Agenda Item G.1
Attachment 4 (**Electronic Only**)
June 2019

DRAFT 11
QUEETS RIVER NATURAL COHO

(MAY, 2019)

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

PLEASE NOTE: COMMENTS AND REVIEW SHOULD BE CONCENTRATED ON THE PORTION OF THIS DOCUMENT THAT IS FOCUSED ON THE SALMON REBUILDING PLAN, WHICH ARE MAINLY SECTIONS 1-5, AND ANY APPENDICES NOTED IN THOSE SECTIONS. ALL DATA IS CONSIDERED PRELIMINARY, AND SOME ANALYSIS IS INCOMPLETE.

THIS IS AN INTEGRATED DOCUMENT AND SOME PORTIONS OF THE DOCUMENT [INDICATED BY AN ASTERISK (*)] CANNOT BE COMPLETED AT THIS TIME. THE 'PENDING DATA' OUTSIDE OF SECTIONS 1-5 WILL BE DEVELOPED AT A LATER DATE BY NMFS, AND MADE AVAILABLE FOR PUBLIC COMMENT THROUGH THE NOTICE-AND-COMMENT RULEMAKING PROCESS.

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LIST OF ACRONYMS AND ABBREVIATIONS

ABC	acceptable biological catch
ACL	annual catch limit
BY	brood year
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
ISBM	individual stock-based management
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
OFL	overfishing limit
OY	Optimum Yield
PDO	Pacific Decadal Oscillation
PFMC	Pacific Fishery Management Council (Council)
PSC	Pacific Salmon Commission
PST	Pacific Salmon Treaty
QIN	Quinault Indian Nation
S_{ABC}	spawning escapement associated with ABC
S_{ACL}	spawning escapement associated with ACL (= S_{ABC})
S_{MSY}	MSY spawning escapement
S_{OFL}	spawning escapement associated with the overfishing limit (= S_{MSY})
STT	Salmon Technical Team (formerly the Salmon Plan Development Team)
WDFW	Washington Department of Fish and Wildlife

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.

The long-term average (1976-2017) natural escapement of Queets coho just over 6,100 spawners. Over the most recent 10 years (2008-2017), average natural spawner escapement has averaged about 6,400 fish, which includes the very low return year of 2015. (Table 2.0.a, Figure 2.0.a).

Table 2.0.a. Queets coho spawning escapement.

	Spawning Escapement[b/]			
Year[a/]	Hatchery	Supplemental	Natural	Total
2000	3,834	682	8,097	12,613
2001	6,491	1,080	23,890	31,461
2002	2,240	1,065	13,968	17,273
2003	7,002	1,081	9,846	17,929
2004	3,985	1,225	7,484	12,694
2005	7,843	432	6,539	14,814
2006	2,946	-	5,612	8,558
2007	1,954	-	4,600	6,554
2008	3,461	-	4,629	8,090
2009	14,151	-	9,204	23,355
2010	10,326	-	11,261	21,587
2011	12,887	-	8,588	21,475
2012	1,090	-	4,285	5,375
2013	9,680	-	5,684	15,364
2014	12,271	-	7,558	19,829
2015	3,315	-	2,028	5,343
2016	6,985	-	5,156	12,141
2017	9,947	-	5,232	15,179
GOAL			5,800-14,500	

a/ In 2004, 2005 and 2006 escapement estimates are from non-standard methods due to poor survey conditions during the coho spawning season.

b/ Natural escapement estimates include fish taken for hatchery brood stock.

Source: PFMC 2018 Review of Ocean Fisheries, Table B-31

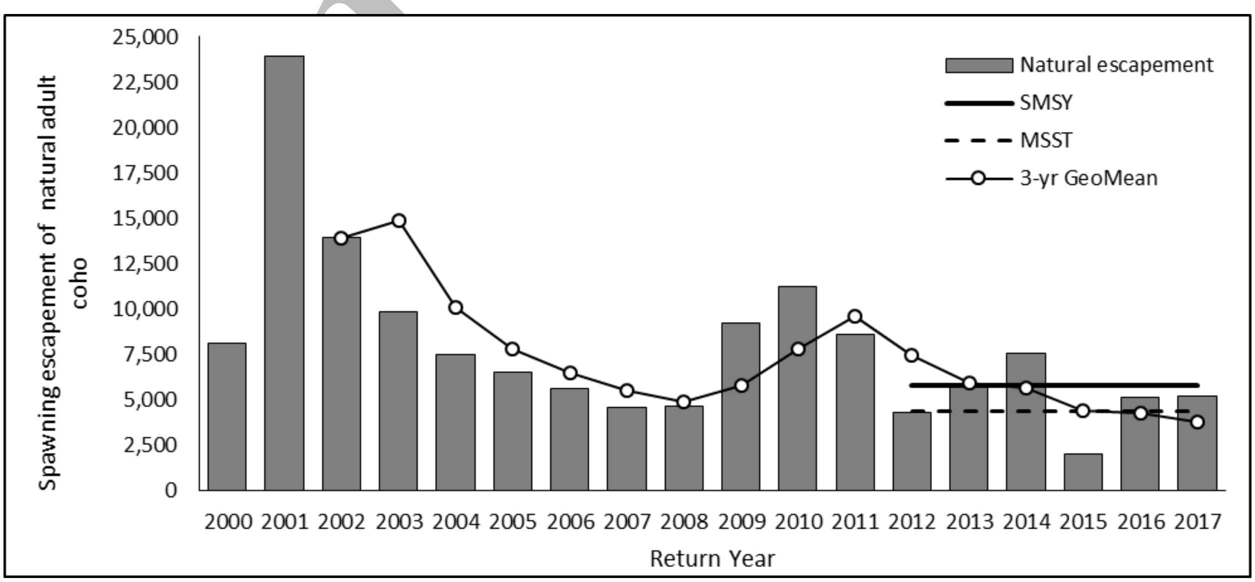

Figure 2.0.a. Spawning escapement of adult natural Queets coho

2.1 Magnuson-Stevens Fishery Conservation and Management Act

The following is a review of NMFS' MSA National Standard 1 (NS1) guidelines regarding rebuilding plans (50 CFR 600.310(j)), and how these guidelines interface with the salmon FMP (e.g., required elements T_{target}, T_{MIN}, and T_{MAX}).

NMFS has developed guidelines for complying with the NS1 provisions of section 301 of the MSA (50 CFR 600.310). Under these guidelines, rebuilding plans must include the following elements; including these elements in rebuilding plan alternatives allows the Council to make an informed decision on adopting rebuilding plans.

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

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

T_{MAX}: the maximum time for rebuilding a stock to B_{MSY} (S_{MSY} for salmon). If T_{MIN} is less than 10 years, T_{MAX} is 10 years.

To be approved, a rebuilding plan must identify T_{target} and state how the plan will accomplish rebuilding to S_{MSY} within that time (e.g., the identified harvest strategy).

To estimate T_{MIN}, an impact rate of zero is assumed, meaning all fisheries affecting the stock would cease until the stock was rebuilt. Because the Council does not have jurisdiction over tribal, in-river, and other fisheries that may impact the stock, a 'no-fishing' alternative is not a viable option for the Council to consider. Also, a 'no-fishing' alternative does not meet the purpose and need because it would restrict tribal fisheries in a manner that is inconsistent with their treaty right.

However, because T_{MIN} does serve as a bookend in the analysis of rebuilding probabilities over a ten year period when assuming an exploitation rate of zero, this 'T_{MIN} scenario' fulfills the requirement of National Standard 1 in calculating the minimum time (T_{MIN}) estimated to achieve rebuilt status. It is for this purpose only that the 'T_{MIN} scenario' is included in this document (See Sections 4 and 5).

2.2 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).

2.2.1 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.

2.2.2 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.

2.3 Stock overview

Queets River coho is recognized as one of thirteen key management units (MU) of naturally spawning coho stocks under the Pacific Salmon Treaty (PST). The PST provides a southern coho management plan that specifies how U.S. and Canadian fisheries impact coho salmon originating in British Columbia, Washington and Oregon. It also establishes monitoring objectives and funding mechanisms that have been critical to the intensive monitoring of juvenile and adult life stages for Queets coho.

Domestically, the Queets coho run is managed as a unit under the determinations of the *U.S. District Court in U.S. v. Washington, 384 F. Supp. 312 (W.D. Wash. 1974), and Hoh Indian Tribe v. Baldrige, 522 F. Supp. 683 (W.D. Wash. 1981).*

2.3.1 Stock composition

There are currently two components to the run: (1) natural and (2) hatchery. A wild stock supplementation program initiated with the 1984 brood was discontinued with the final release occurring in 2004.

<u>Natural Production</u>

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).

Supplemental Production

The abundance of Queets natural coho relative to the established escapement goal range has frequently limited ocean and terminal fisheries. Cyclical climatic and oceanographic conditions have led to periods of low smolt to adult survival. Degraded habitats in the Clearwater basin and Queets tributaries and dynamic environments within the Queets basin cause substantial variability in freshwater production. To address chronic production limits in the Queets system, a supplementation program was developed beginning with the 1984 brood. The program was designed to stabilize and improve the stock status of natural coho. The program used natural-origin broodstock, reared progeny in a hatchery environment to a pre-smolt stage, acclimated juveniles in natural, off-channel habitats in the vicinity of broodstock capture and allowed volitional migration. All production was adipose clipped and coded-wire tagged to ensure none of the adult returns were utilized for broodstock. Returning fish were allowed to spawn naturally in order to supplement fry recruitment. Results of the program indicated that the supplementation protocols used could produce smolts with nearly the same survival rate to adults as that of wild smolts and increase adult abundance without short-term adverse impacts to intrinsic productivity or overall smolt production. Reinitiating the program with the same operational protocols and associated monitoring programs could contribute to future improvement and stabilization of stock status while habitats are being repaired through ongoing restoration efforts.

Hatchery Production

The Quinault Indian Nation operates a fish culture facility at river mile 4 on the Salmon River, a major tributary entering the Queets river at river mile 10.1. Coho released at this facility are early-timed stock derived from Quinault National Fish Hatchery located on the lower Quinault River. Broodstock are now collected from adult returns to the Salmon River facility. The early run timing of this segregated stock allows an intensive terminal area fishery to occur before the peak entry timing of wild coho. Straying is minimized within the Salmon River sub-basin through the operation of an adult collection trap located downstream of the hatchery water intake diversion. Virtually no straying is observed outside of the Salmon River sub-basin. Hatchery origin coho spawn through early November with peak activity occurring in early October and the highest spawning densities occurring within the main stem of Salmon River. The spawn timing and spatial extent of this stock places the stock at a competitive disadvantage compared to natural stock.

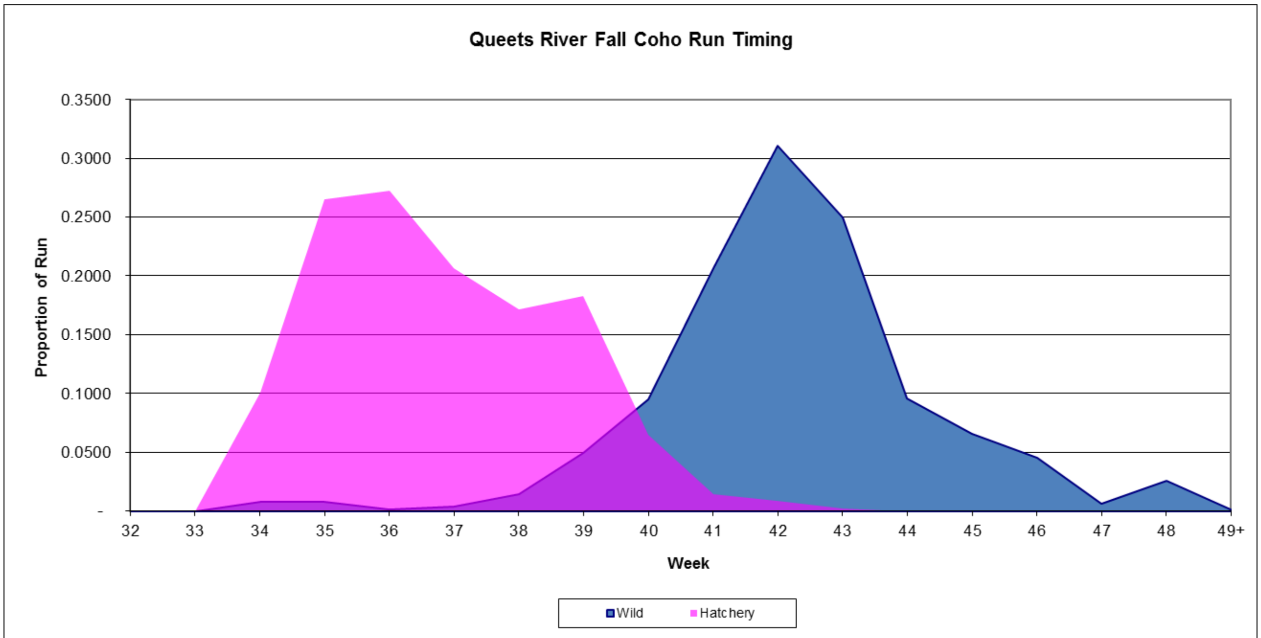

Figure 2.3.1.a. Queets coho run timing of hatchery and wild fish.

2.3.2 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).

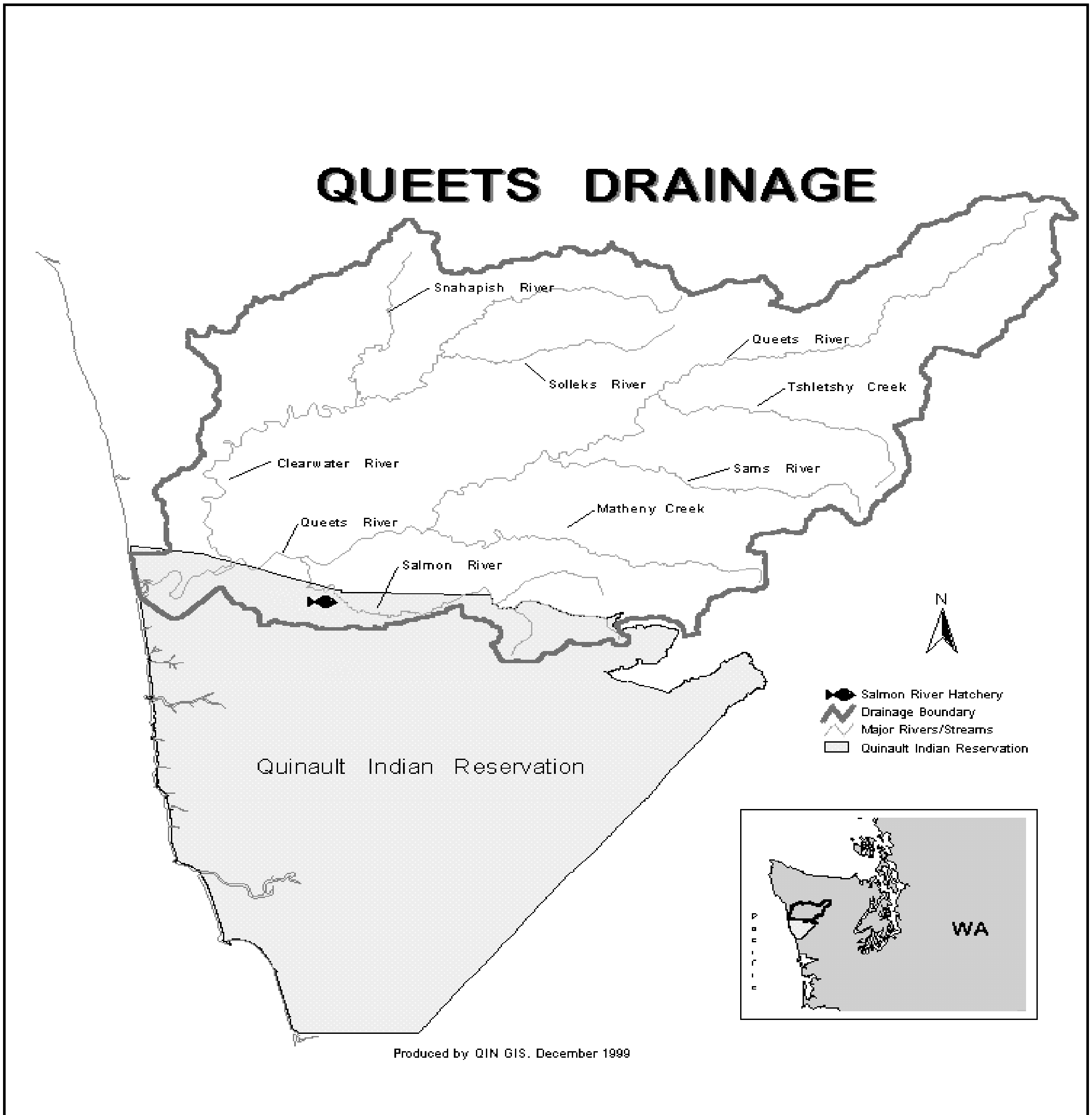

Figure 2.3.2.a. Location of the Queets River Basin.

