Hatchery and Genetic Management Plans (HGMPs)

Purpose and Alignment with the Joint Agreement for the Management of Anadromous Salmon and Steelhead Hatcheries

Presented to the Washington Fish and Wildlife Commission

by Tom Chance

Lummi Natural Resources Department

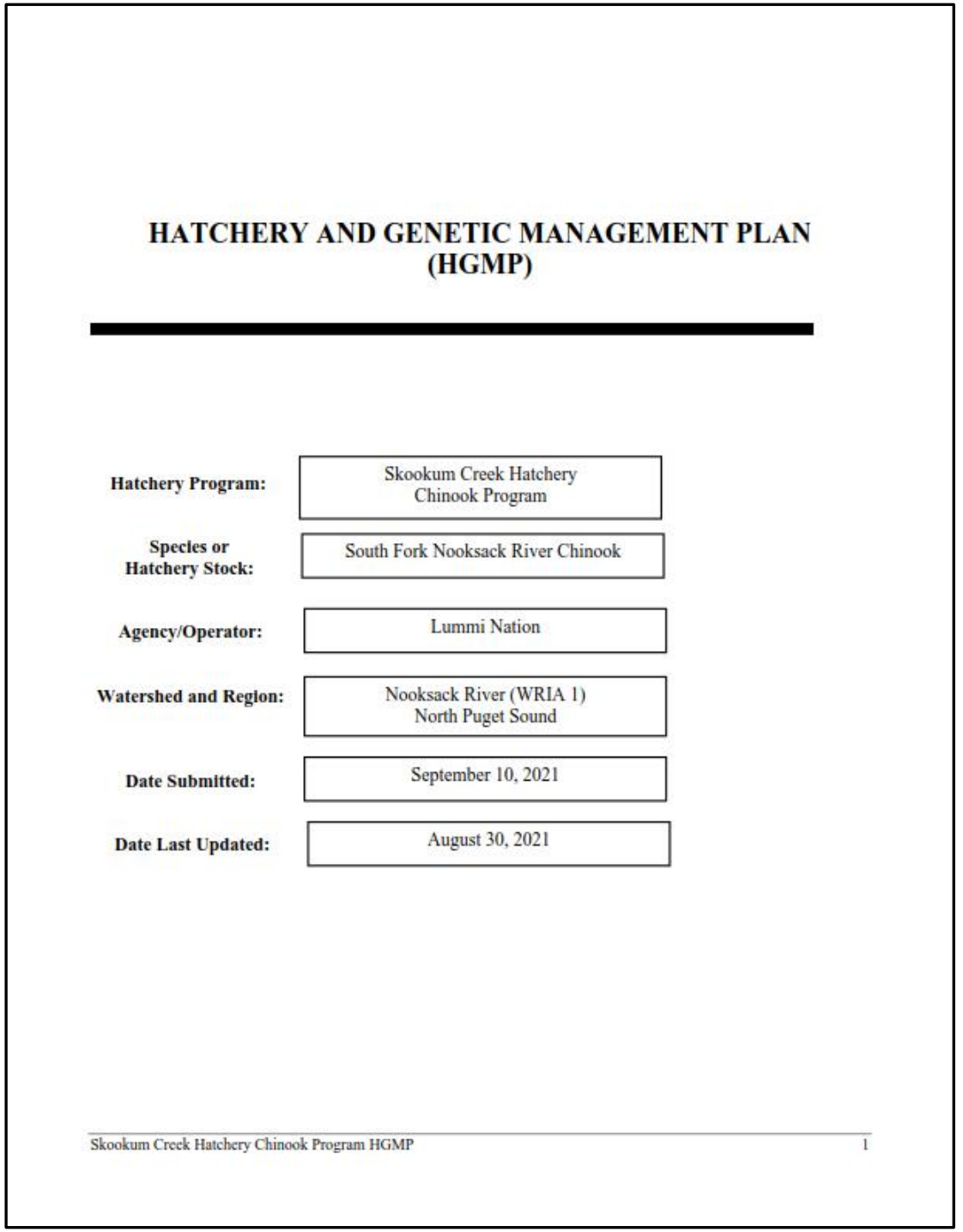
Presentation Objectives

- Provide an overview of Hatchery and Genetic Management Plans (HGMPs)
- Demonstrate the alignment between an HGMP, a regional watershed plan, and the Co-Manager Hatchery Policy
- Show that hatchery programs:
  - Have supporting, robust basin-wide monitoring and evaluation (M&E) programs
  - Apply objective science and local ecological understanding, not theory
  - Are essential to Treaty-Reserved Fishing Rights and non-tribal fisheries

