14	9	3	15	18	17	13
Deep salinity (May-Sept)	18	3	8	4	5	15	16	9	6	1	2	13	17	12	11	10	19	14	7
Copepod richness anom. (no. species; May-Sept)	17	2	1	7	6	13	12	16	14	10	8	9	15	4	5	3	11	18	19
N. copepod biomass anom. (mg C m^{-3}; May-Sept)	17	13	9	10	3	15	12	18	14	11	6	8	7	1	2	4	5	16	19
S. copepod biomass anom. (mg C m^{-3}; May-Sept)	19	2	5	4	3	13	14	18	12	10	1	7	15	9	8	6	11	16	17
Biological transition (day of year)	17	11	6	7	8	12	10	16	15	3	1	2	14	4	9	5	13	19	19
Ichthyoplankton biomass (log(mg C 1000 m^{-3}); Jan-Mar)	19	10	2	6	8	17	16	12	15	14	1	11	3	13	9	7	18	4	5
Ichthyoplankton community index (PCO axis 1 scores; Jan-Mar)	9	13	1	6	4	10	18	16	3	12	2	14	15	11	5	7	8	17	19
Chinook salmon juvenile catches (no. km^{-1}; June)	18	4	5	16	10	13	17	19	12	8	1	6	7	15	3	2	9	14	11
Coho salmon juvenile catches (no. km^{-1}; June)	18	7	12	5	6	2	15	19	16	3	4	9	10	14	17	1	11	8	13
Mean of ranks	16.4	7.0	5.7	6.9	5.8	11.9	14.6	15.5	11.0	8.7	2.7	8.1	11.8	7.9	6.3	7.4	12.0	15.3	15.3
Rank of the mean rank	19	6	2	5	3	13	15	18	11	10	1	9	12	8	4	7	14	16	16
Ecosystem Indicators not included in the mean of ranks or statistical analyses																			
Physical Spring Trans. UI based (day of year)	3	7	18	15	4	12	14	19	12	1	6	2	8	11	16	9	17	10	5
Physical Spring Trans. Hydrographic (day of year)	18	3	13	8	5	12	14	19	6	9	1	9	17	3	11	2	15	7	16
Upwelling Anomaly (April-May)	9	3	16	5	8	13	12	19	9	4	6	7	14	16	14	11	18	1	2
Length of Upwelling Season UI based (days)	6	2	17	11	1	12	9	19	5	3	8	3	14	16	14	13	18	10	7
SST NH-5 (°C; May-Sept)	8	6	5	4	1	3	19	15	9	17	2	18	10	7	13	12	14	11	16
Copepod Community Index (MDS axis 1 scores)	18	5	4	8	1	13	14	16	15	10	2	6	12	9	7	3	11	17	19
Coho Juv Catches (no. fish km^{-1}; Sept)	11	2	1	4	3	6	12	14	8	9	7	15	13	5	10	NA	NA	NA	NA

Figure 3.2.1.a. Summary of marine indicators from 1998-2017 (Peterson et al 2017a). The top block is basin-wide climate indices, the second block is specific physical oceanographic indicators, and the third block is biological indicators. Numbers inside each block are rank value of that indicator across all years with one being the best and 20 the worst. It is color-coded to reflect ocean conditions for salmon growth and survival; Color coding is green for values in the lower 1/3, yellow for values in the middle 1/3, and red for values in the highest 1/3. The bottom block is indicators not included in the mean ranks.

In 2013, there were mixed ocean conditions. Climate indicators, such as the Pacific Decadal Oscillation (PDO) and El Niño, were 'neutral'; sea surface temperatures were warmer than usual, and the majority of the upwelling occurred over a short period of time (i.e., July) with the upwelling 'season' ultimately ending much earlier than usual. Biological indicators pointed to good ocean conditions, with a high abundance of large, lipid-rich zooplankton; a moderate abundance of winter fish larvae that develop into salmon prey in the spring; and catches of juvenile spring Chinook salmon during the June survey off Washington and Oregon that were the second highest in 16 years. Overall, juvenile salmon entering the ocean in 2013 encountered average to above average ocean conditions off Oregon and Washington.

In 2014 many of the ecosystem indicators pointed towards a relatively poor year for salmon survival. The summer PDO values were strongly positive (i.e., warm), coinciding with a ‘warm blob’ of water centered in the Gulf of Alaska. El Niño conditions were ‘neutral’, sea surface temperatures were warmer than usual, and the upwelling season started late and ended early. Biological indicators featured a high abundance of large, lipid-rich zooplankton, but a low abundance of winter fish larvae that develop into salmon prey in the spring, and moderate catches of juvenile spring Chinook salmon during the June survey off Washington and Oregon.

Overall, juvenile salmon entering the ocean in 2014 encountered below average ocean conditions off Oregon and Washington, likely leading to below average returns of adult coho salmon in 2015 and Chinook salmon in 2016.

In 2015, many of the ocean ecosystem indicators suggested it was a relatively poor year for juvenile salmon survival. The PDO was strongly positive (i.e., warm) throughout 2015, coinciding with anomalously warm ocean conditions in the NE Pacific called “The Blob” that began in the fall of 2013 and persisted through 2015. El Niño conditions also turned positive in April 2015 and remained strongly positive, signaling a strong El Niño at the equator. Despite the strongest upwelling observed since 1998, sea surface and deep water temperatures off Newport, Oregon remained warmer than usual (+2°C) throughout most of 2015. During the strongest upwelling period in June, shelf waters did cool and salinity increased; but returned to positive temperature anomalies quickly from July onward. The zooplankton community remained in a lipid-depleted state throughout 2015, and was dominated by small tropical and sub-tropical copepods and gelatinous zooplankton that generally indicate poor feeding conditions for small fishes upon which juvenile salmon feed. Krill biomass was also among the lowest in 20 years. On the other hand, the biomass of larval fish species that are common in salmon diets in spring was above average this year, however, there were also high concentrations of larval rockfish and Northern anchovy which are generally indicators of poor feeding conditions for salmon. There were also many new copepod species encountered that had never been seen off Newport since sampling began in 1969.

3.2.2 Early life survival rates

Marine survival estimates are available for 1991 through 2015. During those years, marine survival averaged 4.9 percent. More recently (2004-2015), smolt survival averaged 4.4 percent, ranging from 1.7 percent to 11.1 percent. During the years 2013-2015, smolt survival averaged 3.7 percent, ranging from 1.7 percent (2014) to 5.1 percent (2015).

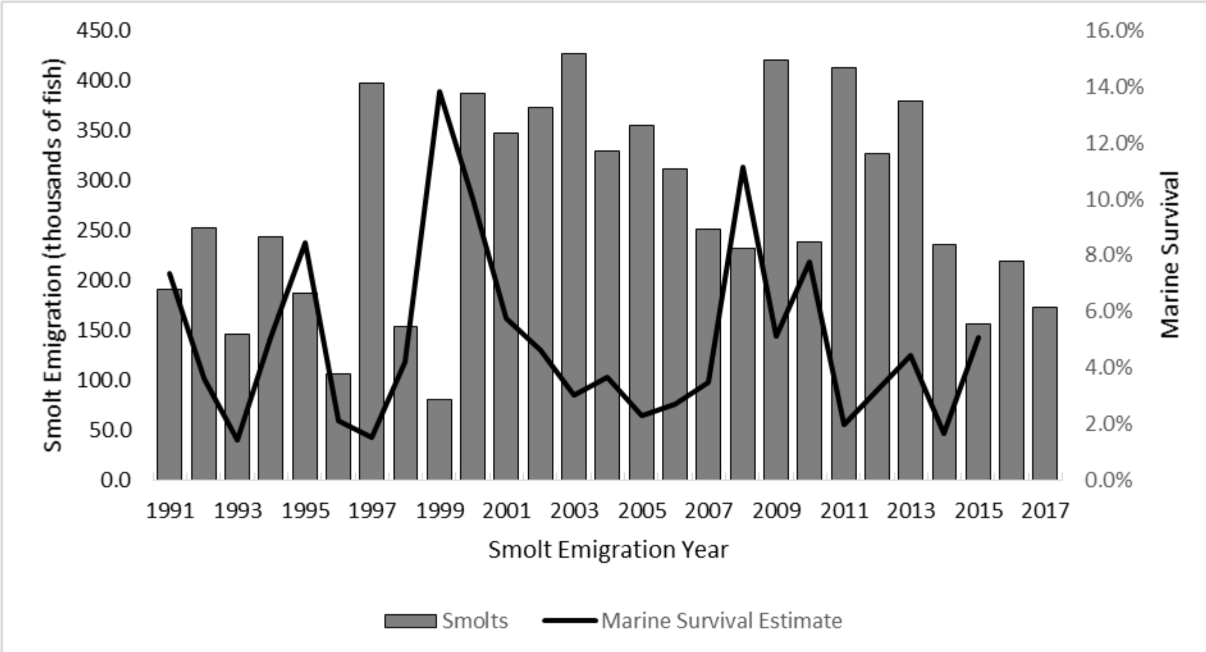

Figure 3.2.a. Marine survival of Queets River natural coho by smolt year.

3.3 Harvest Impacts

3.3.1 Ocean Fisheries

<u>Season Descriptions</u>

Queets coho migrate to the north and are more vulnerable to Canadian fisheries than they are to Council managed fisheries in U.S. waters. Beginning in 1997, Canada curtailed fisheries targeting coho salmon out of concern for depressed Canadian coho stocks. While there has been a general declining trend in ocean fishery impacts on natural Queets coho since the 1982 return year, primarily due to restrictive management actions taken in U.S. fisheries, the coho conservation measures implemented by Canada are readily apparent as a dramatic decrease in ocean exploitation rates beginning in 1997. Impacts in Canadian fisheries have remained low as Canada has implemented a policy of maintaining impacts on critically depressed upper Fraser River coho as near to zero as possible. Queets River natural coho are also caught in low levels in the Strait of Juan de Fuca, Puget Sound, and as pre-terminal "dip-ins" into other coastal river system fisheries. The term "dip-ins" refers to fish that temporarily enter non-natal rivers or streams, but could be expected to return to their natal systems if not harvested in other coastal terminal regions.