2.4 Management Overview

Queets River coho are one of four coastal (or outside) coho MU's included in the coho chapter of the PST. Under the PST, outside 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 maximum allowable exploitation rate is the maximum exploitation rate that would meet the escapement goal given the current year's abundance (CoTC, 2013). This rate determines the abundance category of Washington outside coho MU's under the coho chapter of the PST (Table 2.3.a), which in turn places limits on the allowable total exploitation rate in intercepting Canadian fisheries. For example, if two or more of the WA coastal coho MUs are in the low abundance category, the maximum allowable exploitation rate in Canadian fisheries on those MUs is 10%; if one of the Washington coastal coho MUs in the low category, the maximum allowable ER on it in Canadian fisheries is 12%.

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%

2.4.1 Conservation objectives

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).

2.4.2 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

A number of factors may contribute to a stock falling below the MSST and becoming classified as overfished. Fishing mortality may be higher than was expected when management measures were adopted, or the abundance may be less than forecast. Abundance may be less than forecast because low freshwater survival resulted in fewer smolts than expected, or because low marine survival resulted in fewer adult returns than expected. Freshwater and/or marine survival may be low enough, that even if anticipated, there will simply be too few adults produced to prevent the stock from falling below the MSST, even in the absence of fishing. The FMP specifies that the roles of freshwater survival, marine survival, and fishing should be considered in any rebuilding plan.

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).

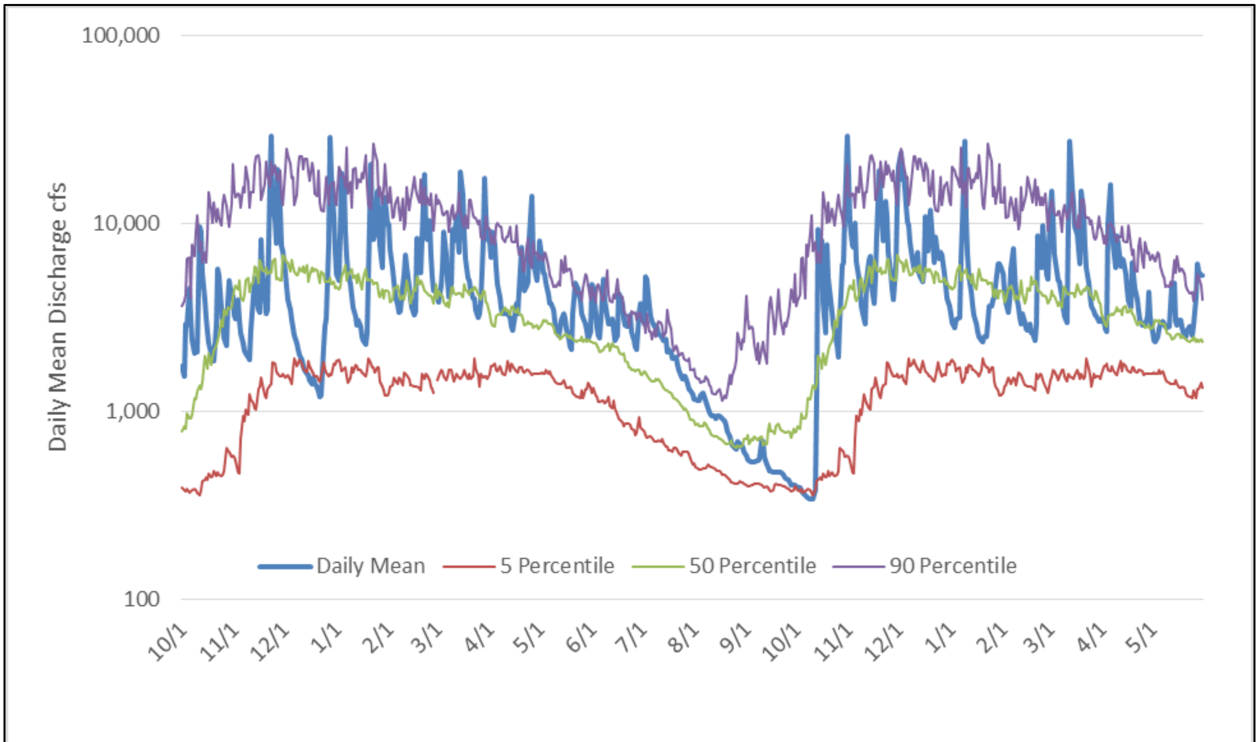

Figure 3.1.1.a: Daily mean discharge measurements for the Queets River for October 2011 through May 2013. Values for the 5, 50 and 90 percentile flow levels derived from approximately 63 years of record are also shown. For example, the 5-percentile flow is the level at which 5 percent of flows are equal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

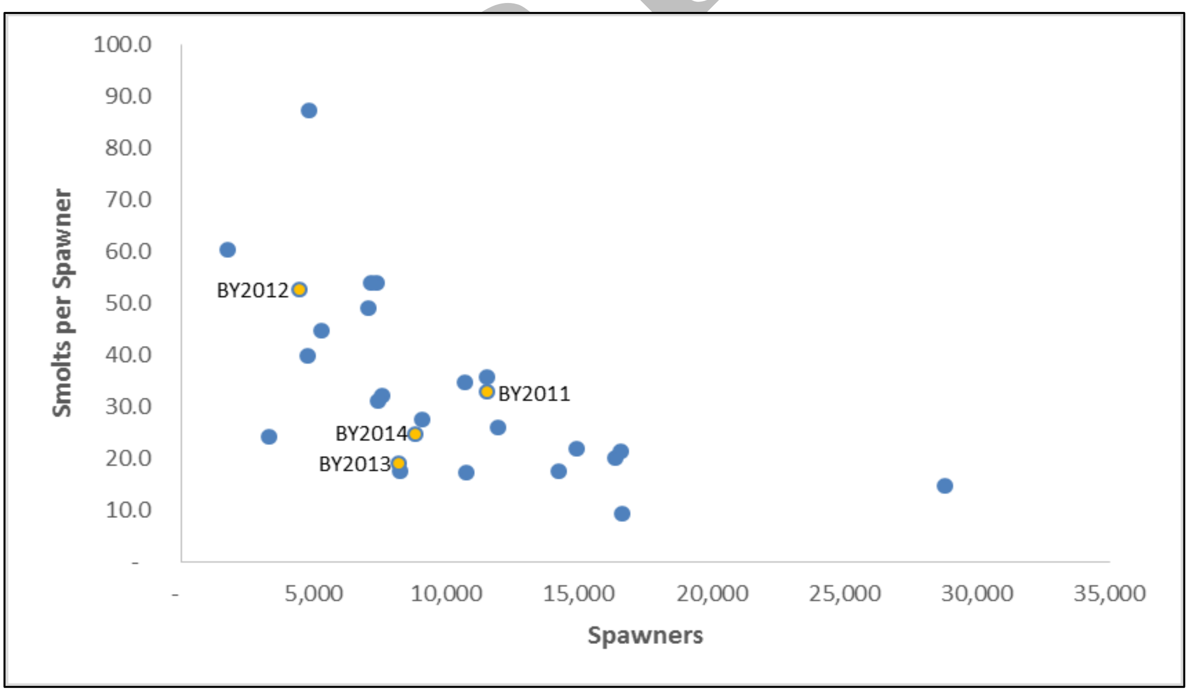

Figure 3.1.1.b Coho smolts-per-spawner as a function of natural spawning escapement of Queets River coho salmon for brood years 1989 through 2014. Note: the estimates of spawning escapement include all natural spawners including hatchery origin returning fish. The brood years 2011-2014 are highlighted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

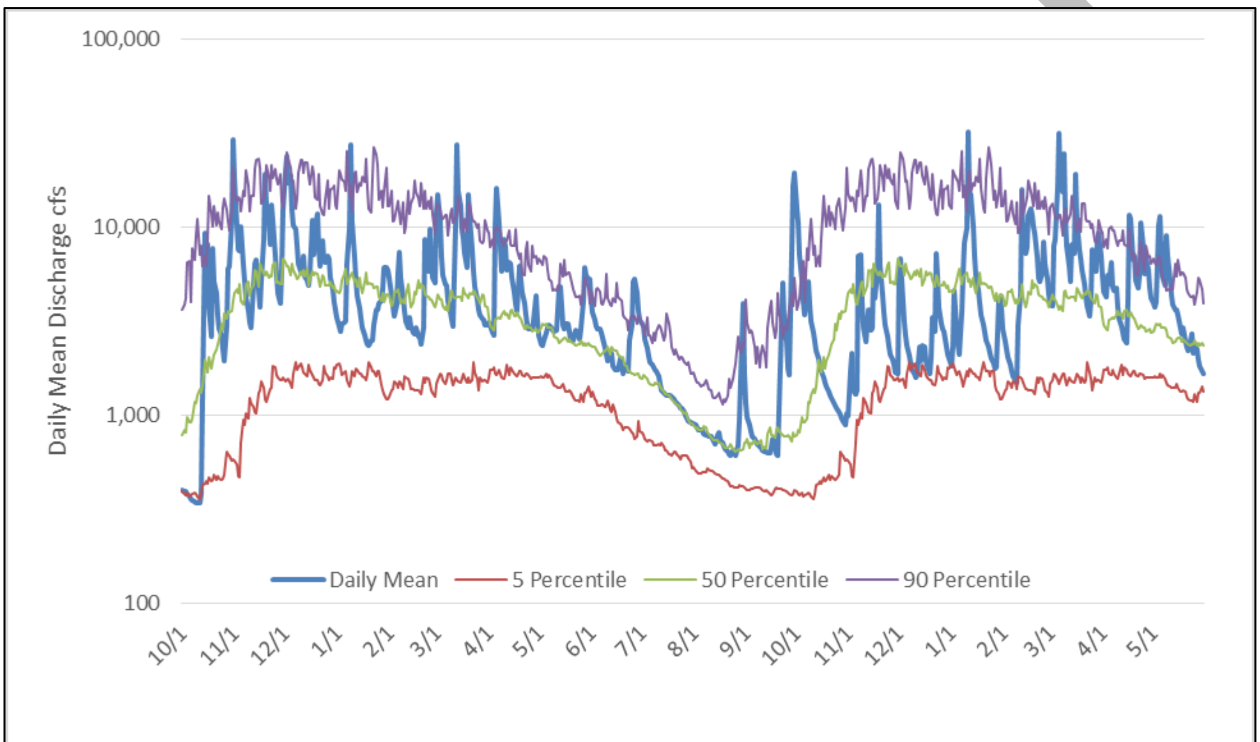

Figure 3.1.1.c: Daily mean discharge measurements for the Queets River for October 2012 through May 2014. Values for the 5, 50 and 90 percentile flow levels derived from approximately 63 years of record are also shown. For example, the 5-percentile flow is the level at which 5 percent of flows are equal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

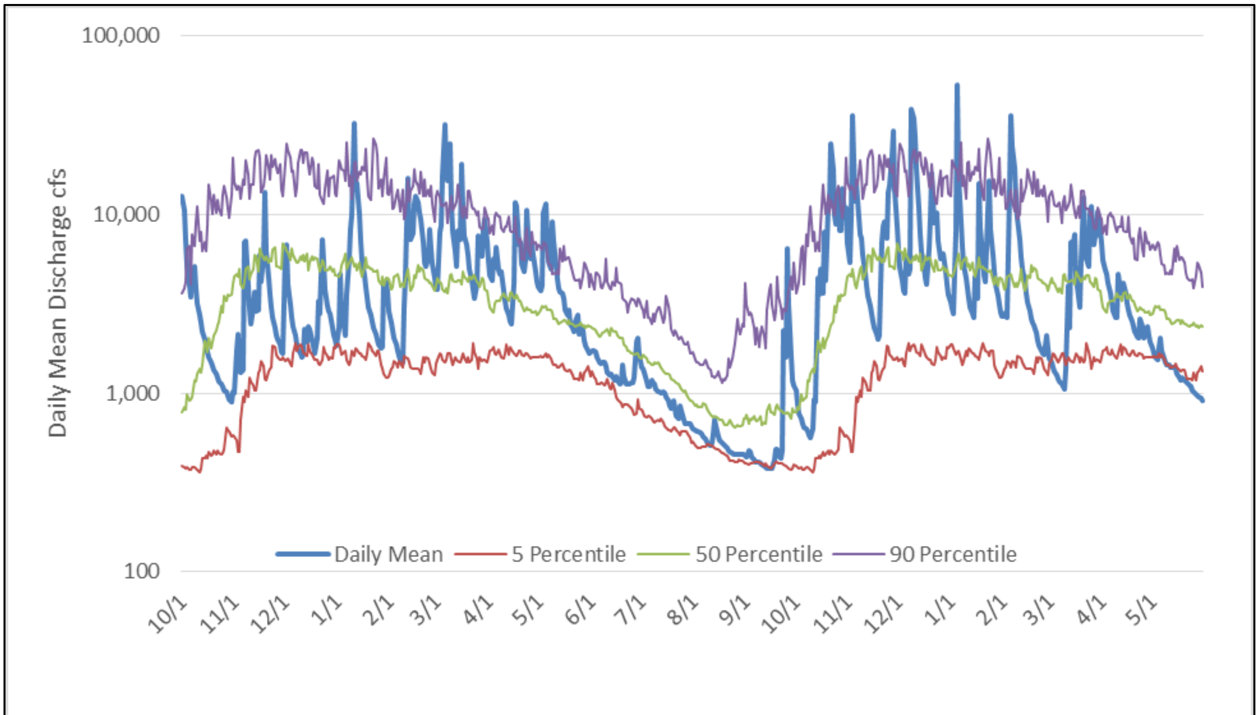

Figure 3.1.1.d: Daily mean discharge measurements for the Queets River for October 2013 through May 2015. Values for the 5, 50 and 90 percentile flow levels derived from approximately 63 years of record are also shown. For example, the 5-percentile flow is the level at which 5 percent of flows are equal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