South Fork Nooksack Chinook
(Ian Smith, 2022)

Lummi Nation's Skookum Creek Hatchery Chinook HGMP (59 pages) is highlighted for this presentation

- This HGMP is not unique (but the program it describes is)
- Management approaches or M&E methods alone shown today are not unique to the Nooksack River basin
- All aspects and factors combined *are* unique



HATCHERY AND GENETIC MANAGEMENT PLAN (HGMP)

Hatchery Program:	Skookum Creek Hatchery Chinook Program
Species or Hatchery Stock:	South Fork Nooksack River Chinook
Agency/Operator:	Lummi Nation
Watershed and Region:	Nooksack River (WRIA 1) North Puget Sound
Date Submitted:	September 10, 2021
Date Last Updated:	August 30, 2021

What is an HGMP?

The overarching purpose: Obtain Section 7 ESA authorization for a hatchery program where “take” of listed species may occur

- Essentially the written application for obtaining ESA coverage
- Provides the background and objectives of one hatchery program necessary for NOAA Fisheries to conduct an effects analysis
- Contains clearly stated goals and protocols for the program’s operation
- Describes relationships and dependencies with fisheries management
- Describes how the program will be monitored and evaluated
- Must be scientifically defensible
- Each HGMP is part of a “bundle” evaluated by NOAA

The Parts of an HGMP

1. General Program Description
2. Program Effects on NMFS ESA-Listed Salmonid Populations
3. Relationship of Program to Other Management Objectives
4. Water Source (not covered today)
5. Facilities (not covered today)
6. Broodstock Origin and Identity
7. Broodstock Collection
8. Mating
9. Incubation and Rearing
10. Release
11. Monitoring and Evaluation of Performance Indicators
12. Research

Each section has several sub-sections (16 in the case of Section 1.) and the majority of sub-sections will not be highlighted today

Snapshots of the Skookum Creek Hatchery Chinook HGMP will be used frequently

Why is an HGMP Required?

- Mandated in **CFR-2010-Title 50-vol 17-sec223.203** (Anadromous Fish section of the ESA)
- NMFS adopted the 4(d) rule in 2000 prohibiting the take of threatened species, except where take is associated with an approved program
- "Take" as defined by the ESA:
  - Harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect
- For a hatchery program, take may involve these and more:
  - Collecting ESA-listed fish for broodstock
  - Rearing ESA-listed fish
  - Potential effects from releasing smolts
  - Potential effects from adults
  - Facility effects
- In short, an anadromous salmon or steelhead hatchery program needs ESA coverage to comply with federal law and federal agency policy

(5) The prohibitions of paragraph (a) of this section relating to threatened species of salmonids listed in §223.102(a) do not apply to activity associated with artificial propagation programs provided that:

(i) A state or Federal Hatchery and Genetics Management Plan (HGMP) has been approved by NMFS as meeting the following criteria:

(A) The HGMP has clearly stated goals, performance objectives, and performance indicators that indicate the purpose of the program, its intended results, and measurements of its performance in meeting those results. Goals shall address whether the program is intended to meet conservation objectives, contribute to the ultimate sustainability of natural spawning populations, and/or intended to augment tribal, recreational, or commercial fisheries. Objectives should enumerate the results desired from the program that will be used to measure the program's success or failure.