<u>Commercial Ocean Seasons</u>

Council area commercial troll fisheries south of Cape Falcon typically do not allow retention of coho. North of Cape Falcon, non-Indian and Treaty Indian troll regulations typically allow coho retention from July through September. In 2014 and 2015, coho retention in the non-Indian commercial troll fishery was limited to adipose-marked coho through August; non-selective coho fisheries occurred in September. In 2016, the non-Indian commercial troll fishery was limited to 30 total fishing days in July and August; September was closed to all troll fishing. Coho retention was not allowed in the fishery in 2016. The Treaty Indian troll fishery was open from July through mid-September in 2014 and 2015 for all salmon species, and was limited to July and August in 2016, with no coho retention.

Recreational Ocean Seasons

North of Cape Falcon, the all-species recreational salmon fisheries were open from mid-June through late September in 2014 and 2015. In both years, coho retention was limited to adipose-marked coho through August, and unmarked coho retention was allowed in September. In 2016, the recreational fishery was limited to July 1 through August 27. Coho retention was not allowed north of Leadbetter Point in 2016.

South of Cape Falcon, coho retention was allowed from late June through early August in 2014, 2015, and 2016 with retention limited to adipose-marked coho. Unmarked coho retention was allowed each year in September.

Ocean Harvest

During the three (critical) years that resulted in the overfished status, ocean harvest of coho all fell well within the allowable quotas or guidelines. In the area north of Cape Falcon, coho harvest was severely restricted, if not prohibited, in 2016 due to the low forecasted returns. In the area North of Cape Falcon, Council-area fisheries harvested 78 percent of the 282,500 coho quota in 2014, 42 percent of the 216,770 fish quota in 2015, 85 percent of the very low quota of 18,900 in 2016. Table 3.3.1.a shows coho quotas and catch by fishery during 2014, 2015, and 2016.

Table 3.3.1.a. Coho harvest quotas for Council area commercial and recreational fisheries compared with actual harvest by management area and fishery.

	2014			**2015**			**2016**		
Fishery Governed by Quota or Guideline	Quota	Catch	Catch/ Quota	Quota	Catch	Catch/ Quota	Quota	Catch	Catch/ Quota
NORTH OF CAPE FALCON									
TREATY INDIAN COMMERCIAL TROLL	62500	55897	0.894	42,500	3,983	9%	-	-	-
NON-INDIAN COMMERCIAL TROLL	35200	23141	0.657	19,200	5,059	26%	-	-	-
RECREATIONAL	184,800	140,450	76%	155,070	82,986	54%	18,900	16,059	85%
TOTAL NORTH OF CAPE FALCON	**282,500**	**219,488**	**78%**	**216,770**	**92,028**	**42%**	**18,900**	**16,059**	**85%**
SOUTH OF CAPE FALCON									
RECREATIONAL									
Coho mark-selective	80,000	48,530	61%	55,000	14,896	27%	26,000	1,547	6%
Coho non-mark-selective	35,000	34,267	98%	20,700	4,445	21%	7,500	4,170	56%
TOTAL SOUTH OF CAPE FALCON	**115,000**	**82,797**	72%	**75,700**	**19,341**	26%	**33,500**	**5,717**	17%
GRAND TOTAL COUNCIL AREA	**397,500**	**302,285**	**76%**	**292,470**	**111,369**	**38%**	**52,400**	**21,776**	**42%**

Source: PFMC Review of Ocean Fisheries, Table I-6, Feb 2015, Feb 2016, Feb 2017

3.3.2 In-river fisheries

Tribal fisheries

Data pending

River recreational fisheries

The recreational fishery regulations in the Queets River Basin from 2004 through 2014 were fairly standard. The Clearwater River was open September through November with retention of two adult salmon allowed per angler per day. The Salmon River was open September through November with a three-fish limit to allow for extra hatchery coho retention. The open portion of the Queets River is in Olympic National Park and is managed by Park regulations, but these typically follow State rules similar to the Clearwater River.

In 2015, the Clearwater River was open September through November, but only one adult salmon could be retained per angler per day and required the release of all unmarked adult coho. The Salmon River was also open September through November allowing retention of three adult salmon per angler per day, but required the release of all unmarked adult coho. In 2016, only the Salmon River was open. The season was only open during the month of September and allowed retention of only two adult salmon per angler per day and required the release of unmarked adult coho.

Unmarked hatchery-origin coho contribute to the total recreational hatchery catch in the Queets River Basin. However, because these fish have adipose fins, they are tabulated with natural-origin fish in the catch record card (CRC) database. To account for these unmarked hatchery-origin coho some assumptions are made. First, all coho caught in September are considered to be hatchery origin. The hatchery program is a segregated early-timed program with distinct runtime compared to the natural stock. Second, survival rates for all hatchery fish releases are considered to be the same, marked or unmarked. Third, unmarked coho in the CRC database contains a portion of unmarked hatchery-origin coho from catch record cards. To account for these unmarked hatchery-origin coho, the number of marked coho in the CRC data is expanded by the mark rate from the hatchery releases of the appropriate year (i.e., two years prior to the year in which the coho were caught). These unmarked hatchery-origin fish are then deducted from the unmarked portion of the CRC data and added to the hatchery-origin catch. Data used in these analyses are from the WDFW CRC database and the Regional Mark Processing Center's Regional Mark Information System (RMIS; https://www.rmpc.org/).

In-river harvest

Table 3.3.2.a. Terminal harvest of Queets River natural coho (Data from QIN with co-manager agreed to sport harvest).

Year	Commercial Net	Ceremonial & Subsistence	In-river Sport	Escapement	Terminal run
2004	1,461	185	401	7,484	9,531
2005	2,539	201	480	6,539	9,759
2006	729	36	36	5,612	6,413
2007	1,219	101	89	4,600	6,009
2008	1,243	126	284	4,629	6,282
2009	6,460	510	383	9,204	16,557
2010	5,773	472	649	11,261	18,155
2011	3,620	347	922	8,588	13,477
2012	2,716	192	473	4,285	7,666
2013	1,313	188	834	5,684	8,019
2014	1,788	259	910	7,174	10,131
2015	126	46	-	2,028	2,200
2016	310	187	-	5,156	5,653

3.3.3 Total Exploitation Rates

Postseason harvest and exploitation rate data for Queets natural coho were compiled from post season model runs of the Fishery Regulation Assessment Model (FRAM) that are generated annually by the Coho Technical Committee (CoTC) of the Pacific Salmon Commission. Over the 13 year period from 2004 through 2016, the total exploitation rate on Queets natural coho averaged 37.7 percent and ranged from a high of 49.0 percent in 2004 to a low of 15.1 percent in 2016, showing a general declining trend (Figure 3.3.3.a, Table 3.3.3.a). Over this time period, approximately 7 percent of the total exploitation occurred in Alaskan and Canadian fisheries while 19 percent occurred in Council fisheries on average. Of the remaining 74 percent, on average 16 percent occurred in other pre-terminal fisheries (primarily "dip-ins" to the Quinault and Hoh Rivers), 14 percent in freshwater sport fisheries, and 45 percent in freshwater net fisheries (Figure 3.3.3.a, Table 3.3.3.a). Prior to 1997, Canadian fishery impacts on Queets natural coho were much higher than current levels, averaging between 20 percent and 30 percent. Beginning in 1997, Canada significantly reduced coho directed fisheries in an effort to limit impacts on depressed Canadian coho stocks (STT, 2010).

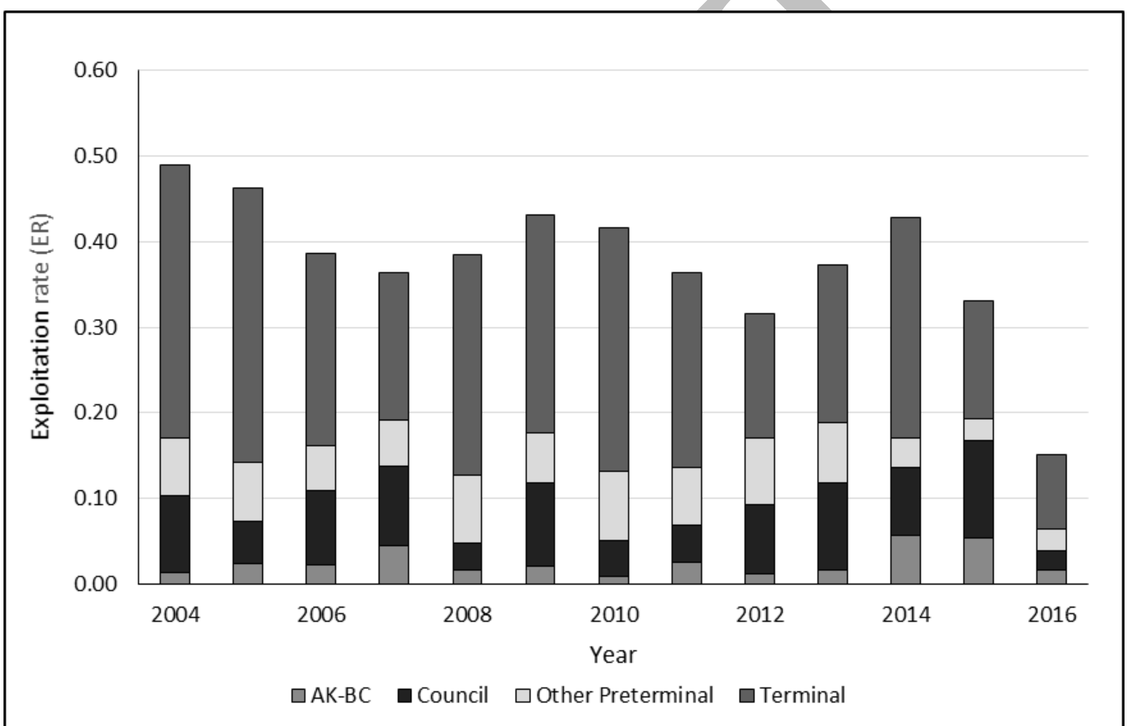

Figure 3.3.3.a. Total exploitation rates on Queets wild coho by major fishery group, estimated by postseason coho FRAM.

Table 3.3.3.a. Ocean abundance, escapement and exploitation rates for Queets wild coho from postseason FRAM.