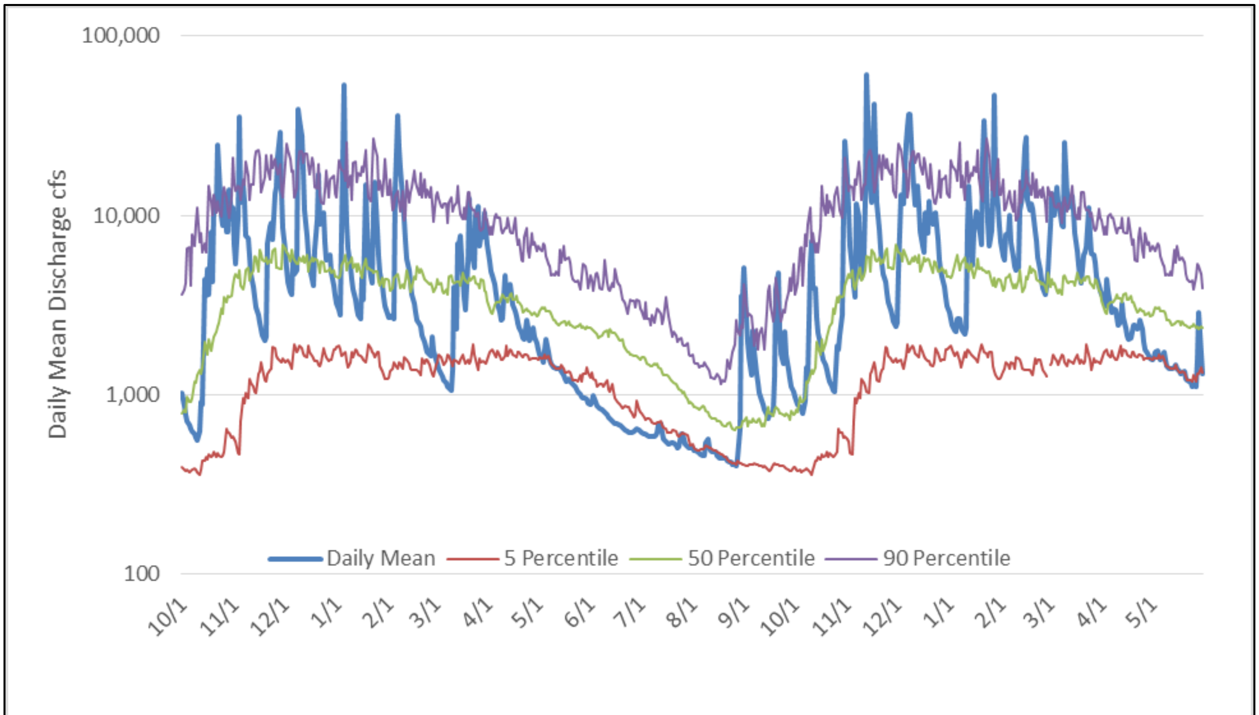

Figure 3.1.1.e: Daily mean discharge measurements for the Queets River for October 2014 through May 2016. Values for the 5, 50 and 90 percentile flow levels derived from approximately 63 years of record are also shown. For example, the 5-percentile flow is the level at which 5 percent of flows are equal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

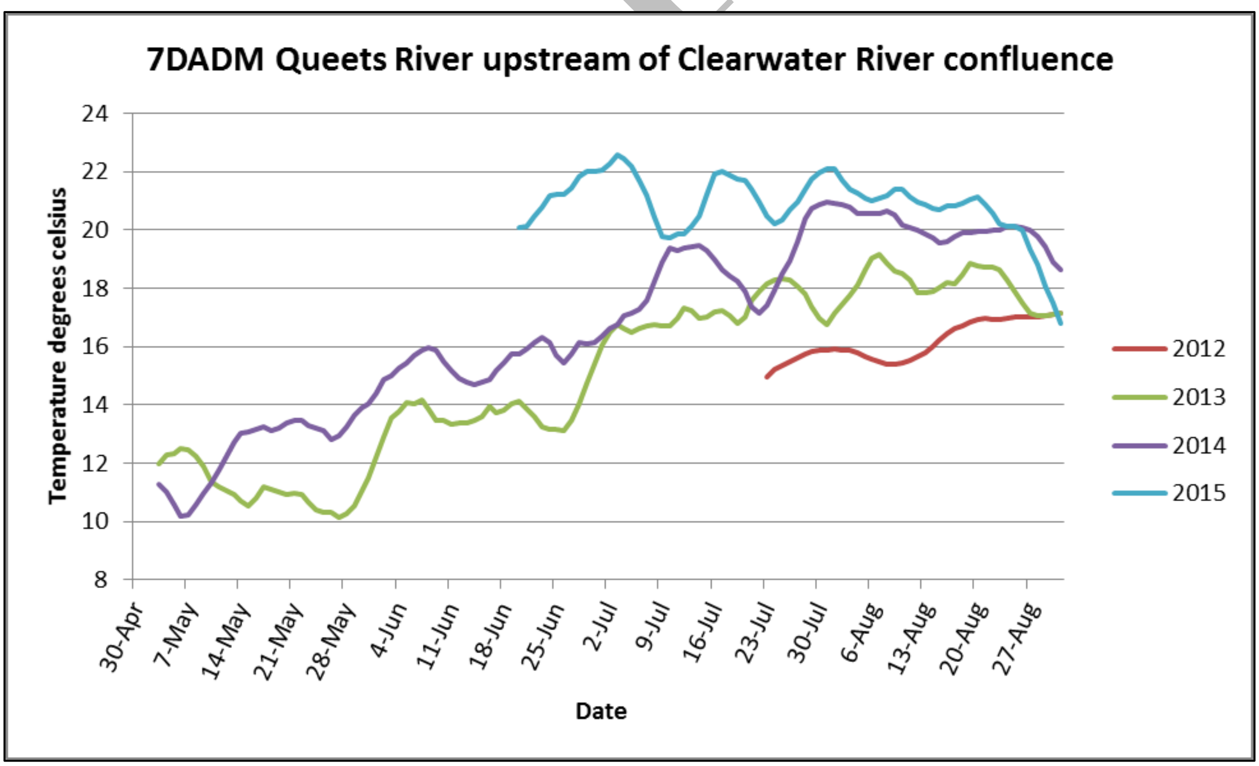

Figure 3.1.1.f: Seven day average daily maximum water temperatures (degrees celsius) measured from 4/30-8/31 for years 2012-2015.

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.

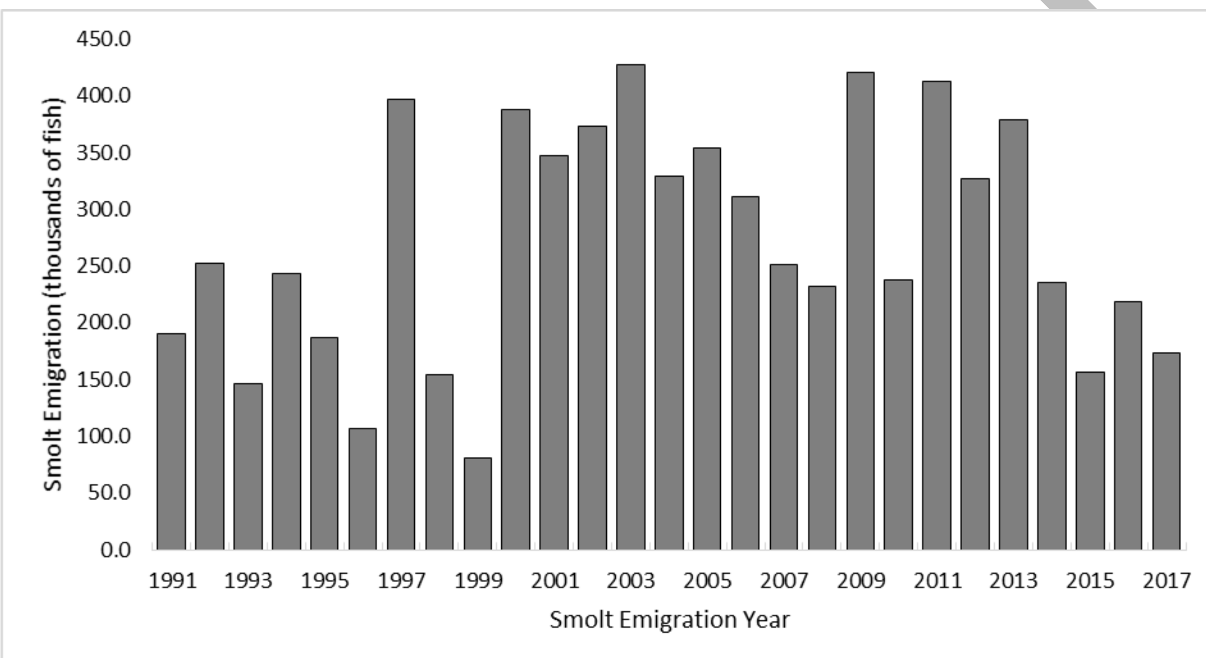

Figure 3.1.2.a. Natural smolt production of Queets River coho salmon by smolt year (data from QIN).

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 2018). 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	2017	2018
PDO (Sum Dec-March)	18	6	3	13	7	20	12	16	14	9	5	1	15	4	2	8	10	21	19	17	11
PDO (Sum May-Sept)	10	4	6	5	11	17	16	18	12	14	2	9	7	3	1	8	19	21	20	15	13
ONI (Average Jan-June)	20	1	1	7	14	16	15	17	9	12	3	11	18	4	6	8	10	19	21	13	5
46050 SST (°C; May-Sept)	16	9	3	4	1	8	21	15	5	17	2	10	7	11	12	13	14	20	18	6	19
Upper 20 m T (°C; Nov-Mar)	20	11	8	10	6	15	16	12	13	5	1	9	17	4	3	7	2	21	19	18	14
Upper 20 m T (°C; May-Sept)	17	12	14	4	1	3	21	19	7	8	2	5	13	10	6	18	20	9	15	11	16
Deep temperature (°C; May-Sept)	21	6	8	4	1	10	12	16	11	5	2	7	14	9	3	15	20	18	13	17	19
Deep salinity (May-Sept)	19	3	9	4	5	16	17	10	6	1	2	14	18	13	12	11	20	15	8	7	6
Copepod richness anom. (no. species; May-Sept)	19	2	1	7	6	14	13	18	15	10	8	9	17	4	5	3	11	20	21	16	12
N. copepod biomass anom. (mg C m^{-3}; May-Sept)	19	14	10	11	3	16	13	20	15	12	6	9	8	1	2	4	5	17	21	18	7
S. copepod biomass anom. (mg C m^{-3}; May-Sept)	21	2	5	4	3	14	15	20	13	10	1	7	16	9	8	6	11	18	19	17	12
Biological transition (day of year)	18	8	5	7	9	14	13	19	12	2	1	3	16	6	10	4	11	21	21	17	15
Ichthyoplankton biomass (mg C 1,000 m^{-3}; Jan-Mar)	21	12	3	8	10	19	18	15	17	16	2	13	5	14	11	9	20	6	7	1	4
Ichthyoplankton community index (PCO axis 1 scores; Jan-Mar)	10	13	2	7	5	11	20	18	3	12	1	14	15	8	4	6	9	19	21	17	16
Chinook salmon juvenile catches (no. km^{-1}; June)	19	4	5	16	8	12	17	20	11	9	1	6	7	15	3	2	10	13	18	21	14
Coho salmon juvenile catches (no. km^{-1}; June)	19	8	13	6	7	3	16	20	17	5	4	10	11	15	18	1	12	9	14	21	2
Mean of ranks	17.9	7.2	6.0	7.3	6.1	13.0	15.9	17.1	11.3	9.2	2.7	8.6	12.8	8.1	6.6	7.7	12.8	16.7	17.2	14.5	11.6
Rank of the mean rank	21	5	2	6	3	15	17	19	11	10	1	9	13	8	4	7	13	18	20	16	12
Ecosystem Indicators not included in the mean of ranks or statistical analyses																					
Physical Spring Trans. UI based (day of year)	3	7	20	17	4	13	15	21	13	1	6	2	8	11	18	9	19	10	5	16	11
Physical Spring Trans. Hydrographic (day of year)	20	3	13	8	5	12	14	21	6	9	1	9	18	3	11	2	16	7	17	19	14
Upwelling Anomaly (April-May)	10	3	17	6	9	14	13	21	10	4	7	8	15	17	15	12	19	1	2	20	5
Length of Upwelling Season UI based (days)	6	2	19	12	1	14	10	21	5	3	9	3	16	18	16	15	20	11	8	13	7
SST NH-5 (°C; May-Sept)	9	6	5	4	1	3	21	16	10	18	2	19	11	7	14	13	15	12	17	8	20
Copepod Community Index (MDS axis 1 scores)	20	3	4	8	1	13	15	18	16	10	2	6	12	9	7	5	11	19	21	17	14
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	NA	NA

Figure 3.2.1.a. Summary of marine indicators from 1998-2018. 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 21 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. Source: NWFSC.

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.

In 2017, the anomalous warm ocean conditions that have persisted since September of 2014 might be dissipating. While ocean ecosystem indicators in 2015 and 2016 suggested some of the poorest outmigration years for juvenile salmon survival in the 20 year time series, some of the indicators in 2017 were fair, indicating that the ecosystem might be returning to normal. The PDO was strongly positive (warm) throughout the first half of 2017, however the index declined to more neutral levels from July through November 2017. Strong La Niña conditions at the equator persisted from August through December of 2016, and then became neutral throughout most of 2017. Prior to the onset of upwelling in 2017, ocean conditions off Newport Oregon remained warm and fresh. However, after the onset of upwelling, sea surface temperatures were cooler than average and the near bottom water on the shelf was salty. In 2015 and 2016, the seasonal shift from a warm winter copepod community to a cold summer community did not occur because of the extended period of warm ocean conditions. However, in June 2017, the copepod community transitioned to a cold water community, signaling that the marine ecosystem might be transitioning back to normal.

In 2018, the anomalous warm ocean conditions that had persisted since September of 2014 are dissipating. While ocean ecosystem indicators in 2015 and 2016 remain some of the poorest outmigration years for juvenile salmon survival in the 21 year time series, some of the indicators in 2017 were fair, while the indicators in 2018 pointed towards neutral conditions, indicating that the ecosystem might be returning to normal. However, sea surface temperatures in the Northeast Pacific are anomalously warm with a spatial pattern similar to the "Blob" in late 2013. Further, model projections point towards warm ocean conditions of approximately +1°C in the Northeast Pacific through spring 2019.

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).

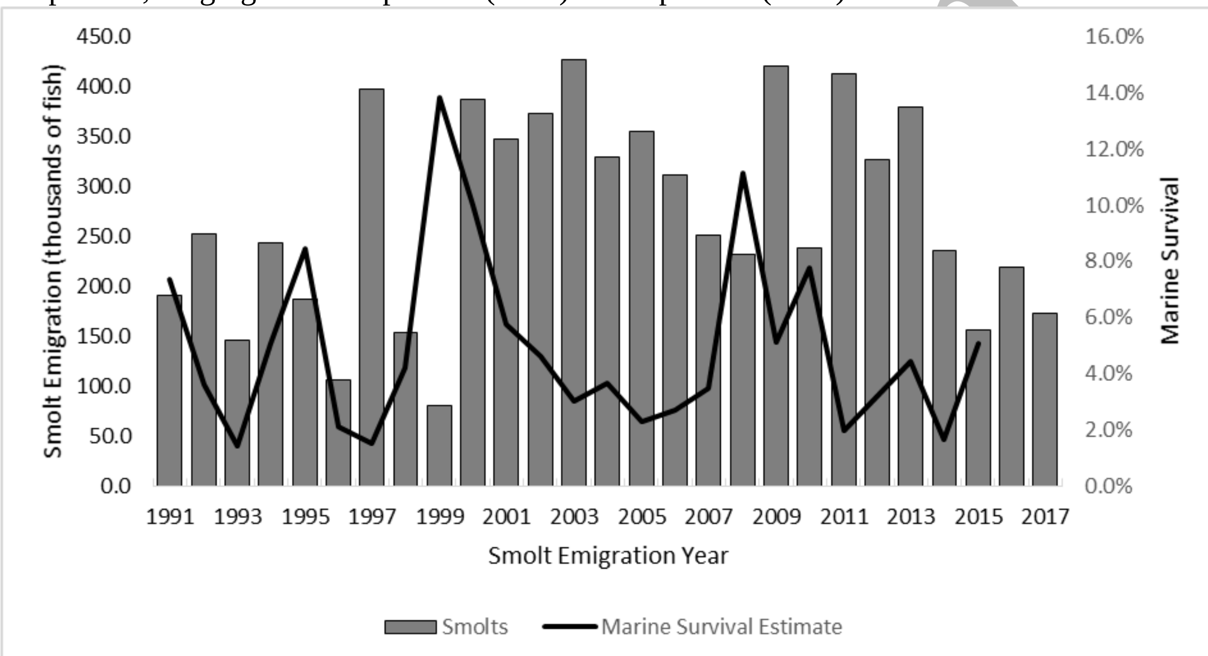

Figure 3.2.a. Marine survival of Queets River natural coho by smolt year.