HGMP Submission Process

- Where a tribal Co-Manager has fisheries management jurisdiction, HGMPs are jointly submitted for review and evaluation under **Limit 6** of the 4(d) rule
- NOAA mandates joint submission unless there is no tribal Co-Manager with jurisdiction
- Full Co-Manager agreement on any and all aspects of an HGMP must reached before NOAA will begin review of a bundle
- Here, NOAA recognizes Co-Management is federal law

Limit No. 6 – Joint Tribal/State Plans Developed under the *United States v. Washington* or *United States v. Oregon* Settlement Processes

Non-tribal salmonid management in the Puget Sound and Columbia River areas is profoundly influenced by the fishing rights of numerous Indian tribes and must be responsive to the court proceedings that interpret and define those tribal rights. Various orders of the *United States v. Washington* court, such as the Puget Sound Salmon Management Plan (originally approved by the court in 1977; recently amended in *United States v. Washington*, 626 F. Supp. 1405, 1527 (1985, W.D. Wash.)), mandate that many aspects of fishery management, including but not limited to harvest and artificial production actions, be jointly coordinated by the State of Washington and the Western Washington Treaty tribes. The State of Washington, affected tribes, other interests, and Federal agencies are all working toward an integrated set of management strategies and strictures that respond to the biological, legal, and practical realities of salmon management in Puget Sound. Similar principles apply in the Columbia River basin where the States of Oregon, Washington, and Idaho and five treaty tribes work within the framework and jurisdiction of *United States v. Oregon*.

A Citizen's Guide to the 4(d) Rule (NMFS 2000)

HGMP Approval Process

1. Co-Managers formally submit HGMP bundle to NOAA Fisheries
2. Initial sufficiency review
3. If sufficient for 4(d) exemption, pre-consultation commences
4. NOAA initiates development of Biological Opinion
   a) Started with Proposed Actions – Captures and refines actions and programmatic relationships proposed in the HGMPs
5. Information provided to NOAA for NEPA process
6. Proposed Evaluation and Pending Determination (PEPD) and subsequent Federal Register Notice (FRN) issued
7. Public comment period for PEPD
8. Final NOAA Biological Opinion issued with mandated terms and conditions for lawful operation of program(s)
   a) Conditions generally apply to monitoring and evaluation requirements
9. 4(d) Limit 6 Executive Record of Decision (ERD)
10. Record of Determination (ROD) issued

U.S. Fish and Wildlife Service BA Process Begins for species under USFWS jurisdiction (mainly bull trout)

- BA drafted after completion of HGMPs
- Bi-Op needs to be signed before NOAA issues ERD