Strata	2004	2005	2006	2007	2008	2009	2010
Ocean Age 3 Abundanc	13,445	12,149	8,695	6,828	7,335	18,733	19,277
Escapement	6,860	6,534	5,334	4,349	4,513	10,665	11,261
Alaska-Canada	1.3%	2.4%	2.2%	4.4%	1.6%	2.1%	0.8%
NOF - Treaty Troll	3.8%	2.3%	5.3%	4.2%	1.9%	4.5%	1.3%
NOF - Nontreaty Troll	1.7%	1.1%	1.6%	1.5%	0.5%	1.7%	1.5%
NOF - Sport	2.4%	1.3%	1.2%	2.4%	0.6%	2.5%	1.1%
SOF all	1.0%	0.3%	0.6%	1.2%	0.1%	1.0%	0.4%
Preterminal Other	6.8%	6.9%	5.2%	5.4%	7.9%	5.9%	8.0%
Terminal Sport	9.3%	6.1%	0.4%	2.2%	6.7%	3.4%	4.1%
Terminal Net	22.6%	25.9%	22.1%	15.1%	19.1%	22.0%	24.4%
Total ER	49.0%	46.2%	38.7%	36.3%	38.5%	43.1%	41.6%

Strata	2011	2012	2013	2014	2015[a/]	2016	
Ocean Age 3 Abundanc	13,862	6,251	9,250	11,923	3,372	6,071	
Escapement	8,819	4,278	5,801	6,823	2,255	5,157	
Alaska-Canada	2.5%	1.2%	1.7%	5.6%	5.4%	1.7%	
NOF - Treaty Troll	1.4%	3.5%	4.0%	4.9%	1.5%	0.1%	
NOF - Nontreaty Troll	1.2%	1.8%	3.0%	1.0%	2.5%	0.6%	
NOF - Sport	1.4%	1.8%	2.6%	1.3%	6.3%	0.9%	
SOF all	0.4%	0.9%	0.6%	0.8%	1.0%	0.5%	
Preterminal Other	6.9%	7.8%	7.1%	3.4%	2.5%	2.6%	
Terminal Sport	8.3%	5.5%	11.1%	4.4%	6.2%	0.2%	
Terminal Net	14.4%	9.0%	7.3%	21.4%	7.7%	8.4%	
Total ER	36.4%	31.6%	37.3%	42.8%	33.1%	15.1%	

a/ See text in section 3.4.2 regarding an input error for the freshwater sport fishery in the 2015 postseason model run.

3.4 Assessment and management

3.4.1 Abundance forecast errors

Description of forecasting methods. Pending

In examining the forecast error over time for Queets River natural coho, there appears to have been a shift in performance that occurred between 2002 and 2003. During the 13 year time period between 1990 and 2002, the tendency was towards under forecasting, as preseason forecasts were less than the observed returns in nine of these years. There were two years where large over forecasts occurred, but the overall mean percent error was negative 14 percent. During the 14 year time period between 2003 and 2016, however, the tendency was towards over forecasting, as the preseason forecast was greater than the observed returns in 11 of these years, with a mean percent error of 71 percent (Figure 3.4.1.a, Figure 3.4.1.b, Table 3.4.1.a).

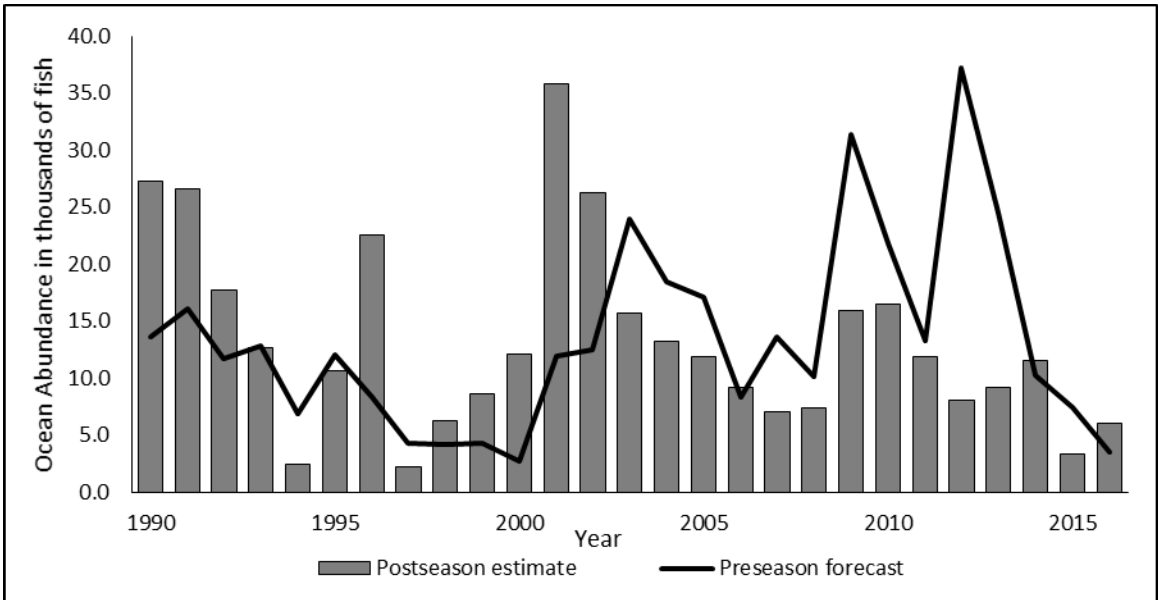

Figure 3.4.1.a. Queets River natural coho preseason forecasts and postseason FRAM estimates of ocean age 3 abundance. Preseason forecasts are generated by salmon co-managers and postseason FRAM estimates are generated by the PSC CoTC.

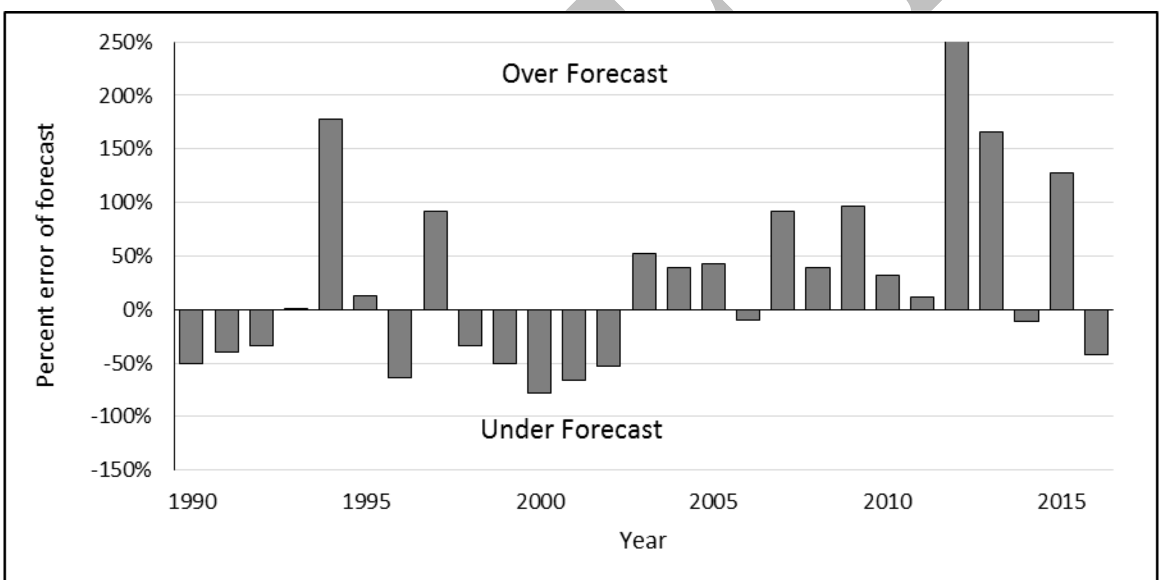

Figure 3.4.1.b. Preseason forecast error when compared to postseason estimates of ocean age 3 abundance of Queets River natural coho. Preseason forecasts are generated by salmon co-managers and postseason FRAM estimates are generated by the PSC CoTC.

Table 3.4.1.a. Preseason and postseason estimates of ocean age 3 abundance for Queets River natural coho. (in thousands of fish; Queets River Fall Natural stock).

Year	Preseason Forecast	Postseason Estimate[a/]	Pre/ Postseason
		Queets	
1990	13.6	27.3	0.50
1991	16.1	26.6	0.60
1992	11.7	17.7	0.66
1993	12.9	12.7	1.01
1994	6.9	2.5	2.78
1995	12.1	10.7	1.13
1996	8.3	22.6	0.37
1997	4.3	2.2	1.92
1998	4.2	6.3	0.66
1999	4.3	8.6	0.50
2000	2.7	12.1	0.22
2001	12.0	35.8	0.33
2002	12.5	26.3	0.47
2003	24.0	15.7	1.52
2004	18.5	13.4	1.38
2005	17.1	12.1	1.41
2006	8.3	8.7	0.95
2007	13.6	6.8	1.99
2008	10.2	7.3	1.39
2009	31.4	18.7	1.68
2010	21.8	19.3	1.13
2011	13.3	13.9	0.96
2012	37.2	6.3	5.95
2013	24.5	9.3	2.65
2014	10.3	11.9	0.86
2015	7.5	3.4	2.22
2016	3.5	6.1	0.58

a/ Coho FRAM was used to estimate post season ocean abundance.

3.4.2 Exploitation rate forecast errors

The escapement years that contributed to the overfished determination for Queets coho were 2014 through 2016. In most cases, the differences between pre- and postseason exploitation rate (ER) caps, was related to the accuracy of the forecast. For example, in years when the abundance was over forecast, there were less fish available for harvest while still achieving the escapement goal in the post season, thus, the allowable ER was lower in the postseason compared to the preseason. This was most apparent in 2012 and 2013, when the ER caps decreased from 85 percent and 77 percent in the preseason to 7 percent and 37 percent in the postseason, respectively.

Over the seven most recent years with postseason data available, the postseason observed ER was equal to or lower than the preseason ER in all but one year (31 percent preseason vs 33 percent postseason in 2015; Table 3.4.2.a). In two out of the seven years the postseason observed ER exceeded the postseason ER cap. These exceedances were likely caused by over forecasting and the subsequent reduction in ER cap rather than exceeding preseason estimates of ERs (Table 3.4.2.a). Over the three years that contributed to the overfished status, the postseason ER was less than the preseason ER projected in 2014 and 2016, and 2015 exceeded the preseason ER just slightly. This 2015 overage is potentially due to an error identified in the terminal sport fishery input for the postseason model run. The correct input here is 19, opposed to the 209 value that were initially modeled. Correcting this error would result in an exploitation rate closer to 0.6 percent in the terminal sport fishery and a total exploitation rate closer to 27.5 percent.