3.3 Harvest Impacts

3.3.1 Ocean Fisheries

Season Descriptions

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.

Commercial Ocean Seasons

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. In 2017 and 2018, the troll fishery was assigned minimal coho quotas, and no non-selective coho fisheries occurred.

The Treaty Indian troll fishery was open from July through mid-September in 2014, 2015, 2017 and 2018 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. In 2017 and 2018, recreational salmon fisheries were assigned minimal coho quotas, and seasons were shortened relative to most recent years, ending on Labor Day. No non-selective coho fisheries occurred in 2016, 2017, or 2018.

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. In 2017, mark-selective coho retention was allowed in late June and July, and in 2018, mark-selective coho retention was allowed late June through early September. Unmarked coho retention was allowed all years in September.

Ocean Harvest

Table 3.3.1.a shows coho quotas and catch by fishery during the period 2014 through 2018. During the three (critical) years that resulted in the overfished status, ocean harvest of coho 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 2017 and 2018, coho harvest remained restricted relative to recent years prior to 2016. 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, 96 percent of the 60,100 coho quota in 2017, and 91 percent of the 60,100 coho quota in 2018.

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	62,500	55,897	89%	42,500	3,983	9%	-	-	-
NON-INDIAN COMMERCIAL TROLL	35,200	23,141	66%	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%**

	2017			2018		
Fishery Governed by Quota or Guideline	Quota	Catch	Catch/ Quota	Quota	Catch	Catch/ Quota
NORTH OF CAPE FALCON						
TREATY INDIAN COMMERCIAL TROLL	12,500	13,084	105%	12,500	11,301	90%
NON-INDIAN COMMERCIAL TROLL	2,500	1,838	74%	4,600	1,384	30%
RECREATIONAL	45,100	42,658	95%	43,000	41,838	97%
TOTAL NORTH OF CAPE FALCON	**60,100**	**57,580**	**96%**	**60,100**	**54,523**	**91%**
SOUTH OF CAPE FALCON						
RECREATIONAL						
Coho mark-selective	18,000	6,177	34%	35,000	11,601	33%
Coho non-mark-selective	7,900	8,451	107%	7,600	6,898	91%
TOTAL SOUTH OF CAPE FALCON	**25,900**	**14,628**	56%	**42,600**	**18,499**	43%
GRAND TOTAL COUNCIL AREA	**86,000**	**72,208**	**84%**	**102,700**	**73,022**	**71%**

Source: PFMC Review of Ocean Fisheries, Table I-6, Feb 2015, Feb 2016, Feb 2017, Feb 2018, Feb 2019

3.3.2 In-river fisheries

<u>Tribal fisheries</u>

Terminal area fishing regimes were established by QIN and WDFW in 2014-2016 using estimates of ocean escapement from the FRAM and estimated harvest rates to target agreed levels of spawning escapements for Queets Coho. In-river fall season fisheries regulated by QIN target comingled stocks of hatchery coho, natural coho and chinook while limiting impacts on the weakest stock. Annual fishery management plans include adjustments to the timing and duration of fishing seasons and gear restrictions in order to meet annual management objectives. Effort in the commercial gillnet fishery is typically front-loaded to optimize harvest of early returning hatchery coho and effort is reduced through the season when natural stocks are expected to be depressed.

Inriver fisheries in 2014 were directed at both hatchery and natural coho and chinook. The expected treaty harvest rate on natural coho was 25.3 percent. Fisheries were prosecuted as planned with a post season harvest rate of 19.4 percent.

Inriver fisheries in 2015 were directed at early-timed hatchery coho and natural and hatchery chinook. The expected treaty harvest rate on natural coho was 14.5 percent. Quinault enacted emergency regulations to close all tribally-regulated fisheries in late October based on in-season run size updates indicating natural coho returns were well below the minimum spawning escapement objective listed in the FMP. The actual post season harvest rate in tribal inriver fisheries was 7.9 percent.

In-river fisheries in 2016 were again directed at early-timed hatchery coho and chinook. The expected in-river tribal harvest rate on natural coho was further reduced to 7.9 percent. The post season harvest rate was 8.8 percent.

<u>River recreational fisheries</u>
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/).

<u>In-river harvest</u>

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 14 year period from 2004 through 2017, the total exploitation rate on Queets natural coho averaged 38.5 percent and ranged from a high of 53.2 percent in 2012 to a low of 14.7 percent in 2016 (Figure 3.3.3.a, Table 3.3.3.a). Over this time period, approximately 8 percent of the total exploitation occurred in Alaskan and Canadian fisheries while 20 percent occurred in Council fisheries on average. Of the remaining 72 percent, on average 12 percent occurred in other pre-terminal fisheries (primarily “dip-ins” to the Quinault and Hoh Rivers), 10 percent in freshwater sport fisheries, and 50 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).

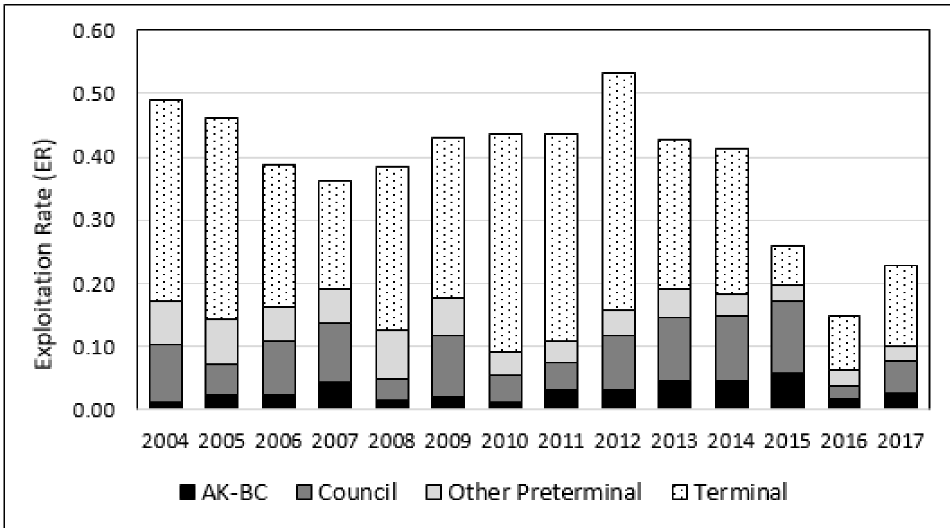

Figure 3.3.3.a. Total exploitation rates on Queets wild coho by major fishery group, estimated by postseason coho FRAM.

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[a/]**
Ocean Age 3 Abundance	13,445	12,149	8,695	6,828	7,335	18,733	19,933
Escapement	6,860	6,534	5,334	4,349	4,513	10,665	11,234
Alaska-Canada	1.3%	2.4%	2.2%	4.4%	1.6%	2.1%	1.1%
NOF - Treaty Troll	3.8%	2.3%	5.3%	4.2%	1.9%	4.5%	1.2%
NOF - Nontreaty Troll	1.7%	1.1%	1.6%	1.5%	0.5%	1.7%	1.6%
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%	3.7%
Terminal Sport	9.3%	6.1%	0.4%	2.2%	6.7%	3.4%	3.3%
Terminal Net	22.6%	25.9%	22.1%	15.1%	19.1%	22.0%	31.3%
Total ER	49.0%	46.2%	38.7%	36.3%	38.5%	43.1%	43.6%

Strata	**2011[a/]**	**2012[a/]**	**2013[a/]**	**2014[a/]**	**2015[a/]**	**2016[a/]**	**2017[a/]**
Ocean Age 3 Abundance	15,063	9,117	9,862	12,801	2,729	6,526	6,797
Escapement	8,512	4,264	5,646	7,521	2,020	5,566	5,248
Alaska-Canada	3.2%	3.2%	4.5%	4.5%	5.8%	1.7%	2.6%
NOF - Treaty Troll	1.3%	3.5%	4.0%	5.3%	1.2%	0.1%	1.9%
NOF - Nontreaty Troll	1.0%	1.6%	2.9%	1.2%	2.7%	0.8%	0.6%
NOF - Sport	1.5%	2.7%	2.7%	2.6%	6.4%	0.8%	1.9%
SOF all	0.4%	0.9%	0.6%	1.2%	1.0%	0.5%	0.8%
Preterminal Other	3.4%	4.1%	4.6%	3.5%	2.6%	2.6%	2.3%
Terminal Sport	6.1%	5.7%	8.4%	7.1%	0.0%	0.1%	0.0%
Terminal Net	26.6%	31.7%	15.1%	15.8%	6.3%	8.2%	12.8%
Total ER	43.5%	53.2%	42.7%	41.2%	26.0%	14.7%	22.8%

a/ 2010-2017 results are preliminary

3.4 Assessment and management

3.4.1 Abundance forecast errors

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 15 year time period between 2003 and 2017, however, the tendency was towards over forecasting, as the preseason forecast was greater than the observed returns in 10 of these years, with a mean percent error of 59 percent (Figure 3.4.1.a, Figure 3.4.1.b, Table 3.4.1.a).

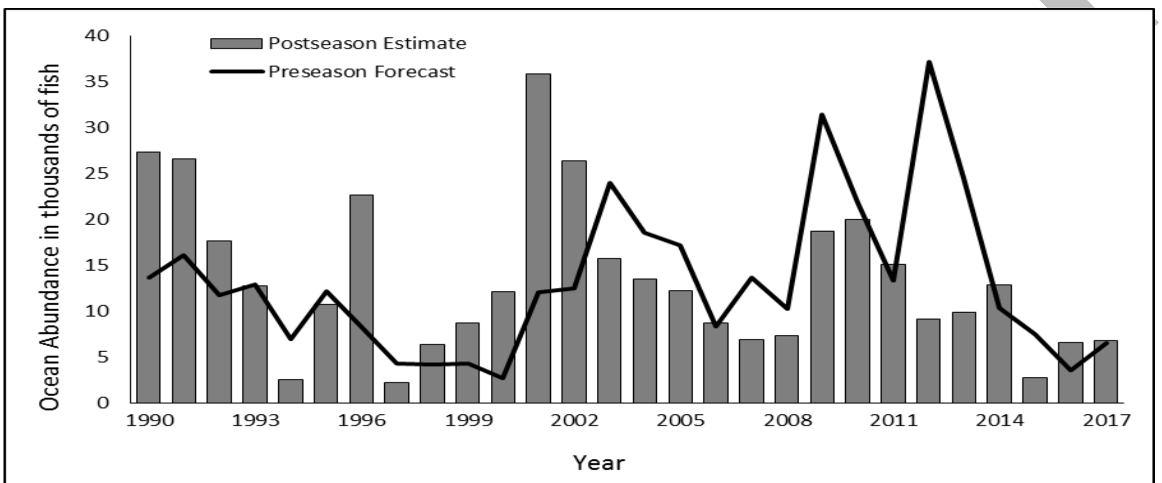

Figure 3.4.1.a. Queets River natural coho preseason forecasts and postseason FRAM estimates of ocean age 3 abundance. Preseason forecasts are generated by salmon co-managers and postseason FRAM estimates are generated by the PSC CoTC.

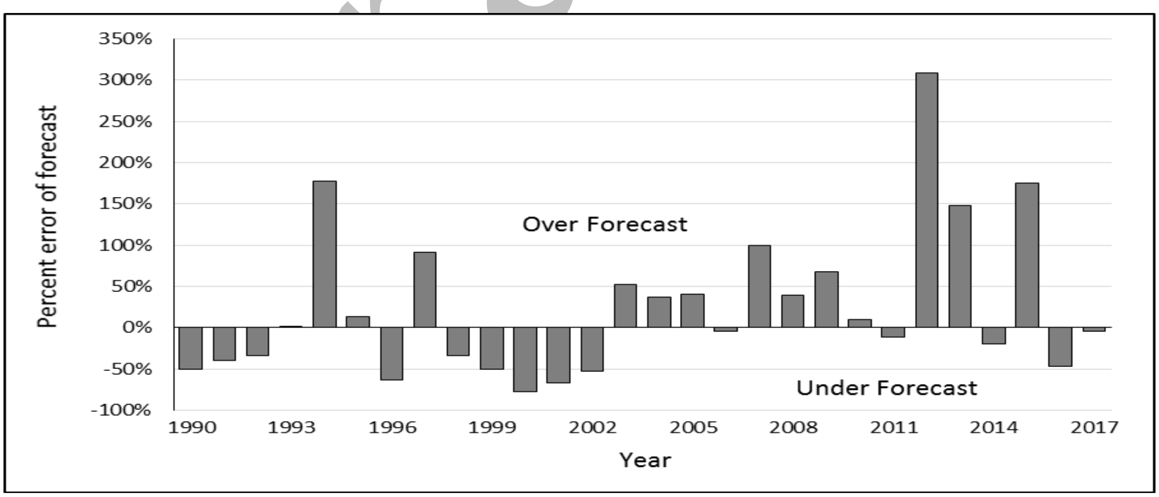

Figure 3.4.1.b. Preseason forecast error when compared to postseason estimates of ocean age 3 abundance of Queets River natural coho. Preseason forecasts are generated by salmon co-managers and postseason FRAM estimates are generated by the PSC CoTC.

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	19.9	1.09
2011	13.3	15.1	0.88
2012	37.2	9.1	4.08
2013	24.5	9.9	2.48
2014	10.3	12.8	0.80
2015	7.5	2.7	2.75
2016	3.5	6.5	0.54
2017	6.5	6.8	0.96

a/ Coho FRAM was used to estimate post season ocean abundance.
2010-2017 postseason values are preliminary.

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 84 percent and 76 percent in the preseason to 36 percent and 41 percent in the postseason, respectively.

Over the eight most recent years with postseason data available, the postseason observed ER was equal to or lower than the preseason ER in all years, with the exception of 2017 where the postseason ER was 1% higher than the preseason ER (Table 3.4.2.a). In four out of the eight 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 projection in all three years.

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 generated in FRAM modeling conducted by the PFMC Salmon Technical Team (preseason) and the PSC CoTC (postseason).

Return Year	Exploitation Rate			
	Preseason		Postseason	
	ER	ER cap[a/]	ER[b/]	ER cap[a/]
2010	0.48	0.73	0.44	0.71
2011	0.48	0.56	0.43	0.61
2012	0.62	0.84	0.53	0.36
2013	0.62	0.76	0.43	0.41
2014	0.44	0.44	0.41	0.55
2015	0.31	0.24	0.26	0.20
2016	0.18	0.20	0.15	0.20
2017	0.22	0.20	0.23	0.20
Average	0.42	0.50	0.36	0.41

a/ See CoTC 2013 for information on determination of ER caps

b/ Postseason exploitation rates are preliminary.