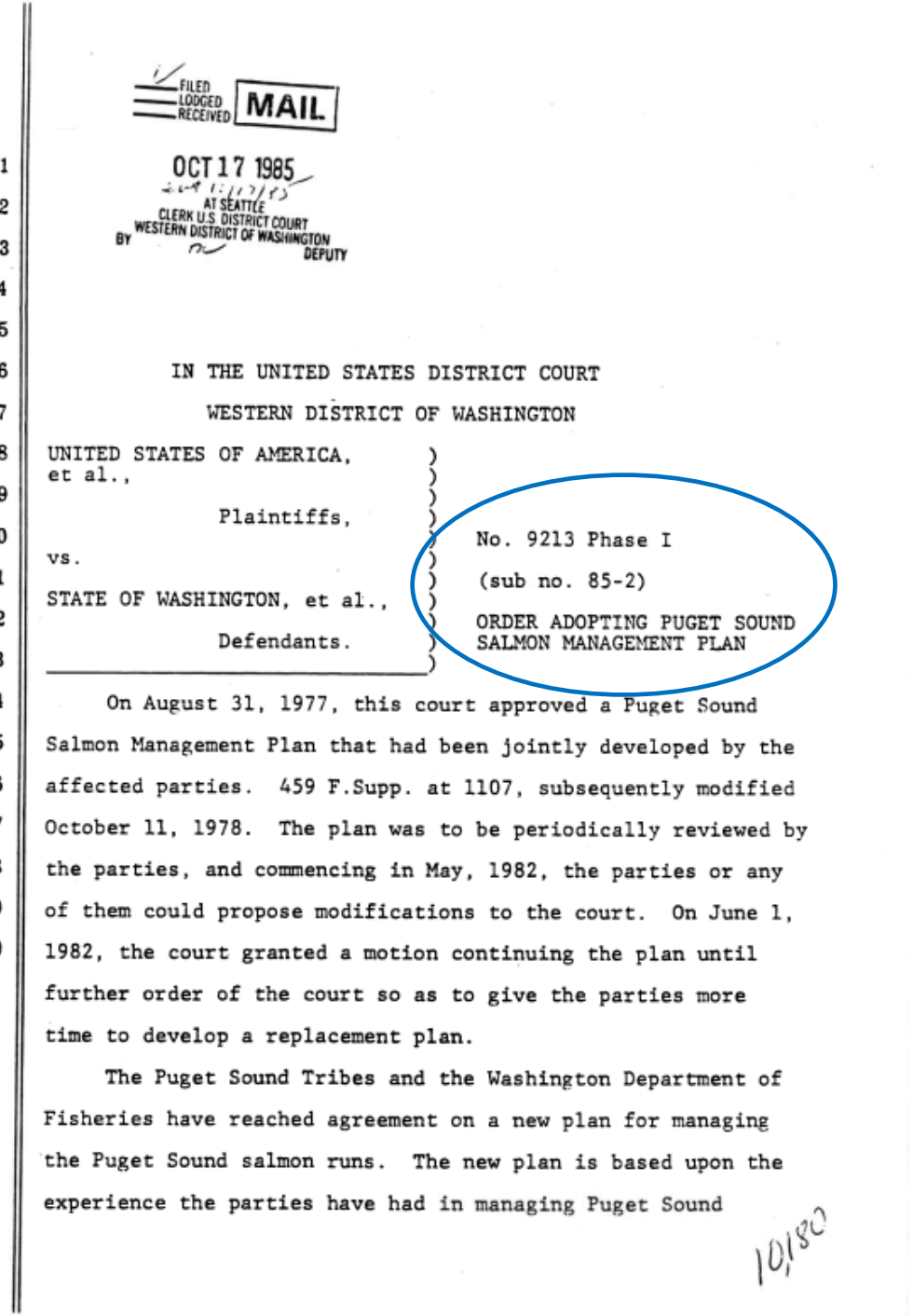
NEPA Process Begins in Parallel

1. Scoping process
2. EA or EIS drafted
3. Public comment period
4. Finding of no significant impact (FONSI) issued (for EAs only)
5. Final EA/EIS issued

This process is the same for the Columbia River basin and Puget Sound

What an HGMP Does Not Do

- Does not serve as a legally binding plan on its own
  - But does establish specific actions associated with eventual ESA authorization
- Does not replace or diminish Co-Manager agreements, federal mandates, or the plethora of other Co-Manager requirements
  - These are integrated *into* an HGMP (or Bi-Op)
- Does not serve as *the* recovery plan
  - It is a component of a recovery plan
- Serve as a living document



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CLERK U.S. DISTRICT COURT
WESTERN DISTRICT OF WASHINGTON
BY DEPUTY

IN THE UNITED STATES DISTRICT COURT
WESTERN DISTRICT OF WASHINGTON

UNITED STATES OF AMERICA, et al.,
Plaintiffs,
vs.
STATE OF WASHINGTON, et al.,
Defendants.

No. 9213 Phase I
(sub no. 85-2)
ORDER ADOPTING PUGET SOUND SALMON MANAGEMENT PLAN

On August 31, 1977, this court approved a Puget Sound Salmon Management Plan that had been jointly developed by the affected parties. 459 F.Supp. at 1107, subsequently modified October 11, 1978. The plan was to be periodically reviewed by the parties, and commencing in May, 1982, the parties or any of them could propose modifications to the court. On June 1, 1982, the court granted a motion continuing the plan until further order of the court so as to give the parties more time to develop a replacement plan.