It is noteworthy that, over the three years that contributed to the overfished status, postseason exploitation rates in Council fisheries as a whole were lower than those anticipated in the preseason (Table 3.4.2.b). A summary of preseason projected and postseason estimated total exploitation rates, compared to those allowed (cap) since 2010 is provided in the following table. This helps illustrate the change in preseason/postseason exploitation rates, and also the change in the ER 'cap'. In 2015, the projected preseason ER was greater than the ER cap. This may occur from time to time if the co-managers agree to manage for an escapement level lower than the S_{MSY} identified in the FMP.

Table 3.4.2.a. Preseason and postseason exploitation rates for Queets River natural coho.

	Exploitation Rate			
Return	Preseason		Postseason	
Year	Projected	ER cap[a/]	Estimated[/b]	ER cap[a/]
2010	48%	73%	42%	70%
2011	48%	56%	36%	58%
2012	62%	84%	32%	20%
2013	62%	77%	37%	37%
2014	44%	44%	43%	51%
2015	31%	24%	33%	20%
2016	18%	20%	15%	20%
Average	45%	54%	34%	39%

a/ See CoTC 2013 for information on determination of ER caps
b/ For 2015: correcting an input error to freshwater sport would result in a total of 28% and change the postseason estimate to 33%. See text in section 3.4.2.

Table 3.4.2.b. Preseason forecast and postseason estimates of escapement, total mortality, and exploitation rate by fishery for Queets River natural coho during years that contributed to the overfished classification. Data Sources: preseason forecasts generated by salmon co-managers, preseason exploitation rates from FRAM modeling by the PFMC STT, and postseason FRAM estimates generated by the PSC CoTC..

	2014		2015[a/]		2016	
FISHERY COMPONENT	**Preseason**	**Postseason**	**Preseason**	**Postseason**	**Preseason**	**Postseason**
Ocean Age 3 Abundance	10,348	11,923	7,590	3,372	3,520	6,071
Ocean Escapement	8,450	9,889	6,211	2,723	3,155	5,679
FMP Smsy	5,800	5,800	5,800	5,800	5,800	5,800
Escapement after all fisheries	5,830	6,823	5,255	2,255	2,900	5,157
Alaska-Canada	157	670	210	181	100	104
Council North of Falcon						
Treaty Troll	498	590	317	52	4	4
Nontreaty Troll	262	121	171	85	34	37
Sport	377	156	287	212	65	57
Council South of Falcon	163	92	107	35	43	32
Council Subtotal	**1,300**	**959**	**882**	**384**	**146**	**130**
Preterminal Other	441	405	287	84	119	158
Terminal Net	2,177	2,547	924	260	254	510
Terminal Sport	444	519	33	209	0	12
Total Fishing Mortality	**4,518**	**5,100**	**2,335**	**1,117**	**619**	**914**
Alaska-Canada	1.5%	5.6%	2.8%	5.4%	2.8%	1.7%
Council North of Falcon						
Treaty Troll	4.8%	4.9%	4.2%	1.5%	0.1%	0.1%
Nontreaty Troll	2.5%	1.0%	2.3%	2.5%	1.0%	0.6%
Sport	3.6%	1.3%	3.8%	6.3%	1.8%	0.9%
Council South of Falcon	1.6%	0.8%	1.4%	1.0%	1.2%	0.5%
Council Subtotal	**12.6%**	**8.0%**	**11.6%**	**11.4%**	**4.1%**	**2.1%**
Preterminal Other	4.3%	3.4%	3.8%	2.5%	3.4%	2.6%
Terminal Net	21.0%	21.4%	12.2%	7.7%	7.2%	8.4%
Terminal Sport	4.3%	4.4%	0.4%	6.2%	0.0%	0.2%
Total Exploitation Rate	**43.7%**	**42.8%**	**30.8%**	**33.1%**	**17.6%**	**15.1%**

a/ See text in section 3.4.2 regarding an input error for the freshwater sport fishery (Terminal sport) in the 2015 postseason model run.

3.5 Summary of potential contributing factors

Smolt production was above average for the brood that returned in 2014, but below average for broods returning in 2015 and 2016.

Marine survival was above the median value for the broods returning in 2014 and 2016, but the third lowest on record for the brood returning in 2015. This was the lowest marine survival for any of the broods in the 2004 to 2016 time period, and resulted in the lowest ocean abundance in that time frame. This was most likely the result of marine conditions that deteriorated in 2014 and persisted into 2016.

Though this stock was subject to an overfishing review in 2010, with the exception of 2015, preseason planned exploitation rates have been lower than allowed under the FMP, and postseason exploitation rates were lower than the preseason expectation. In 2015 the co-managers elected to manage for a lower escapement than the 5,800 lower end of the escapement goal range.

Forecasting errors have been large in past years, with forecasts in some years being greater than five times the actual abundance. In 2014 and 2016, the postseason estimate of abundance was greater than the preseason forecast. However, the abundance in 2015 was less than half the forecast value. This coupled with fisheries that were already expected to produce less than 5,800 adult spawners resulted in the lowest spawning escapement since 2017. In each year the ER in Council fisheries was less than the preseason expectation, so management error in Council fisheries did not play a role in the stock becoming overfished.

The adult abundance and subsequent escapement of Queets coho in 2015 was the third lowest on record since 1990, primarily due to abnormally low marine survival. This low escapement value has a large impact on the 3-yr geometric mean spawning escapement. Once the 2015 escapement value is no longer included in the most recent 3-yr geometric mean, the chances of reaching the rebuilt criteria will be substantially improved.

4.0 RECOMMNDATIONS FOR ACTION

4.1 Recommendation 1: Rebuilt Criterion

Consider the Queets coho 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 adopt a management strategy (control rule) that will be used to guide management of fisheries that impact Queets coho until rebuilt status is achieved. We offer three alternative management strategies for consideration. The rebuilding time frame under each of the three Alternatives are not expected to exceed 10 years. The probability of achieving rebuilt status for years 1 through 10 are projected for Alternatives I and III in Section 4.3. *Analysis of Management Strategy Alternatives*.

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 maximum time (T_{MAX}) estimated to achieve rebuilt status is acknowledged within the suite of alternatives.

> Alternative I: Status quo control rule. During the rebuilding period continue to use the current management framework and reference points, as defined in the FMP and the PST, to set maximum allowable exploitation rates on an annual basis. Projected rebuilding time is four years (see Section 4.3). This is considered a ‘no-action’ alternative, representing T_{MAX}.
>
> Alternative II: Reduced Coho Harvest. The Council will plan ocean fisheries to limit impacts on the rebuilding stock consistent with escapement thresholds and exploitation rate limits identified by the Washington co-managers, and consistent with the FMP. The co-managers may adjust escapement thresholds and exploitation rate limits annually, as described in the FMP, to promote rebuilding of the stock while allowing limited fisheries to occur. The state and tribal co-managers will plan inside fisheries during the North of

Falcon preseason process that, when combined with PFMC fisheries, will meet the applicable escapement and exploitation rate objectives.

Alternative III: Suspend all salmon-directed ocean and in-river fisheries from the U.S/Canada border to Cape Falcon until rebuilt status is achieved. Projected rebuilding time is two years (see Section 4.3). This is considered an 'action' alternative, representing T_{MIN}.

Alternative III includes fisheries that the Council does not have jurisdiction over. It also does not meet the purpose and need because it would restrict tribal fisheries in a manner that is inconsistent with their treaty right. Alternative III is provided solely to serve as a bookend in the analysis of rebuilding probabilities over a ten year period when assuming an exploitation rate of zero. This Alternative fulfills the requirement of National Standard 1 in calculating the minimum time (T_{MIN}) estimated to achieve rebuilt status.

4.3 Analysis of Management Strategy Alternatives

The STT has developed a simple model to assess the probability of a stock achieving rebuilt status in each year following the overfished declaration. Future abundance is based on observed past abundance levels for the stock. Realistic levels of error in abundance forecasts, escapement estimates, and exploitation rate implementation contribute to the projected adult spawner escapement. Replicate simulations are performed to allow for computation of the probability of rebuilt status by year. The model framework allows for evaluation of alternative rebuilding plans by specifying the rebuilding plans as alternative harvest control rules. The tool has some elements of a management strategy evaluation (MSE), but lacks an explicit biological operating model. This simplification is necessary because for many stocks data limitations do not allow for the development of full population dynamics models. Model structure, parameterization, and additional results are presented in Appendix B.

Figure 4.3.a. displays the projected probability of achieving rebuilt status in year one through 10 of the rebuilding period for status quo (Alternative I) and no directed salmon fishery impacts (Alternative III). Year one is assumed to be the year following the stock meeting the criteria for overfished status. Thus, year one in Figure 4.3.a represents year 2017. Under each of the alternatives the probability of achieving rebuilt status in year one is low. For Alternative I, the probability of achieving rebuilt status by year four is greater than 0.50, and greater than 0.80 by year 10. For Alternative III, the probability of achieving rebuilt status by year two is greater than 0.50, and near 1.0 by year 10.

The projected rebuilding time is defined as the number of years needed for the probability of achieving rebuilt status to exceed 0.50. Rebuilding times are projected to be four years for Alternative I, and two years for Alternative III.