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 (2014-16) plus data for the most recent year available (2017). 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		2016		2017	
FISHERY COMPONENT	**Preseason**	**Postseason**	**Preseason**	**Postseason**	**Preseason**	**Postseason**	**Preseason**	**Postseason**
Ocean Age 3 Abundance	10,348	12,801	7,590	2,729	3,520	6,526	6,590	6,797
FMP Smsy	5,800	5,800	5,800	5,800	5,800	5,800	5,800	5,800
Escapement after all fisheries	5,830	7,521	5,259	2,020	2,900	5,566	5,136	5,248
Alaska-Canada	157	572	210	157	100	108	155	174
Council North of Falcon								
Treaty Troll	498	683	317	34	4	4	128	131
Nontreaty Troll	262	155	171	73	34	53	92	42
Sport	377	333	287	176	65	54	103	128
Council South of Falcon	163	157	107	28	43	30	72	53
Council Subtotal	**1,300**	**1,328**	**882**	**311**	**146**	**141**	**395**	**354**
Preterminal Other								
Troll	-	-	-	-	-	-	-	-
Net	395	371	250	41	116	165	210	146
Sport	46	81	32	29	3	5	11	7
Terminal Net and Sport	2,620	2,928	957	171	254	541	683	868
Total Fishing Mortality	**4,518**	**5,280**	**2,331**	**709**	**619**	**960**	**1,454**	**1,549**
Alaska-Canada	1.5%	4.5%	2.8%	5.8%	2.8%	1.7%	2.4%	2.6%
Council North of Falcon								
Treaty Troll	4.8%	5.3%	4.2%	1.2%	0.1%	0.1%	1.9%	1.9%
Nontreaty Troll	2.5%	1.2%	2.3%	2.7%	1.0%	0.8%	1.4%	0.6%
Sport	3.6%	2.6%	3.8%	6.4%	1.8%	0.8%	1.6%	1.9%
Council South of Falcon	1.6%	1.2%	1.4%	1.0%	1.2%	0.5%	1.1%	0.8%
Council Subtotal	**12.6%**	**10.4%**	**11.6%**	**11.4%**	**4.1%**	**2.2%**	**6.0%**	**5.2%**
Preterminal Other								
Troll	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Net	3.8%	2.9%	3.3%	1.5%	3.3%	2.5%	3.2%	2.1%
Sport	0.4%	0.6%	0.4%	1.1%	0.1%	0.1%	0.2%	0.1%
Terminal Net and Sport	25.3%	22.9%	12.6%	6.3%	7.2%	8.3%	10.4%	12.8%
Total Exploitation Rate	**43.7%**	**41.2%**	**30.7%**	**26.0%**	**17.6%**	**14.7%**	**22.1%**	**22.8%**

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, in all years since then the 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 three 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 1997. 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 RECOMMENDATIONS 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 two alternative management strategies for consideration. The rebuilding time frame under each of the alternatives are not expected to exceed the maximum rebuilding time (T_{MAX}) of 10 years. The probability of achieving rebuilt status for years 1 (2018) through 10 are projected in Section 4.4., *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 the time estimated to achieve rebuilt status (T_{target}) are acknowledged within the suite of alternatives. See Section 2.1 for a more complete description.

> Alternative I: Status Quo. During the rebuilding period continue to use the current management framework and reference points, as defined in the FMP and the PST, to set maximum allowable exploitation rates on an annual basis. Projected rebuilding time, T_{target}, is two years (see Section 4.4). This is considered a ‘no-action’ alternative.

> Alternative II: Precautionary measures for preseason planning. If a preponderance of evidence indicates hostile environmental conditions prevailed during the marine residence period of the subject recruits, especially during their period of ocean entry, make precautionary adjustments to abundance forecasts or allowable exploitation rates for preseason planning.

During the preseason process, if spawning escapement is projected to be less than 85% of S_{MSY} (5,800), then non-treaty Council area fisheries north of Cape Falcon, Oregon would be structured to minimize coho impacts so that the minimum spawning escapement is projected to reach at least 4,930 (85% of S_{MSY}). The total exploitation rate will not exceed 0.15 if ocean age 3 abundance is less than or equal to 5,800.

Between ocean age 3 abundance of 5,800 and 7,250, the total allowable exploitation rate will ramp linearly from 0.15 to 0.20. Measures to reduce non-treaty Council area fisheries north of Cape Falcon, Oregon would be similar to 2016 non-treaty preseason structure, using actions such as coho non-retention or minimal area/fishery-specific coho quotas.

Inseason actions to convert non-treaty Council area coho fisheries north of Cape Falcon, Oregon from mark-selective to non-selective would be prohibited during such years. Treaty troll fisheries would be minimized and complimentary management of terminal fisheries would be recommended as an auxiliary action.

Projected rebuilding time, T_{target}, is two years (see Section 4.4). This is considered an 'action' alternative.

For the two alternatives and the T_{MIN} scenario, year 1 for the T_{MIN} and T_{target} calculations is defined as 2018. This convention was adopted for Queets coho due to data availability, as the most recent estimates of ocean abundance and spawner escapement are from 2017. Rebuilding times projected here assume the control rules defined in the alternatives were first applied to 2018 fisheries, and each of the nine years thereafter. However, an adopted rebuilding plan will likely be first implemented in 2020.

4.3 Recommendation 3: Comanager recommendations

Habitat topics

If chronic under escapement or low smolt production is indicated, then as comanagers QIN and WDFW should prioritize actions in the Queets and Clearwater basins to improve productivity of habitat or implement supplementation programs.

Suggested recommendations for habitat restoration include the following priorities:

1) Facilitate rapid improvements in accessibility and availability of floodplain habitats in the Clearwater and Lower Queets rivers by implementing periodic maintenance of egress to all major off-channel ponds and enlarging or diversifying structure in off-channel habitats.
2) Improve habitat quality in low gradient tributaries primarily by increasing large wood structure.
3) Restore old-growth characteristics to riparian forests within stream corridors through negotiating conservation set-asides and alternative forestry practices (i.e. replacement of conifer in riparian areas)

In conjunction with habitat restoration actions, redeveloping infrastructure at the Salmon River hatchery and off-channel acclimation sites should also be considered. This would help facilitate native brood outplants into currently under-utilized off-channel habitats and thereby bolstering smolt production. This kind of supplementation program should be designed similar to previous supplementation efforts that minimize potential adverse effects of hatchery-reared fish on the natural environment.

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

<u>Precautionary measures for preseason planning and inseason management</u>

If a preponderance of inseason evidence indicates coho abundance is significantly less than anticipated during preseason planning or coho physical condition is poor, immediate precautionary steps would be taken to reduce exploitation rates including, if necessary, emergency modifications to or closures of coho-directed non-treaty ocean fisheries between the US- Canada border and Cape Falcon, Oregon. Treaty troll fisheries would be minimized and complimentary management of terminal fisheries would be recommended as an auxiliary action. If less severe conditions are indicated, inseason actions on Council area non-treaty fisheries would be limited to actions that would not increase exploitation rates on Queets natural coho relative to the preseason plan.

4.4 Analysis of management strategy alternatives

The STT has developed a model to assess the probability of a stock achieving rebuilt status in the years following an overfished declaration. In this model, future abundance is based on a distribution fitted to past observed abundances (2004-2017), accounting for lag-1 autocorrelation (the dominant lag for Queets natural coho). 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 projecting of the probability of achieving rebuilt status by year. The model framework allows for evaluation of alternative rebuilding plans by specifying the rebuilding plans as alternative harvest control rules. Model structure, parameterization, and additional results are presented in Appendix B.

This model was applied to Queets natural coho in order to provide projected rebuilding times, with year 1 representing 2018. The projected rebuilding time is defined here as the number of years needed for the probability of achieving rebuilt status to meet or exceed 0.50. Given this assumption, rebuilding times are projected to be two years for both alternatives I and II, with a T_{MIN} (based on a no fishing scenario) of one year (Table 4.4.a). The rebuilding probabilities in Table 4.4.a are displayed graphically in Figure 4.4.a. There were relatively small differences in rebuilding time probabilities between alternatives I and II. While a probability of 0.5 has been used here to define rebuilding times, the Council has the discretion to recommend a probability greater than 0.5 to be used for this purpose.

Simulations were performed under a scenario where abundance forecasts were potentially biased. Results for this scenario can be found in Appendix B.

Table 4.4.a. Projected rebuilding probabilities by year for each of the alternatives and the T_{MIN} scenario.

	Year									
	1	2	3	4	5	6	7	8	9	10
Alternative I	0.332	**0.542**	0.659	0.770	0.842	0.890	0.925	0.948	0.965	0.975
Alternative II	0.345	**0.570**	0.686	0.790	0.862	0.908	0.939	0.962	0.974	0.983
T_{MIN}	**0.606**	0.820	0.904	0.958	0.980	0.990	0.996	0.998	0.999	1.000

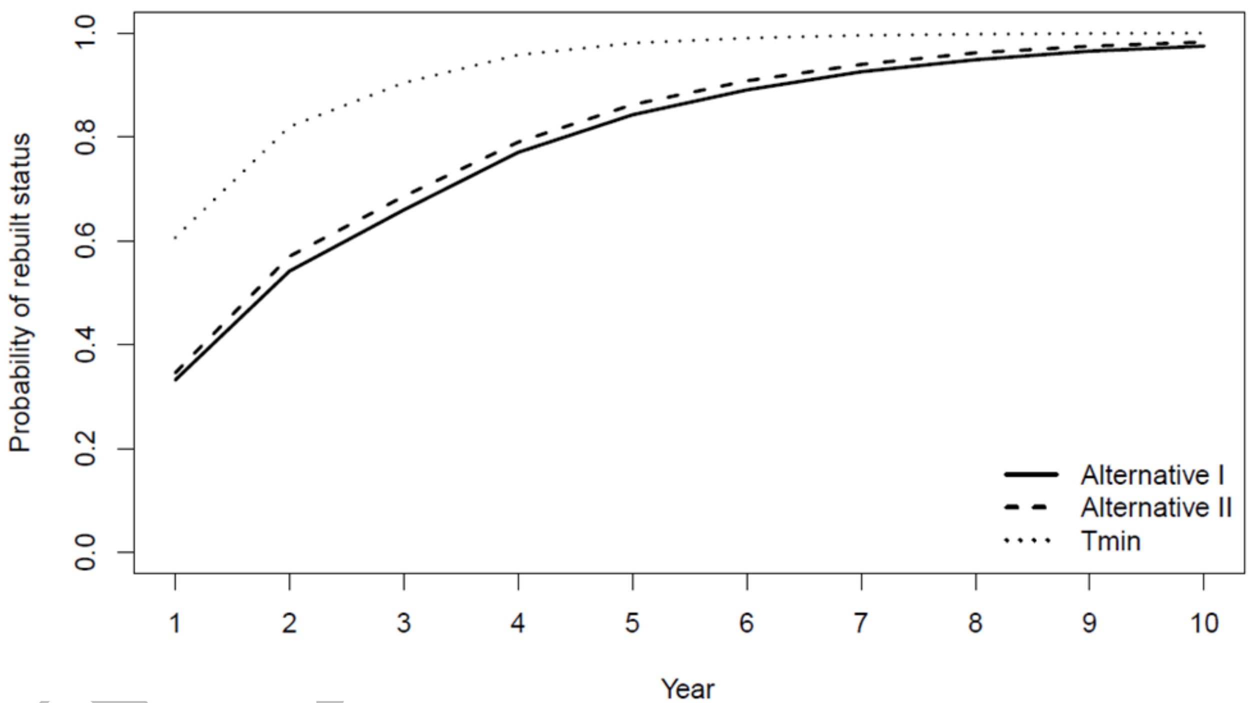

Figure 4.4.a. Projected probability of achieving rebuilt status by year under the two alternatives and the T_{MIN} scenario.

The model described here was created to allow for a quantitative assessment of rebuilding alternatives. The tool has some elements of a management strategy evaluation (MSE), but lacks an explicit biological operating model. It relies on autocorrelated draws from an abundance distribution informed by past abundance levels. As such, no explicit population dynamics are included in the model. Data limitations and the short time frame for development of rebuilding plans did not allow for constructing a more detailed operating model. The model also does not account for mixed-stock effects, where another stock could limit access to Queets natural coho in ocean fisheries and prevent attainment of allowable exploitation rates. Rather, the 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 for alternative rebuilding plans within a 10 year window is the core result of this analysis. The results for particular alternatives may be most useful if interpreted in a relative rather than absolute sense. Actual rebuilding periods may be somewhat shorter or longer than these results suggest due to the vagaries of future production, ocean conditions, and fisheries.

5.0 SOCIOECONOMIC IMPACT OF MANAEMENT STRATEGY ALTERNATIVES

5.1 Approach to the socio-economic analysis and benchmark/baseline

The approach for the analysis is to provide the best information possible on the impacts of each of the alternatives (including both qualitative and quantitative information). This analysis will use recent levels of economic activity and personal income going back to 2004 as a benchmark to indicate the general magnitude of the impacts of the alternatives (the rationale for the timeframe used is discussed later in this section). Even under no action, the baseline (a projection of these benchmark values into the future) would likely vary from the economic activity occurring in recent years—for example, due to changing oceanographic and market conditions. However, development of a projection model for the baseline would be difficult and there would be a great deal of uncertainty about the results. These difficulties are exemplified by the current need for this rebuilding plan. Despite basing management on the best projection models scientists have been able to develop and setting regulations that appropriately manage for MSY spawner levels, certain stocks have declined to levels that meet the criteria for an overfished determination. Furthermore, quantifying the change in the baseline from historic conditions is not practical because of the numerous factors that interact to determine future fishing conditions, including the trends of multiple salmon stocks other than Queets coho and a Council season setting process during which various biological, economic, and social factors are balanced in shaping each season and determining fishing opportunities. Thus, the baseline must be qualitative, but quantitatively informed by the benchmark. Since the baseline is difficult to predict, the information resulting from this analysis that is derived from benchmark information is more useful in describing the differences in impacts between the alternatives rather than the differences between any of the alternatives and the expected baseline (benchmark projected into the future).

For the alternatives that would not change control rules or that would completely close fisheries north of Cape Falcon (Alternatives I and the T_{MIN} scenario, respectively), this is relatively straightforward. For the intermediate alternative (Alternative II), development of quantitative information to inform the assessment is more difficult and results of the analysis are therefore more indirectly informative. The challenges are both in predicting future year stock condition for not only Queets coho but also the multiple other stocks that co-occur in the fishery and might constrain harvest independent of any reduction in Queets coho exploitation rates. Each year the Council engages in an intensive public process in which it shapes seasons to optimize harvest by addressing allocation issues among various harvesting sectors and geographic areas while ensuring that the preseason expectation is that escapement objectives are met for all stocks.

Therefore, for Alternative II (modified control rule), the approach is to address the following. First is the question of whether this stock has typically been a constraint on ocean fisheries, i.e., historically, how frequently has the stock's status constrained ocean fisheries? To the degree that the stock has not or would not be a constraint, the short term economic impacts under a modified control rule would be minimal. Second, to what degree would the new control rule tighten that potential constraint, i.e., what is the effective percent reduction in exploitation rates that would result from the new control rule compared to the current rule for all possible stock abundance levels? And finally, what is the effect of a tightening of the constraint for ranges of potential abundances that may be more likely, i.e., for the actual stock abundances observed in recent years (2004 to the present), how much of a reduction in the exploitation rates would the new rule require as compared to the current control rule (this analysis also involves applying the current control rule to years prior to when the current control rule was adopted)? This quantitative information is intended to provide a sense of the degree of potential constraint that would be likely under the new control rule in the context of the recent benchmark. This comparison is then used as a rough indicator of the magnitude of potential impact, quantitatively informing the qualitative assessment of impacts for Alternative II.

For purposes of describing the benchmark to inform the qualitative assessment of the baseline, data for port areas in Oregon and Washington north of Cape Falcon during 2004 to 2016 are used. There are currently five salmon rebuilding plans in development that are using the same 2004-2016 range for the economic analysis, including for two other Washington coho stocks and two California Chinook stocks. The year 2016 was selected for the last year of the period because it was the most recent year for which data was available when models were developed. Years prior to 2004 are not included because quality of the coho data in those years was not as strong as the more recent years, and the desire to maintain consistency across rebuilding plans. There are not strong reasons to deviate from using these same years across all five plans, and this consistency is expected to simplify review and comprehension of the analyses for both decision makers and the public. These years span recent history and provide a range of escapement levels that could reasonably be expected in future years, although due to ocean, climate, and other conditions, the actual distribution may tend more toward one end of this spectrum than the other, or exhibit increased variability.