The Puget Sound Tribes and the Washington Department of Fisheries have reached agreement on a new plan for managing the Puget Sound salmon runs. The new plan is based upon the experience the parties have had in managing Puget Sound

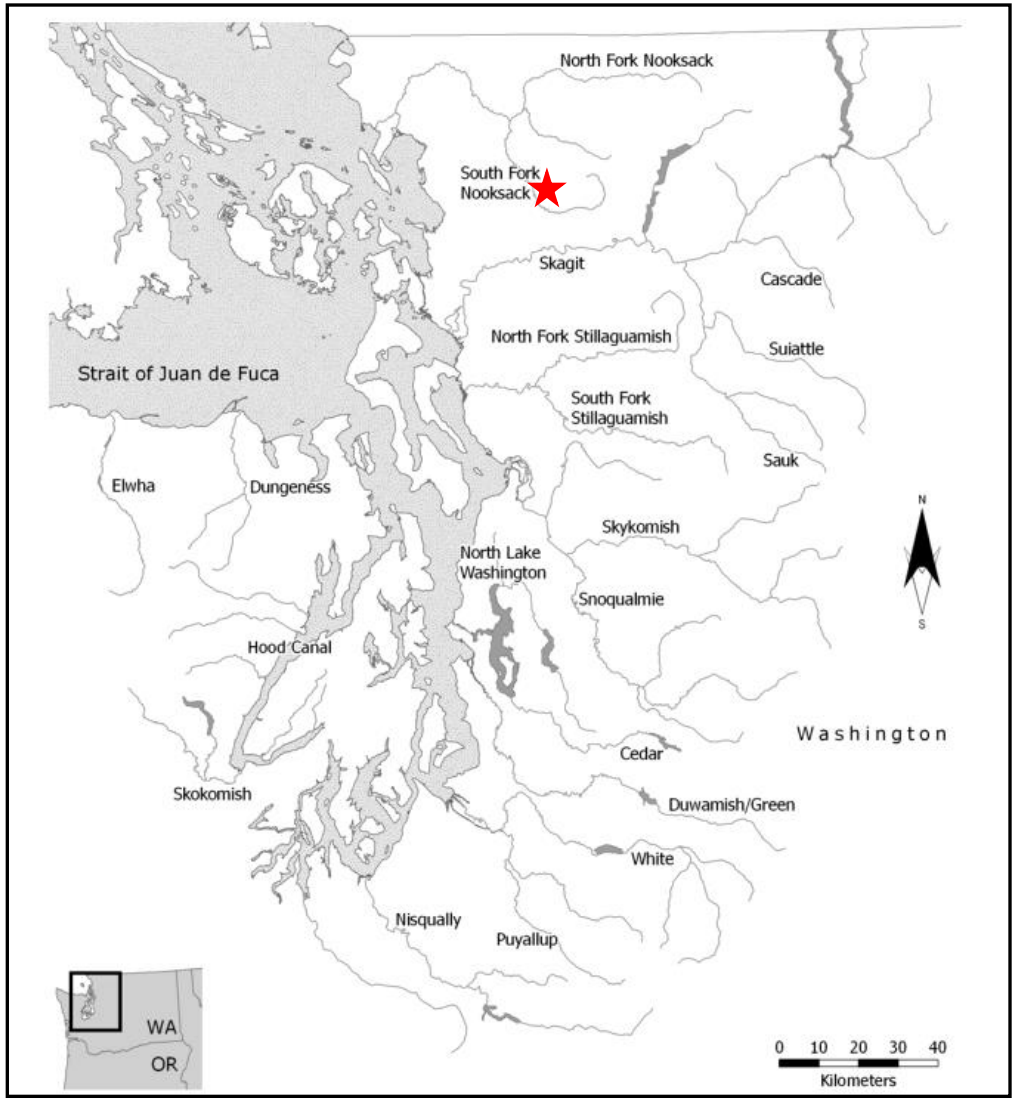
10/80

A Brief Background of the Skookum Creek Hatchery Chinook Program

- Initiated in 2006 in response to high risk of the South Fork Nooksack Chinook population's extinction
- Founded from a captive brood program
- Intensive genetic management component from day one
- As of 2017 relies solely upon returning anadromous adults
- A highly successful example of how well-developed and managed hatchery programs can achieve major preservation and near-term rebuilding objectives