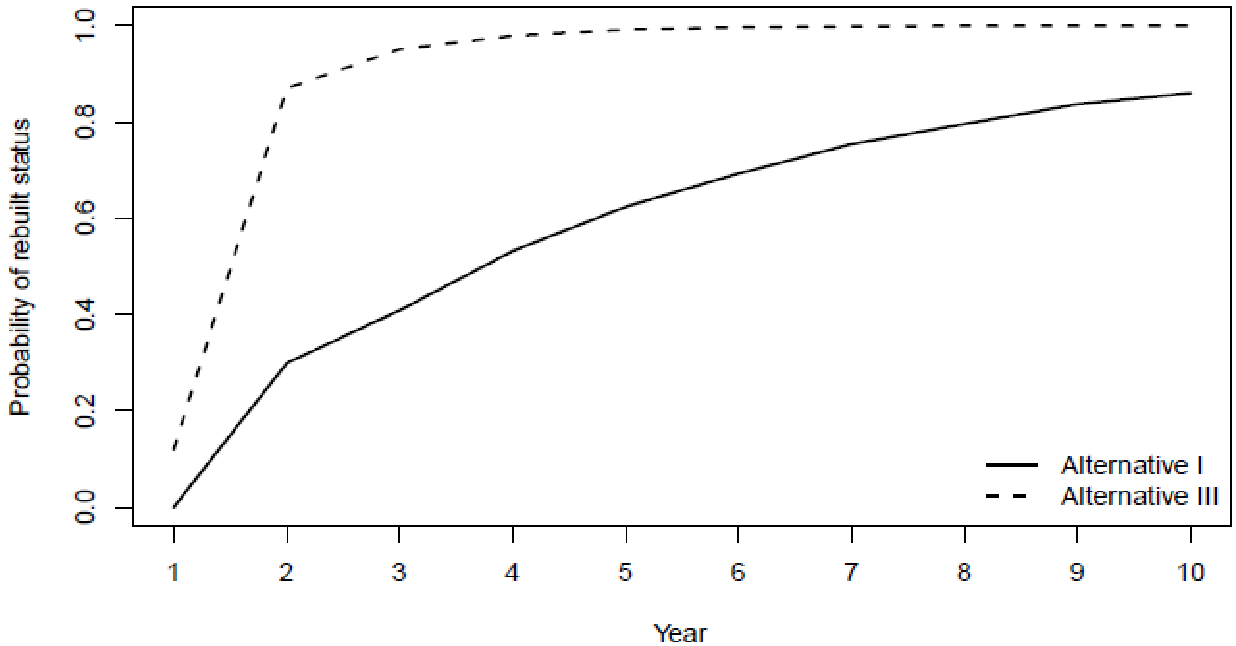

Figure 4.3.a. Projected probability of achieving rebuilt status by year under two alternative rebuilding plans

5.0 SOCIOECONOMIC IMPACT OF MANAEMENT STRATEGY ALTERNATIVES

5.1 Alternative I:

Current management framework and reference points, as defined in the FMP and the PST, to set maximum allowable exploitation rates on an annual basis would remain in place. Domestic ocean fisheries impacting Queets coho occur mainly in Washington state and north of Cape Falcon, Oregon.

For purposes of describing the status quo economic situation, data for port areas in coastal Washington and Oregon north of Cape Falcon during 2004 to 2016 are used, since that period is representative of possible outcomes under the current status quo control rule. Estimates of total coastal community personal income impacts during 2004-2016 in affected port areas for the non-tribal commercial ocean troll salmon fishery averaged approximately $3.4 million (in inflation-adjusted 2016 dollars), ranging from $1.6 million in 2008 to $5.6 million in 2015, and for the ocean recreational salmon fishery averaged approximately $9.9 million, ranging from $4 million in 2008 to $16 million in 2014. Total community personal income impacts in affected areas from the combined non-tribal commercial troll and recreational salmon fisheries conducted in ocean areas averaged approximately $13.3 million during 2004-2016, ranging from $5.6 million in 2008 to $21.3 million in 2014.[1]

For the individual port areas, inflation-adjusted personal income impacts during the period from combined ocean non-tribal commercial troll and recreational salmon fisheries averaged approximately $1.3 million in Neah Bay, ranging from $0.4 million in 2008 to $2.2 million in 2004; $0.7 million in La Push, ranging from $0.3 million in 2016 to $1 million in 2015; $6.7

[1] It is important to note that income impact estimates for the two sectors (commercial and recreational) cannot be directly compared because they are derived using different methodologies.

million in Westport, ranging from $3 million in 2008 to $10.2 million in 2015; $3.3 million in Ilwaco, ranging from $1.2 million in 2008 to $5.8 million in 2014; and $1.5 million in Astoria, ranging from $0.7 million in 2008 to $3.1 million in 2014.

2008 was the lowest year for combined non-tribal ocean salmon fishery inflation-adjusted personal income impacts during the period overall and for three of the five affected port areas: Neah Bay, Westport and Ilwaco, while 2016 was the lowest year for La Push and Astoria. 2014 had the highest inflation-adjusted combined salmon fishery personal income impacts during the period overall and also for two port areas: Ilwaco and Astoria. The highest years for the remaining three port areas were 2004 for Neah Bay, and 2015 for both La Push and Westport.

Although not included in these economic impact estimates, Queets River coho are also taken in inriver commercial and tribal net fisheries and recreational fisheries. During 2004-2016, estimated Queets River coho commercial net fisheries harvests averaged 10,772 fish, ranging from 25,004 fish in 2009 to 2,261 in 2007; ceremonial & subsistence harvests averaged 763 fish, ranging from 1,680 fish in 2009 to 209 in 2015; and inriver recreational harvests of averaged 833 fish, ranging from 1,625 fish in 2014 to 52 in 2006.[2]

Provided that a sufficient likelihood of rebuilding is achieved during the allowable 10-year period under Status Quo (Alternative I), economic impacts under the two action alternatives (Alternatives II and III) are measured relative to the Status Quo fishery. The estimated timeframe needed to achieve rebuilt status (with a probability of at least 50 percent) under Status Quo conditions is four years, during which time it is assumed the 2004-2016 inflation-adjusted average of $13.3 million per year in income from combined ocean commercial and recreational salmon fisheries would accrue in the affected communities north of Cape Falcon. By definition there would be no direct or indirect economic impact from the rebuilding plan under the Status Quo (no-action) alternative.

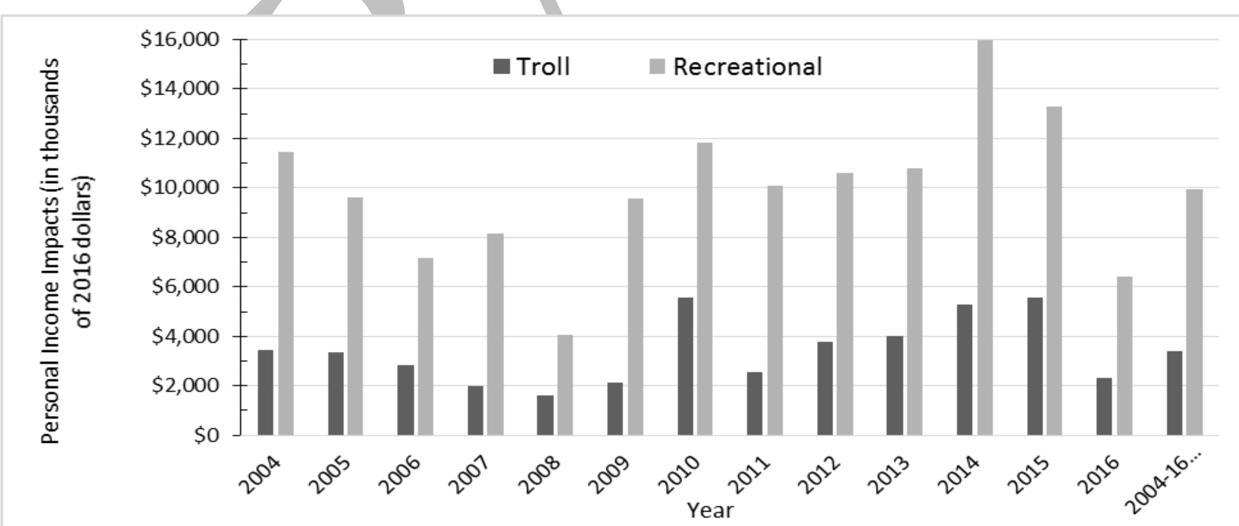

Figure 5.1.a. Estimates of total, aggregated personal income impacts in affected coastal communities in Washington and Oregon north of Cape Falcon in thousands of real (inflation adjusted, 2016) dollars for the non-tribal commercial ocean troll and ocean recreational salmon fisheries.

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2 Inriver catch data from *Review of 2017 Ocean Salmon Fisheries: Stock Assessment and Fishery Evaluation Document for the Pacific Coast Salmon Fishery Management Plan*. Table B-31.

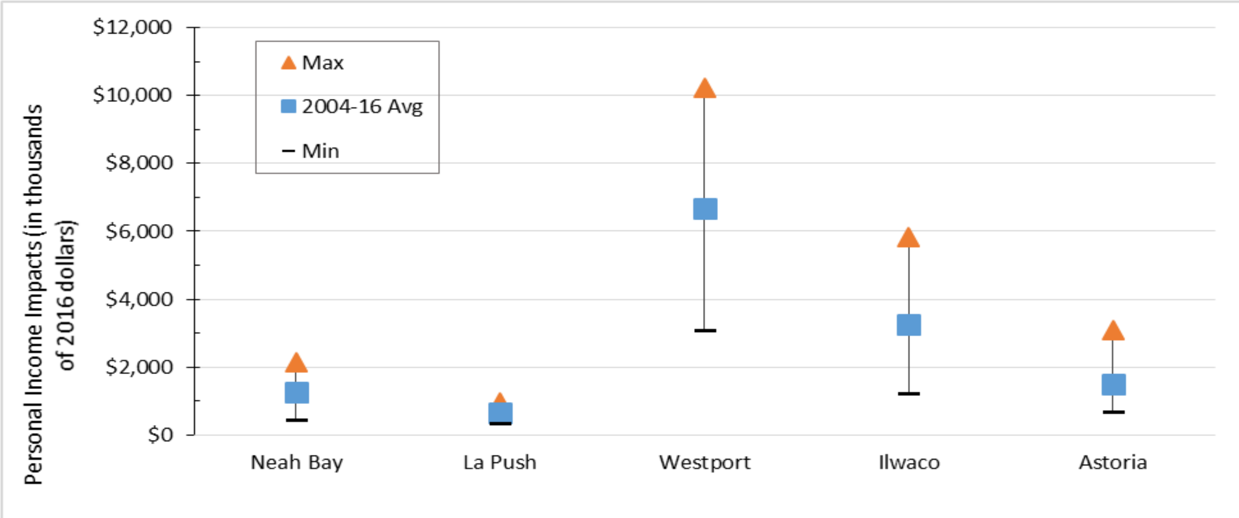

Figure 5.1.b. Estimates of personal income impacts by coastal community in thousands of real (inflation adjusted, 2016) dollars for the combined non-tribal commercial ocean troll and ocean recreational salmon fisheries in Washington and Oregon north of Cape Falcon.

Table 5.1.a. Estimates of personal income impacts by coastal community in thousands of real (inflation adjusted, 2016) dollars for the non-tribal commercial ocean troll and ocean recreational salmon fisheries for major Washington and Oregon port areas north of Cape Falcon.