The main quantitative economic impact indicators used in this analysis are "personal income impacts." Personal income impacts are the personal income generated as a result of direct expenditures related to fishing (recreational and commercial), processing, and support industry activities. These include personal income earned directly by those participating in fishing and processing activities (including charter vessels providing recreational trips), personal income earned by those employed in businesses that supply and service commercial fishing, recreational fishing and processing support activities (e.g., fuel and bait suppliers and mechanics; also called indirect income), and the personal income generated by other businesses when those with direct and indirect income spend their money in the community (e.g., grocery stores and restaurants). On the one hand, when fishing activity is reduced, personal income impacts may not be reduced proportionally because affected individuals may increase their activity in other fisheries or take up substitute economic activity in the same community. On the other hand, with respect to alternative fishing activity a recent study indicates that substitution may be minimal and there can be short and long term amplifications that result in impacts more than proportional to the reduction in the salmon fishery. For example, with respect to vessels that remained active during a closure, there was only limited evidence that more diversified vessels made up for their reduced salmon fishing with increases elsewhere (Richerson and Holland, 2017). Further, vessels that are more dependent on salmon are likely to cease all fishing activity during a salmon closure rather than increase activity in other fisheries and a portion of those will exit the fishery permanently (*Ibid.*). Even if other vessels take up the slack as opportunity returns they may be in different ports, causing geographic redistributions. Additional information on the modeling and interpretation of personal income impacts (also termed community income impacts) is provided in Chapter IV of the most recent annual salmon review (PFMC 2018b).

It is important to recognize, that despite similarity in terminology, personal income impacts differ from the impacts of an alternative. Personal income impacts are the income associated with a particular activity, while the impacts of an alternative are the changes from status quo that occur as a result of implementing a new policy (i.e., an action alternative). For example, suppose that the personal income impacts associated with fishing under status quo are $10 million and those under an action alternative $9 million. Therefore the potential impact of the action alternative, as represented by the reduction or redistribution of personal income compared with status quo, would be $1 million.

Estimates of total coastal community personal income impacts during 2004-2016 in affected port areas north of Cape Falcon for the non-tribal commercial ocean troll salmon fishery averaged approximately $3.4 million per year (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] (Figure 5.1.a and Table 5.1.a).

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 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 (Figure 5.1.b and Table 5.1.a).

2008 was the lowest year for combined non-tribal ocean salmon fishery 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 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 (Figure 5.1.b and Table 5.1.a).

[1] It is important to note that income impact estimates produced for years prior to the 2010 data year were derived using a different methodology than estimates for subsequent years. While strictly speaking, estimates produced using the two methodologies may not be directly comparable, for simplicity this limitation was overlooked for this analysis, since the change more or less equivalently affected both the commercial and recreational sectors and all port areas. A description of the transition to the current income impact methodology and comparisons of results from the earlier and current models are found in Appendix E of the Review of 2014 Ocean Salmon Fisheries.

Although not included in these non-tribal economic impact estimates, tribal commercial ocean troll salmon fisheries also occur and contribute economically to the coastal communities. In addition, Queets coho are also taken in inriver commercial and tribal net fisheries and recreational fisheries which also contribute economically to the coastal communities. During 2004-2016, estimated Queets coho commercial net fisheries harvests averaged 10,823 fish, ranging from 25,004 fish in 2009 to 2,261 in 2007; ceremonial & subsistence harvests averaged 763 fish, ranging from 1,677 fish in 2009 to 187 in 2007; and inriver recreational harvests averaged 790 fish, ranging from 1,625 fish in 2014 to 46 in 2006.[2] Given that these fisheries do occur and contribute to coastal communities, the economic benefit from affected salmon fisheries is likely higher and more widely distributed than reported in this document.

[2] Inriver catch data from *Review of 2018 Ocean Salmon Fisheries: Stock Assessment and Fishery Evaluation Document for the Pacific Coast Salmon Fishery Management Plan*. Table B-31.

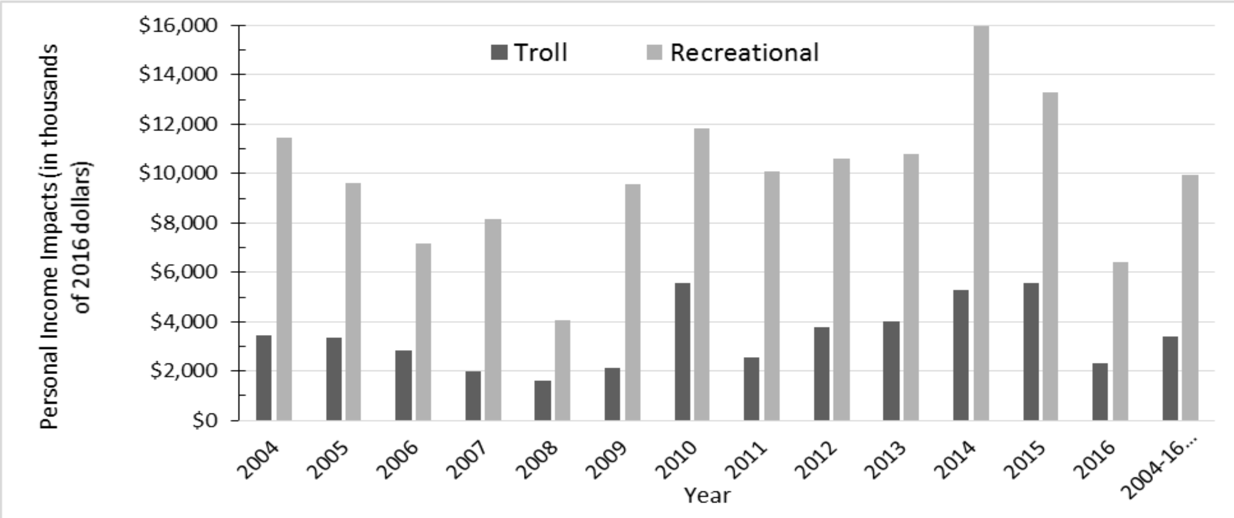

Figure 5.1.a. Estimates of total, aggregated personal income impacts in affected coastal communities in Washington and Oregon north of Cape Falcon in thousands of real (inflation adjusted, 2016) dollars for the non-tribal commercial ocean troll and ocean recreational salmon fisheries.

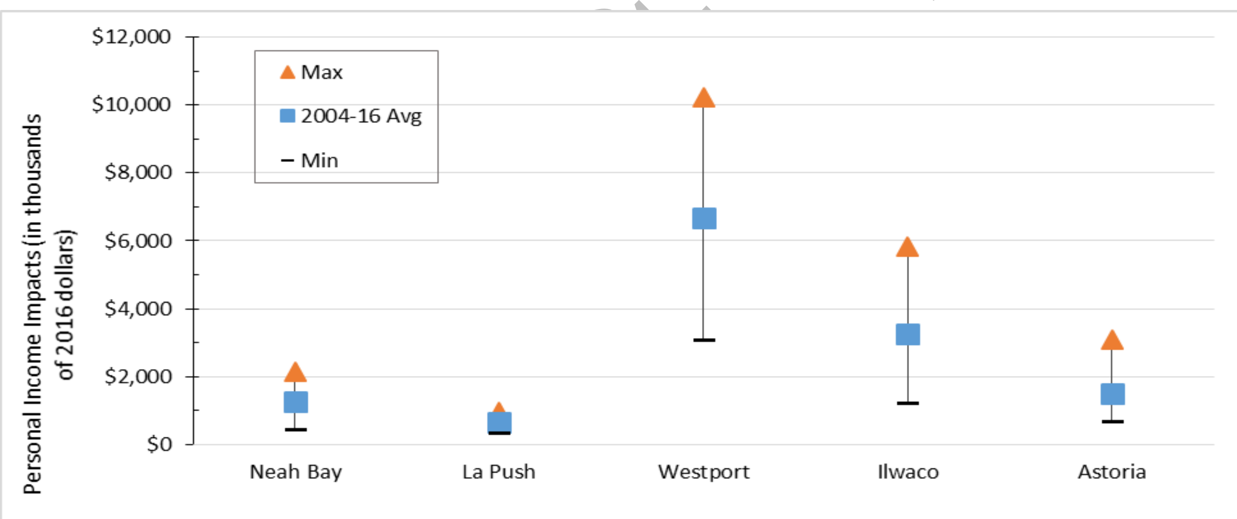

Figure 5.1.b. Estimates of personal income impacts by coastal community in thousands of real (inflation adjusted, 2016) dollars for the combined non-tribal commercial ocean troll and ocean recreational salmon fisheries in Washington and Oregon north of Cape Falcon.

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 I

Under 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. These include ocean commercial and recreational fisheries and inside fisheries. In addition to the ocean fisheries, when Queets coho constrains ocean fisheries, there may be impacts to inside fishing opportunity.

Alternative I would not change harvest policy for Queets coho; thus by definition there would be no direct or indirect economic impact from the rebuilding plan under this alternative. The estimated timeframe needed to achieve rebuilt status (with a probability of at least 50 percent) under status quo exploitation rates is 2 years (Figure 4.4.a and Table 4.4.a). Since harvest policy would not change, economic activity associated with Alternative I would not be expected to change from the baseline, and the general magnitude of that activity is reflected in the benchmark economic data provided in Section 5.1 (i.e., inflation-adjusted 2004-2016 average of $13.34 million per year in income from combined non-tribal ocean commercial and recreational salmon fisheries in the affected coastal communities north of Cape Falcon). At the same time, note that actions under rebuilding plans for other salmon stocks may be associated with deviations from the baseline.

Not including differences in short term impacts (impacts during the rebuilding period), the long-term impacts of Alternative I are expected to be similar to the other alternatives in that all the alternatives are expected to achieve rebuilding in a relatively few number of years.

5.3 Alternative II

Under Alternative II, fishing with an exploitation rate that is on average approximately 4.8 percent reduced from status quo / Alternative I is estimated to result in rebuilding in 4 years, the same as under status quo or Alternative I. The comparative cost of this alternative is the reduced annual harvest opportunity (here estimated with income impacts) times the number of years it takes to rebuild under the alternative.[3]

The impact of the rebuilding policy in a particular year will depend first on the degree to which the new control rule constrains ocean regulations and harvest in a particular year. Because of the large number of considerations that go into the deliberations on each year’s salmon season it is sometimes difficult to determine with certainty whether or not a given stock was a constraint in any particular year.

Table 5.3.a summarizes the degree to which any of the three Washington coho stocks under rebuilding or other coho stocks of concern were constraining to ocean salmon fisheries north of Cape Falcon during the 2004-2019 seasons. The table shows that Queets River natural coho were constraining on ocean salmon fisheries north of Cape Falcon four years during the period: 2015, 2016, 2017 and 2018. Of the other two rebuilding coho stocks, neither JDF coho nor Snohomish coho were the most constraining stock on ocean salmon fisheries north of Cape Falcon in any year

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[3] The analytical approach here is a quantitatively informed qualitative analysis. In an approach that was able to provide a more precise quantitative estimate of the expected annual changes in impacts, discount rates would be applied to the stream of expected changes.

during the period. Other natural coho stocks that were constraining on ocean salmon fisheries north of Cape Falcon include: Fraser River stocks during 11 of the 16 years (2004-2007 and 2009-2015), Lower Columbia River natural coho during four years (2006 and 2008-2010), Oregon coastal natural coho during one year (2008), and Grays Harbor coho during one year (2018). In the most recent year shown, 2019, fisheries north of Cape Falcon were shaped to minimize impacts on Puget Sound Chinook.

Assuming Queets coho were constraining on ocean salmon fisheries each year during the time to rebuild under Alternative II, and assuming an exploitation rate that is on average 4.8 percent reduced from status quo / Alternative I, the estimated upper-bound economic impact in terms of reduction in non-tribal commercial and recreational ocean fisheries income impacts is $0.64 million per year, or 2 x -$0.64 million = -$1.28 million over the 2-year rebuilding period (in 2016 dollars). Note that this estimate excludes effects on tribal, in-river and Puget Sound fisheries. There would also likely be offsetting gains through substitute economic activity and gains in in-river recreational fisheries and escapement benefits for other stocks which are not quantified here.

Table 5.3.a. Stocks that were most constraining to north of Cape Falcon ocean salmon fisheries at the time annual management measures were adopted (Preseason Report III)

		Graphic depiction of which coho stocks were most constraining (Red indicates constraining, Yellow indicates depressed but not constraining)							
Year	Most Constraining Stock(s)	Queets R.	JDF[1/]	Snohomish R.	Fraser R.	LCN[2/]	OCN[3/]	GH[4/]	Other
2004	Fraser								
2005	Fraser								
2006	Fraser and LCN								
2007	Fraser								
2008	LCN and OCN								
2009	Fraser and LCN								
2010	Fraser and LCN								
2011	Fraser								
2012	Fraser								
2013	Fraser								
2014	Fraser								
2015	Fraser and Queets								
2016	Queets								
2017	Queets								
2018	Queets and Grays Harbor								
2019	PS Chinook[5]								
16 yrs	No. of years constraining:	4	-	-	11	4	1	1	1

1/ Strait Juan de Fuca coho
2/ Lower Columbia River natural coho
3/ Oregon coastal natural coho
4/ Grays Harbor coho
5/ In 2019 fisheries north of Cape Falcon were shaped to minimize impacts on Puget Sound Chinook.

5.4 T_{MIN} rebuilding scenario

T_{MIN} rebuilding scenario is that under which rebuilding is estimated to occur as quickly as possible, 1 year assuming an exploitation rate of zero during that time. Compared with the 'no action' or status quo management strategy of Alternative I, under the T_{MIN} scenario the estimated upper-bound economic impact in terms of reduction in non-tribal commercial and recreational fisheries income impacts is $13.34 million per year, or 1 x -$13.34 million = -$13.34 million (in 2016 dollars) over the 1-year rebuilding period under the T_{MIN} scenario. Note that this estimate excludes effects on tribal, in-river and Puget Sound fisheries. As discussed in Section 5.1, even under this upper-bound impact estimate there may be offsetting gains through substitute economic activity and gains in in-river fisheries which are not quantified here.[4] There is some chance that rebuilding could occur before or later than the number of years indicated by T_{MIN} with a 50% probability level, thereby reducing or increasing total short term economic impacts. The T_{MIN} scenario would also increase escapement that may affect productivity of other stocks which may then also have economic impacts. Depending on spawner-recruit relationships, increased escapement that results in increased spawning might positively or negatively impact long-term production.

Not including differences in short term impacts (impacts during the rebuilding period), the long-term impacts of the T_{MIN} scenario are expected to be similar to Alternative I (no action) and Alternative II in that rebuilding would be achieved in a relatively few number of years.

5.5 Summary of socio-economic impacts

The above estimates/indicators of short term impacts should be considered upper bounds on the magnitude of non-treaty economic effect under the action alternatives because it is assumed that all ocean commercial and recreational time and area opportunities north of Cape Falcon would be reduced by the same proportions, whereas past experience has shown that overall economic impacts may be mitigated in many cases by using an approach in which areas and sectors in the affected region are managed differently depending on the degree of interaction between fisheries and stocks of concern in each area. The economic contribution to coastal communities from in-river recreational fisheries may also be affected by changes in ocean fisheries. Additionally, since the economic analysis focuses on non-Indian ocean fisheries, the contribution of tribal fisheries would increase the overall economic benefit of ocean salmon fisheries.

Table 5.5.a illustrates the short-term economic trade-offs, assuming a 50 percent probability of rebuilding for each alternative or scenario. If rebuilding occurs more quickly (i.e., if a lower probability time to rebuilding occurs) then the impacts would be less than indicated, and if rebuilding occurs more slowly (i.e., if a higher probability time to rebuilding occurs) then the impacts would be greater than indicated. The quantitative summary of Alternative II, in particular, must be understood in the context of the qualitative analysis which both describes the derivation of the percent reduction based on past average stock abundances (which may or may not be observed over the rebuilding period) and the Council's opportunity to mitigate some of the socio-economic impacts by season shaping, as discussed in the previous paragraph.