Section 1. General Program Description

1.1	Name of hatchery or program
1.2	Species and population (or stock) under propagation, and ESA status
1.3	Responsible organization and individuals
1.4	Funding source, staffing level, and annual hatchery program operational costs
1.5	Locations(s) of hatchery and associated facilities
1.6	Type of program
1.7	Purpose (goal) of program
1.8	Justification for the program
1.9	List of program "Performance Standards"
1.10	List of program "Performance Indicators"
1.11	Expected Size of Program
1.12	Current program performance, including estimated smolt-to-adult survival rates, adult production levels, and escapement levels
1.13	Date program started (years in operation) or is expected to start
1.14	Expected duration of program
1.15	Watersheds targeted by program
1.16	Indicate alternative actions considered for attaining program goals, and reason why those actions are not being proposed



Sectio

1.2) Species and population (or stock) under propagation, and ESA status.

South Fork Nooksack Chinook (*Oncorhynchus tshawytscha)*, including fish from this hatchery program, which are within the ESA-listed Puget Sound Chinook Evolutionarily Significant Unit – Re-affirmed as Threatened in the most recent 5-year status review (NWFSC ~~2016~~). **2022**

South Fork Nooksack Chinook
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1.7) Purpose (Goal) of program.

The primary goals of this hatchery program are to prevent extinction of the South Fork Chinook population while habitat is restored and protected to properly functioning conditions, while also providing terminal area tribal harvest in directed ceremonial, subsistence, and commercial fisheries. This program has supported the preservation of the South Fork Nooksack Chinook salmon population and has reduced the potential for the stock's extinction through captive intervention and is structured to supplement the natural-origin component by increasing the abundance and distribution of natural spawners.

This program will increase the abundance of genetically diverse South Fork Nooksack Chinook migrants. Program fish will increase the ocean abundance of the stock to buffer predation and incidental fishing pressure on natural production and increase the abundance of prey items for the ESA listed Southern Resident Killer Whale population.

Hatchery program plans should support ecosystem function, such as providing prey for Southern Resident Killer Whales, buffering pinniped and avian predation, and providing nutrients that cycle between freshwater and marine environments.

(Co-manager Hatchery Policy Principle 4, Bullet 1)

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1.8) Justification for the program.

Current habitat conditions that affect species productivity prevent naturally producing Chinook salmon from reaching population abundance levels that will support the harvest of fish that is guaranteed by the Lummi Nation's Federally recognized Treaty Rights. Habitat conditions within the Nooksack River basin are poor and include: excessive fine sediment loads, primarily from timber harvesting, such as clear cuts and roads; loss and removals of in-stream large woody debris, removal of over 90% of the riparian zone mature trees and armoring of banks, etc., have combined to limit the productivity of naturally reproducing fish (WRIA 1 SRB 2005). In addition, the South Fork Nooksack is designated a 303(d) temperature impaired water body due to summertime water temperature consistently exceeding lethal temperature thresholds (WDOE website: https://apps.ecology.wa.gov/ApprovedWQA/ApprovedSearch.aspx, accessed October 17, 2019). Furthermore, marine survival has also declined substantially in recent decades.