OCEAN TROLL	**Neah Bay**	**La Push**	**Westport**	**Ilwaco**	**Astoria**	**Total**
2004	928	293	1,154	113	969	3,457
2005	761	454	1,170	144	803	3,333
2006	566	459	440	295	1,050	2,811
2007	250	254	1,038	129	310	1,981
2008	163	216	616	164	442	1,601
2009	331	342	1,192	83	180	2,128
2010	251	403	3,843	95	972	5,563
2011	575	228	1,407	96	244	2,551
2012	862	501	1,467	234	723	3,788
2013	485	448	2,674	74	354	4,035
2014	385	445	1,528	1,108	1,840	5,305
2015	315	641	3,021	420	1,171	5,568
2016	206	204	1,386	219	305	2,321
2004-16 Avg	**468**	**376**	**1,611**	**244**	**720**	**3,419**
Max	**928**	**641**	**3,843**	**1,108**	**1,840**	**5,568**
Min	**163**	**204**	**440**	**74**	**180**	**1,601**
RECREATIONAL	**Neah Bay**	**La Push**	**Westport**	**Ilwaco**	**Astoria**	**Total**
2004	1,228	260	5,332	3,494	1,151	11,465
2005	842	263	4,866	2,829	835	9,636
2006	552	231	3,593	2,200	600	7,176
2007	563	180	3,687	2,875	842	8,146
2008	244	108	2,425	1,024	242	4,043
2009	657	288	4,626	3,166	848	9,586
2010	777	332	6,312	3,422	976	11,819
2011	758	363	5,180	3,033	756	10,089
2012	944	343	5,848	2,853	606	10,594
2013	1,088	368	5,679	2,987	687	10,810
2014	1,190	484	8,315	4,731	1,242	15,962
2015	1,059	334	7,203	3,793	909	13,298
2016	595	112	2,746	2,604	352	6,410
2004-16 Avg	**807**	**282**	**5,062**	**3,001**	**773**	**9,926**
Max	**1,228**	**484**	**8,315**	**4,731**	**1,242**	**15,962**
Min	**244**	**108**	**2,425**	**1,024**	**242**	**4,043**
Combined	**Neah Bay**	**La Push**	**Westport**	**Ilwaco**	**Astoria**	**Total**
2004	2,156	553	6,486	3,607	2,120	14,922
2005	1,603	718	6,036	2,974	1,638	12,969
2006	1,118	690	4,033	2,495	1,649	9,986
2007	813	434	4,725	3,004	1,151	10,127
2008	407	324	3,041	1,189	683	5,644
2009	989	630	5,819	3,249	1,029	11,715
2010	1,028	735	10,155	3,517	1,948	17,382
2011	1,333	590	6,587	3,129	1,001	12,640
2012	1,806	845	7,315	3,087	1,329	14,382
2013	1,573	816	8,353	3,061	1,041	14,844
2014	1,576	928	9,842	5,839	3,082	21,268
2015	1,374	975	10,223	4,213	2,080	18,866
2016	800	316	4,132	2,824	658	8,730
2004-16 Avg	**1,275**	**658**	**6,673**	**3,245**	**1,493**	**13,344**
Max	**2,156**	**975**	**10,223**	**5,839**	**3,082**	**21,268**
Min	**407**	**316**	**3,041**	**1,189**	**658**	**5,644**

Income impact estimates from *Review of 2017 Ocean Salmon Fisheries: Stock Assessment and Fishery Evaluation Document for the Pacific Coast Salmon Fishery Management Plan.* Tables IV-17 and IV-18

5.2 Alternative II:

Analysis pending

5.3 Alternative III

Under Alternative III, rebuilding is estimated to occur after two years assuming an exploitation rate of zero during that time. Compared to the ‘no-action’, or Status Quo management strategy of Alternative I, this would result in an overall income impact of negative (-) $6.7 million per year in coastal communities in the affected region over the four years it would take to rebuild under Status Quo.

5.4 Note on Economic Impacts:

These estimates should be considered upper bounds on the magnitude of economic effect under the action alternatives because it is assumed that equal, proportional management measures would be put in place for all ocean commercial and recreational fisheries in all affected areas along the coast, whereas past experience has shown that overall economic impacts may be mitigated in many cases by using an approach in which areas in the affected region are managed differentially depending on the degree of interaction between fisheries and stocks of concern in each area.

6.0 AFFECTED ENVIRONMENT AND ENVIRONMENTAL EFFECTS OF MANAGEMENT STRATEGY ALTERNATIVES CONSIDERED

6.1 Introduction

This chapter will analyze the environmental impacts of the alternatives on the resources that would be more than minimally affected by the proposed action. This is a required component to adopt this integrated document as an environmental assessment under NEPA. The action area for the proposed action is the exclusive economic zone (EEZ), from three to 200 miles offshore of the coasts of Washington and Oregon, from the U.S./Canada border to Cape Falcon, Oregon. In this document, the action area and the analysis area are largely synonymous, exceptions are noted below.

6.2 Targeted Salmon stocks

6.2.1 Affected environment

Ocean salmon fisheries in the analysis area target Chinook and coho salmon.

The Council manages several stocks of Chinook salmon under the FMP (PFMC 2016a). In the ocean, stocks of salmon comingle which results in mixed-stock fisheries. Non-target stocks, including ESA-listed stocks, will be encountered in mixed-stock fisheries. The Council’s Salmon Technical Team (STT) models the degree to which target and non-target stocks are impacted by proposed fisheries, and the Council uses tools such as harvest restrictions, time and area closures, and mark-selective fisheries to limit impacts to non-target stocks (PFMC and NMFS 2017).

In the analysis area, the primary management tools are time and area closures and recreational bag limits; some fisheries also have quotas. The primary salmon stocks targeted in the analysis area are: Lower Columbia River hatchery fall-run Chinook salmon, Columbia River Spring Creek

Hatchery fall-run Chinook salmon, and Columbia River late hatchery coho stocks. Coastal coho stocks also contribute to fisheries in the analysis area, but individual stock contributions are minor. Fisheries in the analysis area are managed to meet FMP conservation objectives for these stocks, and to comply with ESA consultation requirements for any ESA-listed salmon stocks that are affected by salmon fisheries in the analysis area.

Detailed information on spawning escapement and fisheries impacts on salmon stocks are reported in the Council's annual Stock Assessment and Fishery Evaluation (SAFE) document, known as the Annual Review of Ocean Salmon Fisheries. These documents are available on the Council's website (www.pcouncil.org/salmon/stock-assessment-and-fishery-evaluation-safe-documents/).

6.2.2 Environmental Consequences of the Alternatives on Targeted stocks

Analysis pending

6.3 Marine Mammals

6.3.1 Affected environment

A number of non-ESA-listed marine mammal species occur in the analysis area. The non-ESA-listed marine mammal species that are known to interact with ocean salmon fisheries are California sea lion (*Zalophus californianus*) and harbor seals (*Phoca vitulina*), both species will feed on salmon, when available, and have been documented preying on hooked salmon in commercial and recreational fisheries (e.g., Weise and Harvey 1999). All marine mammals are protected under the Marine Mammal Protection Act (MMPA). Ocean salmon fisheries employ hook-and-line gear and are classified under NMFS' MMPA List of Fisheries as Category III (83 FR 5349, February 7, 2018), indicating there is no record of substantive impacts to marine mammals from these fisheries (MMPA 118(c)(1)).

ESA-listed marine mammal species that co-occur with Council-managed salmon fisheries include Guadalupe fur seal, southern sea otter, northern sea otter, and Southern Resident killer whale (SRKW). Among the ESA-listed marine mammals, only the SRKW is known to interact with Pacific salmon or salmon fisheries, in that SRKW are known to prey on salmon. The range of SRKW in spring, summer, and fall includes the inland waterways of Washington State and the transboundary waters between the United States and Canada. In recent years, SRKW have been regularly spotted as far south as central California during the winter months (http://www.nmfs.noaa.gov/pr/species/mammals/whales/killerwhale.html) and their range is currently defined as extending as far south as Point Sur, California (Teresa Mongillo, pers. comm.[3]). In 2009 NMFS consulted on the effects of the ocean salmon fisheries on the SRKW and concluded that Council-managed salmon fisheries were not likely to jeopardize these whales. In the time since that consultation, there has been additional research on SRKW life history, feeding habits, fecundity, and mortality rates. This new information indicates that prey base, environmental contaminants, and disturbance by vessel traffic are among the factors that may affect the recovery of SRKW. NMFS is working with researchers from the U.S. and Canada to evaluate impacts of various human activities, including salmon fisheries, on the survival and recovery of SRKW. Until such time as sufficient information is developed to inform a new ESA consultation on the impacts of salmon fisheries on the survival and recovery of SRKW, NMFS is

[3] Personal communication from T. Mongillo (NMFS) to P. Mundy (NMFS), email dated September 28, 2017.

working on identifying and developing short-term management actions to improve Chinook salmon availability and reducing acoustic and vessel disturbance in key SRKW foraging areas.

6.3.2 Environmental Consequences of the Alternatives on Marine Mammals

Analysis pending

6.4 ESA Listed Salmon Stocks

6.4.1 Affected environment

Several ESUs of Pacific salmon that are ESA-listed as threatened or endangered occur in the areas where Council-managed ocean salmon fisheries occur. As stated above, the only salmon species encountered in fisheries in the action area are Chinook and coho salmon. ESA-listed Chinook and coho salmon ESUs that occur within the analysis area are listed in Table 6.4.1.a.

Table 6.4.1.a. ESA-listed Chinook and coho salmon ESUs that occur within the analysis area.

ESA-listed ESUs	Status	Most recent citation
Chinook (*Oncorhynchus tshawytscha*)		
Snake River Fall-run	Threatened	70 FR 37160 (June 28, 2005)
Snake River Spring/Summer-run	Threatened	70 FR 37160 (June 28, 2005)
Puget Sound	Threatened	70 FR 37160 (June 28, 2005)
Lower Columbia River	Threatened	70 FR 37160 (June 28, 2005)
Upper Willamette River	Threatened	70 FR 37160 (June 28, 2005)
Upper Columbia River Spring-run	Endangered	70 FR 37160 (June 28, 2005)
Coho (*Oncorhynchus kisutch)*		
Oregon Coastal	Threatened	76 FR 35755 (June 20, 2011)
Lower Columbia River	Threatened	70 FR 37160 (June 28, 2005)

NMFS has issued biological opinions on the impacts of Council-managed salmon fisheries on ESA-listed salmon. Based on those biological opinions, NMFS provides guidance to the Council during the preseason planning process for setting annual management measures for ocean salmon fisheries based on the coming year’s abundance projections. This guidance addresses allowable impacts on ESA-listed salmon. The Council structures fisheries to not exceed those allowable impacts.