[4] Recent studies have pointed to the difficultly vessels have exhibited in compensating for lost salmon opportunities by increasing activity in other West Coast fisheries, even for vessels with history of participation in those fisheries. See, e.g., Richerson, K., and Holland, D. S. 2017. Quantifying and predicting responses to a US West Coast salmon fishery closure. – ICES Journal of Marine Science, doi:10.1093/icesjms/fsx093.

Table 5.5.a. Summary of economic impacts of the Queets coho rebuilding alternatives.

	Alt I	Alt II	T_{MIN} Scenario
Rebuilding Time Based on a 50% Rebuilding Probability	2 Years (Rebuilding probability is 54%)	2 Years (Rebuilding probability is 57%)	1 Year (Rebuilding probability is 60%)
Economic Impacts	None	Approximately 4.8 percent reduction in the mean ocean exploitation rates each year during the rebuilding period, which results in estimated reduction of $0.64 million in income impacts per year during the 2-year rebuilding period. Excludes effects on tribal, in-river and Puget Sound fisheries. There may be additional off-sets through substitute economic activity and gains in in-river fisheries and escapement benefits for other stocks [a/]	Complete loss of ocean harvest-related economic activity north of Cape Falcon during the rebuilding period, which results in estimated reduction of $13.34 million in income impacts per year during the 1-year rebuilding period. Excludes effects on tribal, in-river and Puget Sound fisheries. There may be partially offset by gains through substitute economic activity and gains in in-river fisheries and escapement benefits for other stocks.[a/]
Total Impacts (Years x Reduction in Economic Activity) (50% probability)	None	2 years x -$0.64 million per year = -$1.28 million, with same caveats and offsets noted above. Impacts will be lower if rebuilding occurs in only one year (probability of 34%).	1 year x -$13.34 million per year = -$13.34 million, with same caveats and offsets noted above.

a/ A recent study also indicates that (Richerson and Holland,2017) impacts may be amplified and duration of impacts lengthened if vessels leave the fishery.

With respect to projecting impacts under Alternative II, note that Table 5.3.a. shows that Queets River natural coho were constraining on ocean salmon fisheries north of Cape Falcon during the period, requiring management measures to reduce the exploitation rate on this stock and co-occurring stocks during four seasons: 2015, 2016, 2017 and 2018. It is likely that under reduced exploitation rates that would be imposed under Alternative II, the stock might be more constraining than in the recent past.

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

{Section to be completed by NMFS after Council adopts a rebuilding plan}

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 "troll" 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)). Of the ESA-listed marine mammals that occur in the analysis area, only Southern Resident killer whales (a distinct population segment of *Orcinus orca*) are likely to be affected by salmon fisheries.

Salmon fisheries affect Southern Resident killer whales by removing Chinook salmon, an important prey species for the whales (NMFS 2009). NMFS issued a biological opinion evaluating the effects of the Pacific Coast salmon fisheries on Southern Resident killer whales in 2009 (NMFS 2009; Appendix B); this opinion concluded that the proposed ocean salmon fisheries were not likely to jeopardize the continued existence of the Southern Resident killer whales or adversely modify their critical habitat. NMFS completed a five-year review of the Southern Resident killer whale ESA listing in September 2016. There is new information regarding status, diet, and potentially the effects of fisheries on Southern Resident killer whale population trends. NMFS is reassessing the effects of salmon fisheries in light of this new information, and has reinitiated consultation on the effects of Council salmon fisheries (memorandum from Ryan Wulff, NMFS, to Chris Yates, NMFS, dated April 12, 2019).

6.3.2 Environmental consequences of the alternatives on marine mammals

{Section to be completed by NMFS after Council adopts a rebuilding plan}

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

{Section to be completed by NMFS after Council adopts a rebuilding plan}

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

{Section to be completed by NMFS after Council adopts a rebuilding plan}

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

{Section to be completed by NMFS after Council adopts a rebuilding plan}

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

{Section to be completed by NMFS after Council adopts a rebuilding plan}

6.8 Cultural resources

6.8.1 Affected environment

{Section to be completed by NMFS after Council adopts a rebuilding plan}

6.8.2 Environmental consequences of the alternatives on cultural resources

{Section to be completed by NMFS after Council adopts a rebuilding plan}

6.9 Cumulative impacts

{Section to be completed by NMFS after Council adopts a rebuilding plan}

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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. Beginning 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 natural coho salmon stock.

Methods

The methods described here are for a single replicate simulation.

For Queets natural coho, there is evidence for positive lag-1 autocorrelation in log-transformed values of the pre-fishery ocean abundance, with autocorrelation coefficient $\rho = 0.295$. To account for this, model log-scale abundance, $\log(N_t)$, is characterized by lag-1 autocorrelated draws from a Normal distribution with parameters estimated from the abundance series. Simulated abundance $\log(N_t)$ is thus a function of $\log(N_{t-1})$, ρ, and the distribution of past abundance on the log scale,

$$\log(N_t) = \rho[\log(N_{t-1})] + (1-\rho)Y_t, \qquad (1)$$

with Y_t a random draw from the distribution

$$Y_t \sim \text{Normal}\left[\log(\overline{\mathrm{Q}}) - 0.5\sigma^2_{\log(\mathrm{Q})}, \sqrt{\frac{(1-\rho^2)\sigma^2_{\log(\mathrm{Q})}}{(1-\rho)^2}}\,\right] \qquad (2)$$

and where $\overline{\mathrm{Q}}$ is the arithmetic mean of the observed Queets natural coho ocean abundance time series and $\sigma^2_{\log(\mathrm{Q})}$ is the variance of the log-transformed abundance time series. The standard deviation term in Equation 2 is derived from the expression for the standard deviation of a sum of two random variables. Simulated log-scale abundance in year *t* is then back-transformed to the arithmetic scale, $N_t = \exp[\log(N_t)]$.

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

$$\widehat{N}_t \sim \text{Lognormal}[\log(N_t) - 0.5\sigma^2_{\log(\widehat{N})},\ \sigma_{\log(\widehat{N})}] \qquad (3)$$

with the bias corrected mean and standard deviation specified on the log scale. The log-scale standard deviation was calculated as

$$\sigma_{\log(\widehat{N})} = \sqrt{\log\left(1 + \mathrm{CV}^2_{\widehat{N}}\right)} \qquad (4)$$

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 $\hat{N}_t$ is applied to a harvest control rule to determine the allowable exploitation rate, $\hat{F}_t$. A several step process was used to determine $\hat{F}_t$ or Queets natural coho. For Alternative I, the steps were: (1) randomly draw, with replacement, from the set of non-terminal exploitation rates (Council and non-Council area fisheries) estimated for years 2010-2017, (2) specify the terminal exploitation rate by applying $\hat{N}_t$ to the parameters of a linear regression fitted to preseason abundance and terminal exploitation rate data for years 2010-2017 (slope = 0.000008448, intercept = 0.09142), (3) cap the terminal exploitation rate at a maximum of 0.35, (4) sum the non-terminal and terminal exploitation rates, (5) if $\hat{N}_t$ is greater than 7,250, $\hat{F}_t$ equals the summed non-terminal and terminal exploitation rate, and (6) if $\hat{N}_t$ is less than or equal to 7,250, $\hat{F}_t$ equals 0.20. For Alternative II, $\hat{F}_t$ was specified by following steps 1-5 described for Alternative I. Then, if $\hat{N}_t$ is between 7,250 and 5,800, $\hat{F}_t$ is set at an exploitation rate between 0.20 and 0.15 based on a linear relationship that ramps down the exploitation rate from 0.20 to 0.15 between abundances of 7,250 and 5,800. Finally, if $\hat{N}_t$ is less than or equal to 5,800, $\hat{F}_t$ equals 0.15. The hat notation for $\hat{F}$ indicates that this exploitation rate is a target exploitation rate that is derived from an abundance forecast.

Adult spawner escapement E_t is thus

$$E_t = N_t \times (1 - F_t) \tag{5}$$

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

$$F \sim \text{Beta}(\alpha, \beta) \tag{6}$$

with parameters

$$\alpha = \frac{1 - \hat{F}_t(1 + \text{CV}_F^2)}{\text{CV}_F^2} \tag{7}$$

and

$$\beta = \frac{\frac{1}{\hat{F}_t} - 2 + \hat{F}_t + (\hat{F}_t - 1)\text{CV}_F^2}{\text{CV}_F^2}. \tag{8}$$

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 $\hat{E}_t$ are drawn from a lognormal distribution,

$$\hat{E} \sim \text{Lognormal}[\log(E_t) - 0.5\sigma^2_{\log(\hat{E})},\ \sigma_{\log(\hat{E})}] \qquad (9)$$

where the bias corrected mean and standard deviation are specified on the log scale. The log-scale standard deviation was computed in the same manner as Equation 4.

The procedure described above is repeated for each year (years 1 [2018] through 10), and each replicate. Simulations are initiated with the 2017 estimated abundance; simulated abundance in $t = 1$ (2018) is therefore a function of the 2017 abundance, the autocorrelation coefficient, and a draw from the abundance distribution (Equation 1).

A stock is assumed to be rebuilt when the geometric mean of $\hat{E}$ computed over the previous three years exceeds 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 natural coho presented here are the product of 10,000 replicate simulations of 10 years. The probability of being rebuilt in year $t = 1$ is the proportion of the 10,000 simulations that resulted in the geometric mean of the estimated escapement in $t = -1$ (5,156: the 2016 natural adult escapement), the estimated escapement in $t = 0$ (5,232: the 2017 natural adult escapement), and the simulated escapement estimate in year $t = 1$ (2018) exceeding S_{MSY}. For $t = 2$, the probability of being rebuilt is the probability that the stock was rebuilt in either $t = 1$ or $t = 2$.

Table 4.4.a and Figure 4.4.a in the body of the report display the probabilities of achieving rebuilt status under two management strategies: (I) status quo and (II) a management strategy with lower exploitation rates at low abundance. A no-fishing scenario was also evaluated to establish T_{MIN}. For these simulations the following parameter values were assumed: $\text{CV}_{\hat{N}} = 0.2$, $\text{CV}_{\hat{E}} = 0.2$, and $\text{CV}_F = 0.1$. The parameter values were chosen because they produce plausible 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 ($\text{CV}_{\hat{N}} = 0.6$), the escapement estimation error CV ($\text{CV}_{\hat{E}} = 0.5$), and the CV of the exploitation rate implementation error ($\text{CV}_F = 0.2$). Figure 1 displays distributions depicting the levels of abundance forecast error, escapement estimation error, and exploitation rate implementation error given the base case CVs and the CVs used for the alternative scenarios. Figure 2 displays results for these alternative scenarios under the status quo control rule. Overall, the probability of achieving rebuilt status by year is relatively insensitive to increased values of these parameters.

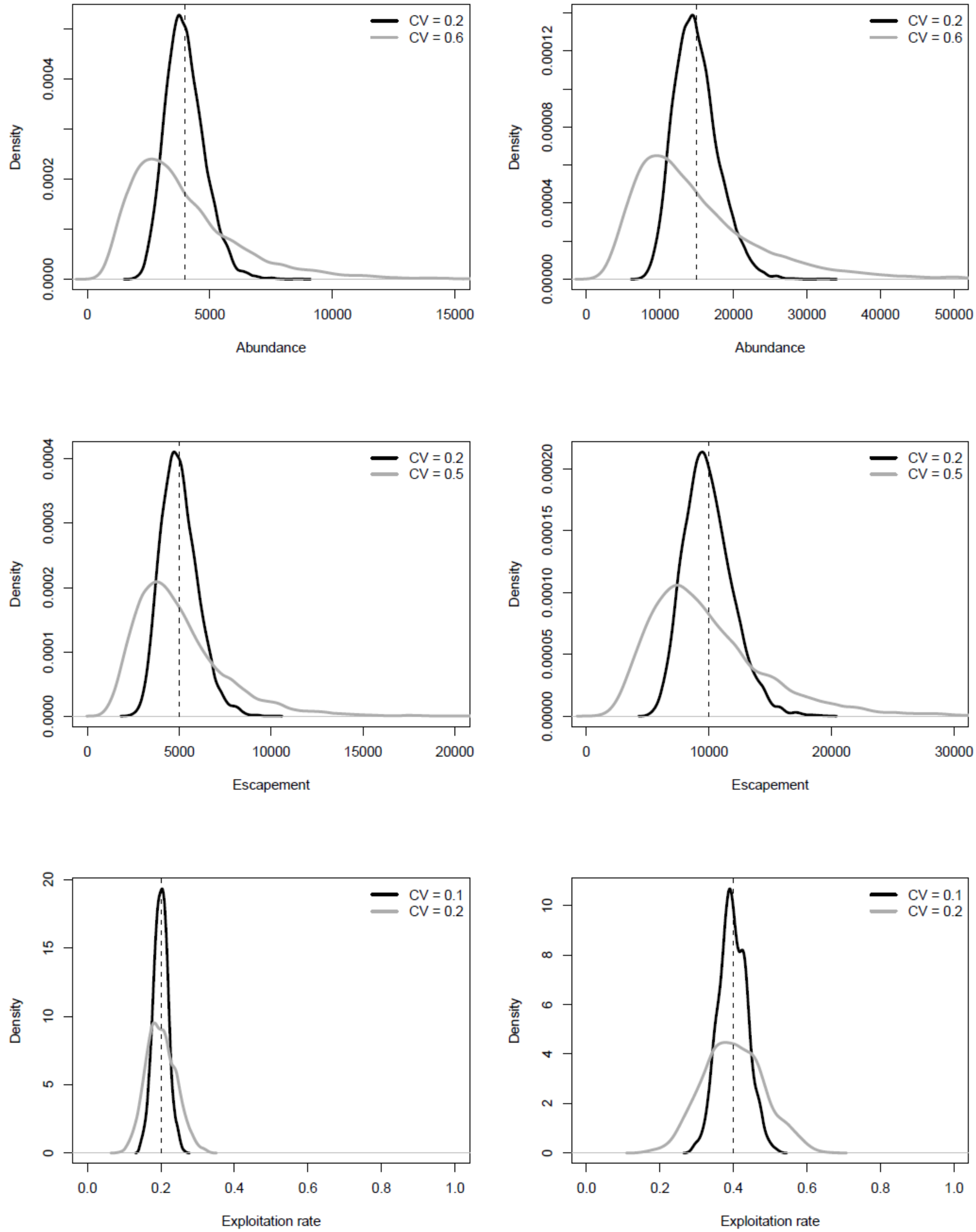

Figure 1. Distributions of the forecast abundance (top row), estimated escapement (middle row), and realized exploitation rate (bottom row) under different levels of known abundance, known escapement, and predicted exploitation rate. Known values are indicated by vertical dashed lines.