NMFS has previously consulted on the effects of Council-area salmon fisheries on the ESA-listed salmon ESUs in the analysis area, and has produced the biological opinions listed in Table 6.4.1.b.

Table 6.4.1.b. NMFS biological opinions regarding ESA-listed salmon ESUs likely to be affected by Council-area ocean salmon fisheries in the analysis area.

Date	Duration	Citation	Species Considered
8-Mar-96	Until reinitiated	NMFS 1996	Snake River spring/summer and fall Chinook (and sockeye)
28-Apr-99	Until reinitiated	NMFS 1999	Oregon Coast coho (S. Oregon/N. California Coast coho, and Central California Coast coho)
30-Apr-01	Until reinitiated	NMFS 2001	Upper Willamette Chinook, Upper Columbia River spring-run Chinook (Lake Ozette sockeye, Columbia River chum, and 10 steelhead ESUs)
30-Apr-04	Until reinitiated	NMFS 2004	Puget Sound Chinook
26-Apr-12	Until reinitiated	NMFS 2012	Lower Columbia River Chinook
9-Apr-15	Until reinitiated	NMFS 2015	Lower Columbia River coho

6.4.2 Environmental Consequences of the Alternatives on ESA listed Salmon Stocks

Analysis pending

6.5 Non-target Fish Species:

6.5.1 Affected environment

Pacific halibut, and Pacific halibut fisheries, occur north of Point Arena, California. Halibut allocations are established annually in the International Pacific Halibut Commission's (IPHC) regulations and the PFMC's Area 2A Catch Sharing Plan (e.g., 82 FR 18581, April 20, 2017). Allocation of halibut quota to fisheries in the analysis area would not be affected by the Proposed Action, as the IPHC's halibut quota for the U.S. West Coast and the sub-area allocations set forth in the Catch Sharing Plan are set annually under separate processes from setting the annual salmon management measures.

Fisheries for coastal pelagic species (e.g., northern anchovy, market squid, Pacific sardine, Pacific mackerel, and jack mackerel), Dungeness crab, shrimp/prawns, and sea cucumbers occur in the analysis area and are managed by either NMFS and the PFMC (coastal pelagics) or the states (crab, shrimp/prawns, and sea cucumbers). The species targeted in these fisheries are not encountered in ocean salmon fisheries. It is possible that reductions in salmon fishing opportunities could result in a shift of effort toward these other species; however, we could not find any documentation to support this.

Fishermen that participate in salmon fisheries, both commercial and recreational, may also fish for groundfish (i.e., species such as rockfish and flatfish that live on or near the bottom of the ocean). Groundfish fisheries are managed under the Council's Groundfish FMP. Commercial salmon trollers that retain groundfish are considered to be participating in the open access groundfish fishery with non-trawl gear; therefore, they must comply with the regulations for the open access groundfish fishery. Likewise, recreational fishers that retain groundfish, must comply with recreational groundfish regulations. As fishery impacts to groundfish are managed under the Groundfish FMP and regulations, there would be no measurable effect on these species from the proposed action.

Albacore (*Thunnus alalunga*) is harvested on the West Coast, including the analysis area, by many of the same commercial and recreational fishermen that fish for salmon. Fishery impacts to albacore are managed under the Council's Highly Migratory Species FMP. Commercial and recreational fishers shift effort between salmon and albacore in response to available fishing opportunities, catch limits, angler demand (recreational fisheries), and changing prices for the species being harvested (commercial fisheries). As fishery impacts to albacore are managed under the Highly Migratory Species FMP and regulations, there would be no measurable effect on these species from the proposed action.

6.5.2 Environmental Consequences of the Alternatives on Non-target Fish Species

Analysis pending

6.6 Seabirds

6.6.1 Affected environment

Numerous seabird species, as well as raptors, are protected under the Migratory Bird Treaty Act, including several species that are present in areas coincident with Pacific salmon. These seabirds include grebes, loons, petrels, albatrosses, pelicans, double-crested cormorants, gulls, terns, auks, and auklets (PFMC 2013c). ESA-listed seabird species include short-tailed albatross (endangered) and marbled murrelet (threatened). Interactions with the Pacific salmon fishery typically occur in two ways: when seabirds feed on outmigrating juvenile salmon, and when seabirds are entangled or otherwise interact with fishing gear or activities. Predation on juvenile salmon by seabirds is known to occur in estuarine environments, such as the lower Columbia River, as salmon smolts migrate downstream and into marine waters. We do not know the extent to which seabirds in the analysis area depend upon juvenile salmonids as prey. Council-managed ocean salmon fisheries are limited to hook-and-line tackle. Interactions with seabirds are uncommon in these fisheries.

6.6.2 Environmental Consequences of the Alternatives on Seabirds

Analysis pending

6.7 Ocean and Coastal Habitats and Ecosystem Function

6.7.1 Affected environment

Salmon FMP stocks interact with a number of ecosystems along the Pacific Coast, including the California Current Ecosystem (CCE), numerous estuary and freshwater areas and associated riparian habitats. Salmon contribute to ecosystem function as predators on lower trophic level species, as prey for higher trophic level species, and as nutrient transportation from marine ecosystems to inland ecosystems. Because of their wide distribution in both the freshwater and marine environments, Pacific salmon interact with a great variety of habitats and other species of fish, mammals, and birds. The analysis area for the Proposed Action is dominated by the CCE. An extensive description of the CCE can be found in chapter three of the Council's Pacific Coast Fishery Ecosystem Plan (PFMC 2013c). Council managed salmon fisheries use hook and line gear, exclusively. This gear does not touch the ocean floor and does not disturb any habitat features. Therefore, salmon fisheries have no physical impact on habitat.

6.7.2 Environmental Consequences of the Alternatives on Ocean and Coastal Habitats and ecosystem function

Analysis pending

6.8 Cultural resources

6.8.1 Affected environment

Analysis pending

6.8.2 Environmental Consequences of the Alternatives on Cultural Resources

Analysis pending

6.9 Cumulative Impacts

Analysis pending

7.0 REFERENCES

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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:

1) notify the NMFS NWR administrator of its finding, and;
2) 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

Salmon rebuilding plans must include, among other requirements, a specified rebuilding period. In addition, the National Environmental Policy Act (NEPA) analysis of rebuilding plans requires the development of rebuilding plan alternatives. In past assessments, the rebuilding period and alternative rebuilding plans were developed using expert knowledge, with no particular quantitative assessment. In 2018 the Salmon Technical Team (STT) developed a simple tool to assess the probability of a stock achieving rebuilt status in each year following an overfished declaration. Here we describe this model and provide additional results for the Queets coho salmon stock.

Methods

The methods described here are for a single replicate in one year.

The "known", true abundance (N) is determined by a random draw from the set of past abundance estimates. For Queets coho, N is the pre-fishery ocean age-3 ocean abundance, defined as the sum of all fishery impacts and spawning escapement.

The forecast abundance ($\hat{N}$) is drawn from a lognormal distribution,

$$\hat{N} \sim \text{Lognormal}[\log(N) - 0.5\sigma_{\log(\hat{N})},\ \sigma_{\log(\hat{N})}] \quad (1)$$

with the bias corrected mean and standard deviation specified on the log scale. The log-scale standard deviation is

$$\sigma_{\log(\hat{N})} = \sqrt{\log\left(1 + \text{CV}_{\hat{N}}^2\right)} \quad (2)$$

with $\text{CV}_{\hat{N}}$ representing the coefficient of variation for the abundance forecast. $\text{CV}_{\hat{N}}$ is a model parameter that defines the degree of abundance forecast error.

The forecast abundance $\hat{N}$ is applied to the harvest control rule to determine the allowable exploitation rate, $\hat{F}$. The hat notation for $\hat{F}$ indicates that this exploitation rate is the target exploitation rate that is derived from an abundance forecast. For Queets coho, $\hat{F}$ was specified as the higher value of (1) $\hat{F}$ that would result in an expected escapement of 5800 adults or (2) $\hat{F} = 0.20$.

Projected natural-area adult spawner escapement E is thus

$$E = N \times (1 - F) \quad (3)$$

where N is the "true" abundance and F is the realized exploitation rate. The realized exploitation rate is a random draw from the beta distribution

$$F \sim \text{Beta}(\alpha, \beta) \tag{4}$$

with parameters

$$\alpha = \frac{1 - \hat{F}(1 + \text{CV}_F^2)}{\text{CV}_F^2} \tag{5}$$

and

$$\beta = \frac{\frac{1}{\hat{F}} - 2 + \hat{F} + (\hat{F} - 1)\text{CV}_F^2}{\text{CV}_F^2}. \tag{6}$$

The coefficient of variation for the exploitation rate implementation error, CV_F, is a model parameter that determines the degree of error between the target and realized exploitation rates.

Because escapement is estimated with error, escapement estimates $\hat{E}$ are drawn from a lognormal distribution,

$$\hat{E} \sim \text{Lognormal}[\log(E) - 0.5\sigma_{\log(\hat{E})},\ \sigma_{\log(\hat{E})}] \tag{7}$$

where the bias corrected mean and standard deviation are specified on the log scale. The log-scale standard deviation is computed in the same manner as Equation (2).

The procedure described above is repeated for each year (years 1 through 10 following the overfished status determination), and each replicate.

A stock is assumed to be rebuilt when the geometric mean of $\hat{E}$ computed over the previous three years exceed the maximum sustainable yield spawner escapement, S_{MSY}. The probability of achieving rebuilt status in year t is the cumulative probability of achieving a 3-year geometric mean greater than or equal to S_{MSY} by year t.

Results

Results for Queets coho presented here are the product of 1000 replicates in each of 10 years. The probability of being rebuilt in year t = 1 is the proportion of the 1000 replicates that resulted in the geometric mean of the estimated Queets coho escapement in t-2 (2255: the 2015 adult escapement), the estimated escapement in t-1 (5157: the 2016 adult escapement), and the simulated escapement estimate in year t (2017) exceeding S_{MSY}. For t = 2, the probability of being rebuilt is the probability that the stock was rebuilt in either t = 1 or t = 2.

Figure 4.3.a in the body of the report displays the probability of achieving rebuilt status under two management strategies: (1) the status quo control rule and (2) no fishing. For these simulations the following parameter values were assumed: $CV_{\hat{N}} = 0.2$, $CV_{\hat{E}} = 0.2$, and $CV_F = 0.1$. The parameter values were chosen because they produce reasonable levels of abundance forecast error, escapement estimation error, and implementation error for realized exploitation rates.

Rebuilding probabilities were also computed for the status quo control rule under an increased CV of the abundance forecast error ($CV_{\hat{N}} = 0.6$), the escapement estimation error CV ($CV_{\hat{E}} = 0.5$), and the CV of the exploitation rate implementation error ($CV_F = 0.2$). Figure (1) displays results for these alternative scenarios. Overall, the probability of achieving rebuilt status by year, for the status quo scenario, is relatively insensitive to increased values of these parameters.

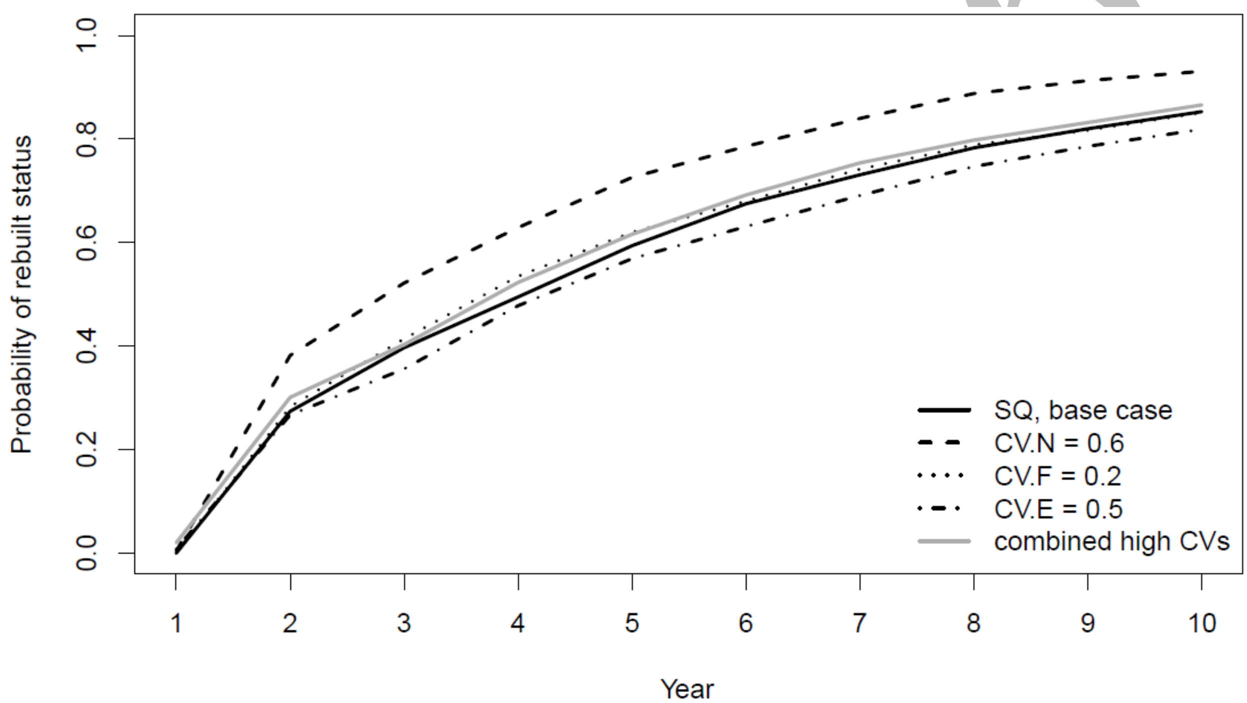

Figure 1. Probability of achieving rebuilt status in years 1 through 10, under the status quo control rule (Alternative 1) and under different parameter values.

Simulations were also performed assuming potentially biased abundance forecasts. Bias was incorporated by modifying the log-scale mean term in Equation (1) by adding the log of the observed ratio of the preseason forecast of the abundance to the postseason estimate of abundance. Thus, the mean term in Equation (1) becomes $\log(N) - 0.5\sigma_{\log(\hat{N})} + \log(r)$, where r is a drawn (with replacement) from the set of 13 ratios of forecast to observed Queets coho abundance. On the arithmetic scale this ratio ranged from 5.95 to 0.58 and r > 1 in 9 of 13 years. The average of these ratios was 1.78. Figure (2) displays the effect of including these ratios, given management under the status quo control rule. Given the positive bias in the abundance forecasts, incorporation of forecast to observed abundance ratios resulted in lower probability of rebuilding in each year relative to the base case.

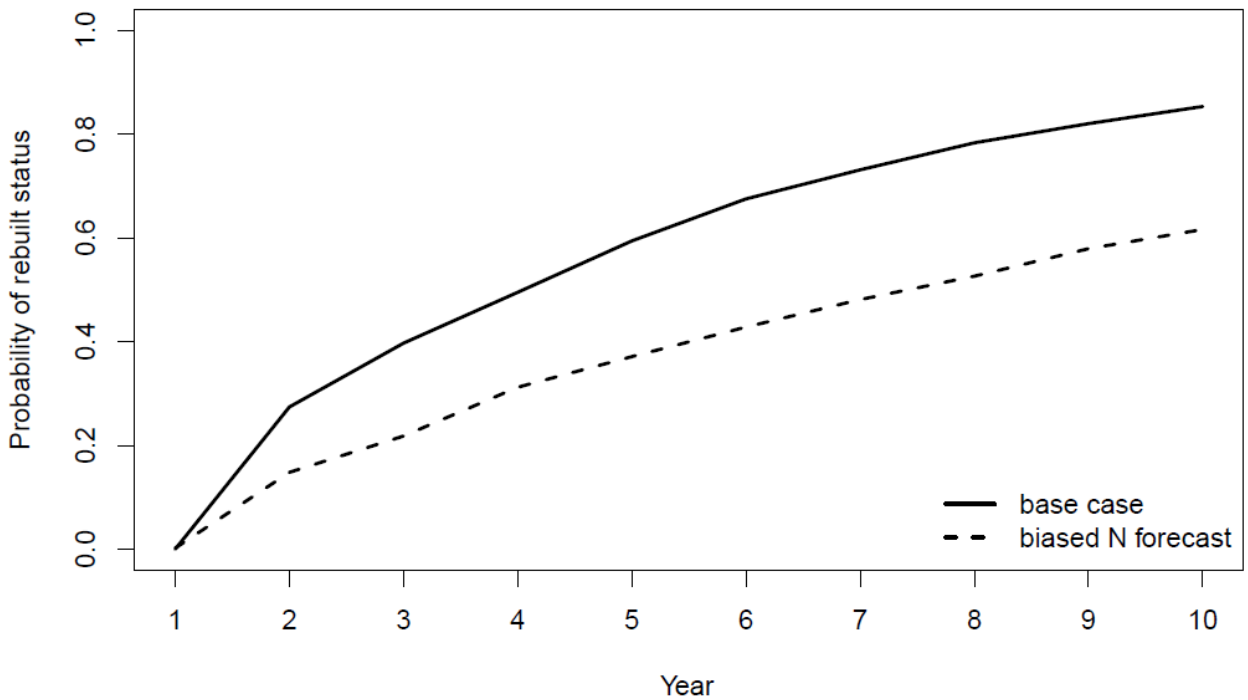

Figure 2. Probability of achieving rebuilt status under unbiased abundance forecasts and abundance forecasts that could potentially be biased.

Discussion

This model was created to allow for a quantitative assessment of alternative rebuilding plans. It shares some attributes with MSE approaches, but lacks some important features.

The model relies on random draws from past estimates of abundance to characterize future abundance. As such, autocorrelation in abundance is not modeled and there is no explicit population dynamics. Thus the model fails to capture multi-year increases or declines in abundance exhibited by many salmon stocks. Data limitations and the short time frame for development of rebuilding plans did not allow constructing a more detailed operating model.

The model also does not account for mixed stock effects, where another stock could limit access to Queets coho in ocean fisheries and thus the allowable exploitation rate is not able to be achieved. Rather, this model assumes that fisheries would be managed to target the exploitation rate specified by the control rule in each year and replicate simulation.

The probability of achieving rebuilt status each year within a 10 year window for alternative rebuilding plans is the core result of this analysis. The results for particular alternatives should be interpreted in a relative rather than absolute sense. Rebuilding periods could be much shorter or longer than these results suggest due to the vagaries of future production and fisheries.

APPENDIX C. DRAFT FINDING OF NO SIGNIFICANT IMPACT

Pending

APPENDIX D. PAST, PRESENT AND REASONABLY FORESEEABLE FUTURE IMPACTS

Pending

APPENDIX E. LIST OF AGENGIES AND PERSONS CONSULTED

Pending, incomplete

The following public meetings were held as part of the salmon management process (Council-sponsored meetings in bold):

March 2018
April 2018
May 17, 2018
June, 2018:
August 2018
September 2018

The following organizations were consulted and/or participated in preparation of supporting documents:

California Department of Fish and Wildlife
Oregon Department of Fish and Wildlife
Washington Department of Fish and Wildlife

National Marine Fisheries Service, West Coast Region, Sustainable Fisheries Division
National Marine Fisheries Service, Northwest Fisheries Science Center
National Marine Fisheries Service, Southwest Fisheries Science Center
U.S. Fish and Wildlife Service, Columbia River Fisheries Program Office
United States Coast Guard

Northwest Indian Fisheries Commission
Columbia River Intertribal Fish Commission
West Coast Indian Tribes

APPENDIX F. REGULATORY IMPACT REVIEW

Pending

APPENDIX G. INITIAL REGULATORY FLEXIBILITY ANALYSIS

Pending

APPENDIX H. NATIONAL STANDARDS ANALYSIS

Pending

APPENDIX I. CONSISTENCY WITH OTHER APPLICABLE LAWS ANALYSIS

Pending, incomplete

- MSA
- CZMA
- ESA
- MMPA
- MBTA
- PRA
- EO 12898 Environmental Justice
- EO 13132 Federalism
- EO 13175 Tribal Consultation and Coordination
- Regulatory Flexibility Act
- EO 12866 Regulatory Planning and Review
- EO 13771 Reducing Regulation and Controlling Regulatory Costs