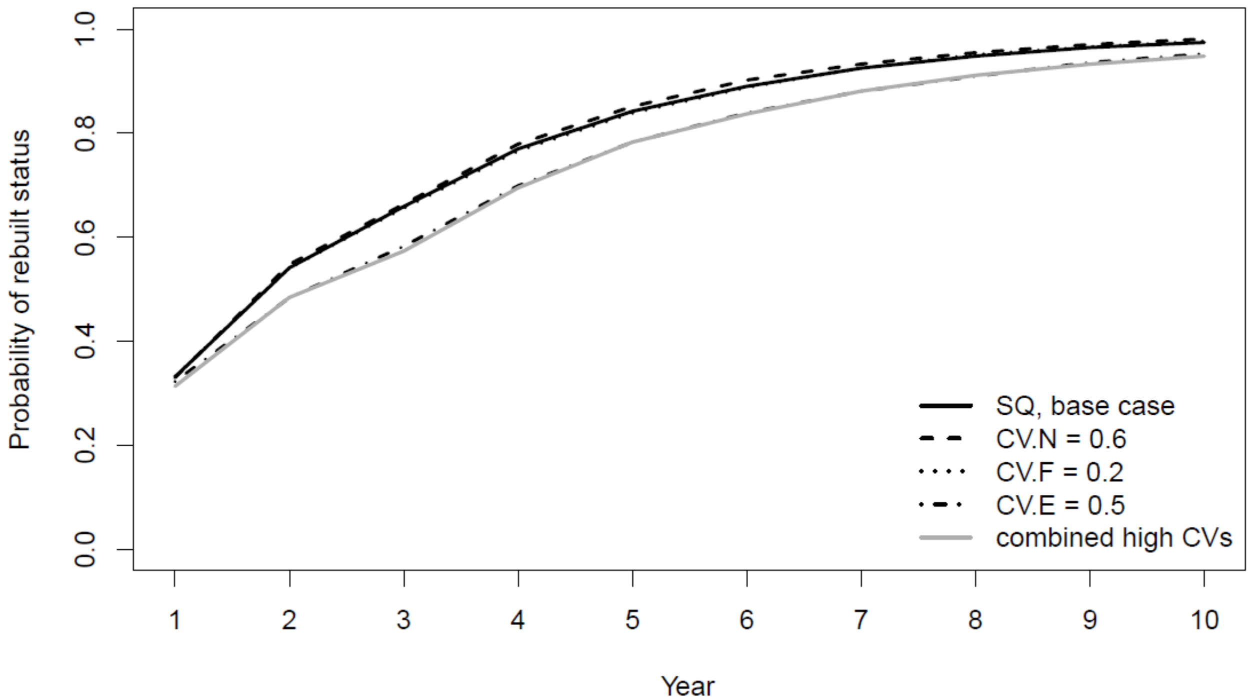

Figure 2. Probability of achieving rebuilt status in years 1 through 10 for the status quo control rule (Alternative I), given different parameter values for abundance forecast error (CV.N), exploitation rate implementation error (CV.F), and escapement estimation error (CV.E).

Simulations were also performed assuming biased abundance forecasts. Bias was incorporated by modifying the log-scale mean term in Equation 3 by adding the log of the observed ratio of the preseason forecast of abundance to the postseason estimate of ocean abundance. Thus, the mean term in Equation 3 becomes $\log(N_t) - 0.5\sigma^2_{\log(\hat{N})} + \log(r)$, where r is a draw (with replacement) from the set of 14 ratios of forecast to observed abundance (years 2004-2017). On the arithmetic scale this ratio ranges from 4.08 to 0.54 and $r > 1$ in 9 of 14 years. Figure 3 displays the effect of including this bias in abundance forecasts, given management under the status quo control rule. Positively biased forecasts (on average) result in lower probabilities of achieving rebuilt status through the 10 year rebuilding period.

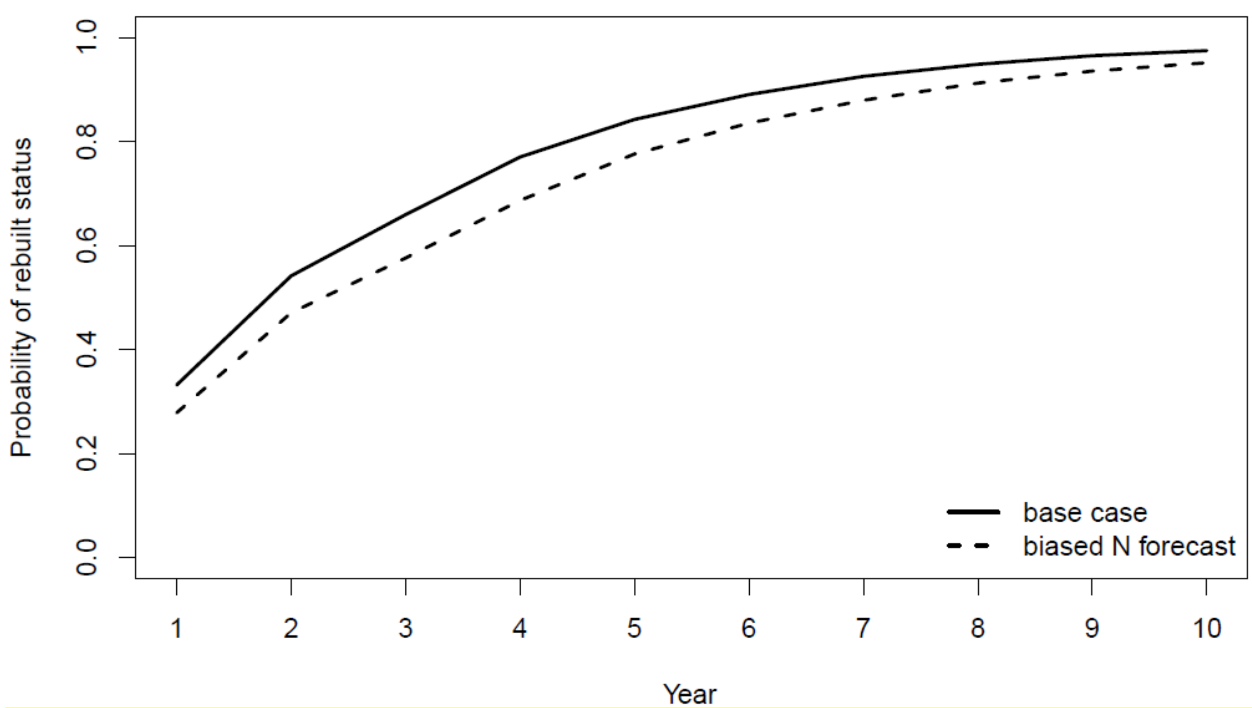

Figure 3. Probability of achieving rebuilt status under unbiased abundance forecasts and simulated abundance forecasts that are on average biased high, based on the observed ratios of preseason forecasts to postseason estimates of ocean abundance.

APPENDIX C. DRAFT FINDING OF NO SIGNIFICANT IMPACT

{Section to be completed by NMFS after Council adopts a rebuilding plan}

APPENDIX D. PAST, PRESENT AND REASONABLY FORESEEABLE FUTURE IMPACTS

{Section to be completed by NMFS after Council adopts a rebuilding plan}

APPENDIX E. LIST OF AGENGIES AND PERSONS CONSULTED

{Section to be completed by NMFS after Council adopts a rebuilding plan}

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

March 2018	**Rohnert Park, CA**
April 2018	**Portland, OR**
May 17, 2018	Public Webinar
June, 2018	Public Meeting in Olympia, WA
August 2018	Public Webinar
September 2018	**Seattle, WA**
November 2018	**San Diego, CA**
March 2019	**Vancouver, WA**
April 2019	**Rohnert Park, CA**
June 2019	**San Diego, CA**

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

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

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

APPENDIX F. REGULATORY IMPACT REVIEW

{Section to be completed by NMFS after Council adopts a rebuilding plan}

Regulatory Impact Review and Initial Regulatory Flexibility Analysis for the
[*Insert Rule Name and RIN #*]

National Marine Fisheries Service, West Coast Region
[*Insert date*]

As applicable, rulemakings must comply with Executive Order (E.O.) 12866 and the Regulatory Flexibility Act (RFA). To satisfy the requirements of E.O. 12866, the National Marine Fisheries Service (NMFS) undertakes a regulatory impact review (RIR). To satisfy the requirements of the RFA, NMFS prepares an initial regulatory flexibility analysis (IRFA) and final regulatory flexibility analysis (FRFA), or a certification.

> The NMFS Economic Guidelines that describe the RFA and E.O. 12866 can be found at: http://www.nmfs.noaa.gov/op/pds/documents/01/111/01-111-05.pdf
>
> The RFA, 5 U.S.C. § 601 *et seq.*, can be found at: http://www.nmfs.noaa.gov/sfa/laws_policies/economic_social/rfa_revised_through_2010_jobs_act.pdf
>
> Executive Order 12866 can be found at: http://www.nmfs.noaa.gov/sfa/laws_policies/economic_social/eo12866.pdf

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REGULATORY IMPACT REVIEW

The President of the United States signed E.O. 12866, "Regulatory Planning and Review," on September 30, 1993. This order established guidelines for promulgating new regulations and reviewing existing regulations. The E.O. covers a variety of regulatory policy considerations and establishes procedural requirements for analysis of the benefits and costs of regulatory actions. The E.O. stresses that in deciding whether and how to regulate, agencies should assess all of the costs and benefits of available regulatory alternatives. Based on this analysis, they should choose those approaches that maximize net benefits to the Nation, unless a statute requires another regulatory approach.

NMFS satisfies the requirements of E.O. 12866 through the preparation of an RIR. The RIR provides a review of the potential economic effects of a proposed regulatory action in order to gauge the net benefits to the Nation associated with the proposed action. The analysis also provides a review of the problem and policy objectives prompting the regulatory proposal and an evaluation of the available alternatives that could be used to solve the problem.

The RIR provides an assessment that can be used by the Office of Management and Budget to determine whether the proposed action could be considered a significant regulatory action under E.O. 12866. E.O. 12866 defines what qualifies as a "significant regulatory action" and requires agencies to provide analyses of the costs and benefits of such action and of potentially effective and reasonably feasible alternatives. An action may be considered significant if it is expected to: (1) Have an annual effect on the economy of $100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or state, local, or tribal governments or communities; (2) Create a serious inconsistency or otherwise interfere with an action taken or planned by another agency; (3) Materially alter the budgetary impact of entitlement, grants, user fees, or loan programs or the rights and obligations of recipients thereof; or (4) Raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in the EO.

Statement of the Problem
See Purpose and Need statement in this document (Section 2.2.2).

Description of the fishery and other affected entities
See Ocean and In-river fishery descriptions in this document (Section 3.3.1 and Section 3.3.2).

Description of the management goals and objectives
See conservation objectives and management strategy in this document (Section 2.4.1 and Section 2.4.2).

Description of the Alternatives
See management strategy alternatives, analysis, and additional information in this document (Section 4.2, Section 4.4, and Appendix B).

An Economic Analysis of the Expected Effects of Each Selected Alternative Relative to the No Action Alternative

See socioeconomic impact of management strategy alternatives considered in this document (Section 5.0).

RIR-Determination of Significant Impact
As noted above, under E.O. 12866, a regulation is a "significant regulatory action" if it is likely to: (1) have an annual effect on the economy of $100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or State, local, or tribal governments or communities; (2) create a serious inconsistency or otherwise interfere with an action taken or planned by another agency; (3) materially alter the budgetary impact of entitlements, grants, user fees, or loan programs or the rights and obligations of recipients thereof; or (4) raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in this Executive Order. Pursuant to the procedures established to implement section 6 of E.O. 12866, the Office of Management and Budget has determined that this action is XXX.

APPENDIX G. INITIAL REGULATORY FLEXIBILITY ANALYSIS

{Section to be completed by NMFS after Council adopts a rebuilding plan}

For any rule subject to notice and comment rulemaking, the RFA requires Federal agencies to prepare, and make available for public comment, both an initial and final regulatory flexibility analysis, unless the agency can certify that the proposed and/or final rule would not have a "significant economic impact on a substantial number of small entities". These analyses describe the impact on small businesses, non-profit enterprises, local governments, and other small entities as defined by the RFA (5 U.S.C. § 603). This analysis is to inform the agency and the public of the expected economic effects of the alternatives, and aid the agency in considering any significant regulatory alternatives that would accomplish the applicable objectives and minimize the economic impact on affected small entities. The RFA does not require the alternative with the least cost or with the least adverse effect on small entities be chosen as the preferred alternative. The IRFA must only address the effects of a proposed rule on entities subject to the regulation (i.e., entities to which the rule will directly apply) rather than all entities affected by the regulation, which would include entities to which the rule will indirectly apply.

Part 121 of Title 13, Code of Federal Regulations (CFR), sets forth, by North American Industry Classification System (NAICS) categories, the maximum number of employees or average annual gross receipts a business may have to be considered a small entity for RFAA purposes. See 13 C.F.R. § 121.201. Under this provision, the U.S. Small Business Administration established criteria for businesses in the fishery sector to qualify as small entities. Standards are expressed either in number of employees, or annual receipts in millions of dollars. The number of employees or annual receipts indicates the maximum allowed for a concern and its affiliates to be considered small (13 C.F.R. § 121.201).

- A fish and seafood merchant wholesaler (NAICS 424460) primarily engaged in servicing the fishing industry is a small business if it employs 100 or fewer persons on a full time, part time, temporary, or other basis, at all its affiliated operations worldwide.

- A business primarily engaged in Seafood Product Preparation and Packaging (NAICS 311710) is a small business if it employs 750 or fewer persons on a full time, part time, temporary, or other basis (13 CFR § 121.106), at all its affiliated operations.[5]

In addition to small businesses, the RFA recognizes and defines two other kinds of small entities: small governmental jurisdictions and small organizations. A small governmental jurisdiction is any government or district with a population of less than 50,000 persons. A small organization is any not-for-profit enterprise that is independently owned and operated and not dominant in its field, while. (5 U.S.C. § 601). There is no available guidance beyond this statutory language regarding how to determine if non-profit organizations are "small" for RFA purposes. The Small Business Administration (SBA) does have provisions for determining whether a business is "small" for RFA purposes and whether it is "dominant in its field," and those provisions can inform how NMFS classifies non-profit organizations for the purposes of RFA analyses in rulemaking. After consultation with the SBA, NOAA Fisheries has decided to use SBA's size standards for non-profit organizations to determine whether a non-profit organization is "small" and, in turn, whether it is "dominant in its field," to apply the statutory definition of a "small organization" in practice:
A nonprofit organization is determined to be “not dominant in its field” if it is considered “small” under SBA size standards:

- Environmental, conservation, or professional organizations (NAICS 813312, 813920): Combined annual receipts of $15 million or less.
- Other organizations (NAICS 813319, 813410, 813910, 813930, 813940, 813990): Combined annual receipts of $7.5 million or less.

Provision is made under SBA’s regulations for an agency to develop its own industry-specific size standards after consultation with Advocacy and an opportunity for public comment (see 13 CFR 121.903(c)). NMFS has established a small business size standard for businesses, including their affiliates, whose primary industry is commercial fishing (80 FR 81194, December 29, 2015). This standard is only for use by NMFS and only for the purpose of conducting an analysis of economic effects in fulfillment of the agency’s obligations under the RFA.

> NMFS' small business size standard for businesses, including their affiliates, whose primary industry is commercial fishing is $11 million in annual gross receipts. This standard applies to all businesses classified under North American Industry Classification System (NAICS) code 11411 for commercial fishing, including all businesses classified as commercial finfish fishing (NAICS 114111), commercial shellfish fishing (NAICS 114112), and other commercial marine fishing (NAICS 114119) businesses. (50 C.F.R. § 200.2; 13 C.F.R. § 121.201).

Description of the reasons why action by the agency is being considered

[55] For purposes of rulemaking, NMFS West Coast Region is applying the seafood processor standard to catcher processors (C/Ps) and mothership processor ships, which earn the majority of their revenue from selling processed Pacific whiting seafood product.

The reasons why agency action is being considered are explained in the "Statement of the Problem" section in the RIR above (Appendix F).

Statement of the objectives of, and legal basis for, the proposed rule

The reasons why agency action is being considered are explained in the "Description of the Management Goals and Objectives" section in the RIR above (Appendix F). The legal basis for the proposed rule is…

A description and, where feasible, estimate of the number of small entities to which the proposed rule will apply

Reporting and recordkeeping requirements

Description and estimate of economic effects on entities, by entity size and industry.

An explanation of the criteria used to evaluate whether the rule would impose "significant" economic effects.

An explanation of the criteria used to evaluate whether the rule would impose effects on "a substantial number" of small entities.

A description of, and an explanation of the basis for, assumptions used.

Relevant Federal rules that may duplicate, overlap or conflict with the proposed rule:

A description of any significant alternatives to the proposed rule that accomplish the stated objectives of applicable statutes and that minimize any significant economic impact of the proposed rule on small entities

APPENDIX H. NATIONAL STANDARDS ANALYSIS

{Section to be completed by NMFS after Council adopts a rebuilding plan}

APPENDIX I. CONSISTENCY WITH OTHER APPLICABLE LAWS ANALYSIS

{Section to be completed by NMFS after Council adopts a rebuilding plan}

- 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