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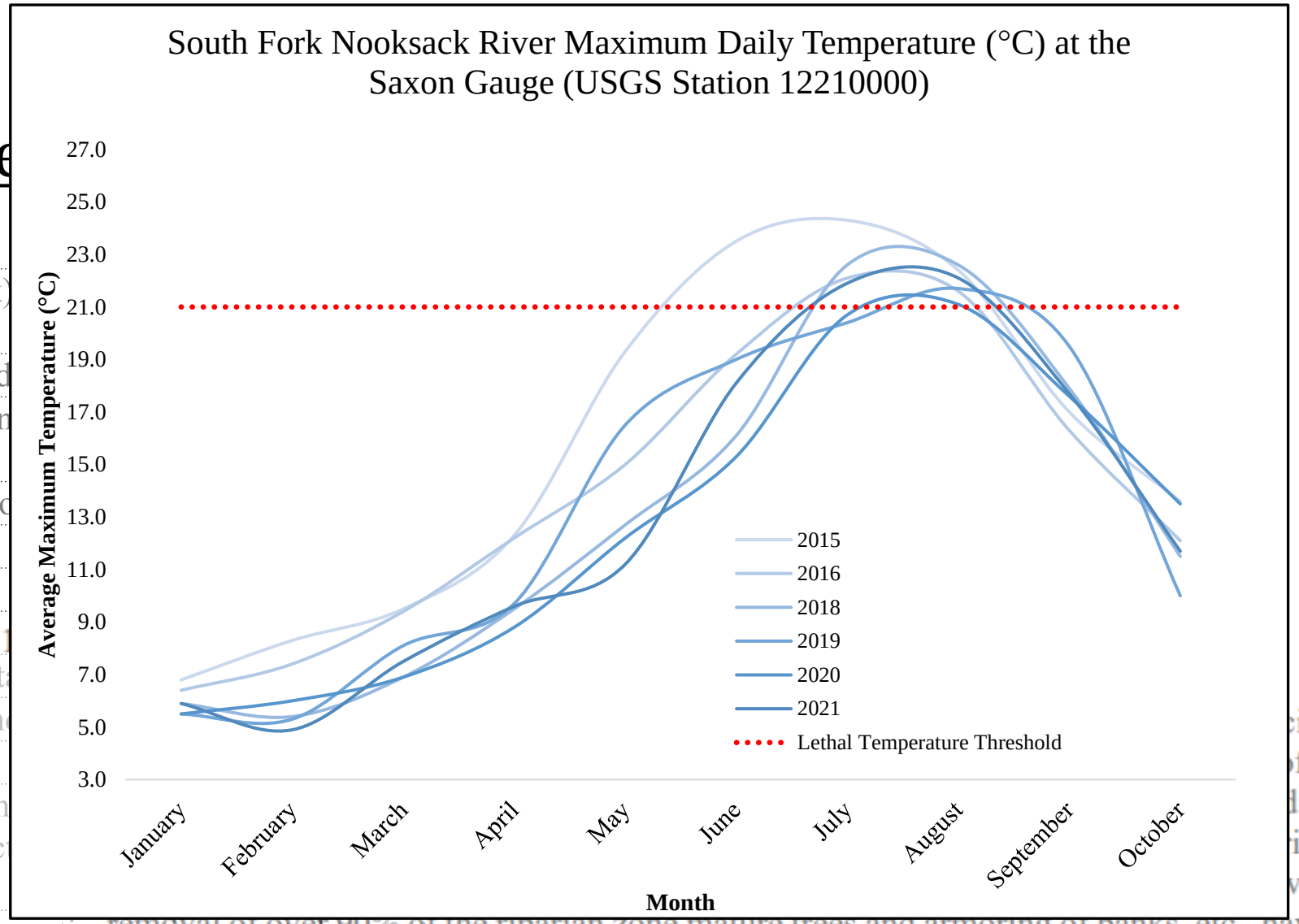

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Section 1. General Program Description

North Fork/Middle Fork Nooksack Native Chinook Hatchery Restoration Program (WDFW's Kendall Creek Hatchery)

1.1 Name of hatchery or program
1.2 Species and population (or stock) under propagation, and ESA status
1.3 Responsible organization and indi
1.4 Funding source, staffing level, and operational costs
1.5 Locations(s) of hatchery and assoc
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1.13 Date program started (years in ope
1.14 Expected duration of program
1.15 Watersheds targeted by program
1.16 Indicate alternative actions considered for attaining program goals, and reason why those actions are not being proposed

1.8 Justification for the program.

Habitat degradation is considered the leading cause for the decline of Nooksack watershed salmonid populations. Current habitat conditions are substantially less productive than historical conditions. Estimated current adult capacity for each Nooksack early Chinook population is less than 10% of historic capacity; similarly, estimated current adult productivity and life history diversity are less than 15% and 45% of historic levels, respectively (WRIA 1 2005). Because of the poor habitat conditions and chronically low abundance of natural-origin early Chinook salmon in the NF/MF Nooksack River basin, Co-managers instituted a hatchery program to decrease extinction risks by increasing the number of naturally spawning Chinook. However, the hatchery program alone will not mitigate for lost escapement and poor habitat conditions if not combined with intense habitat restoration throughout the basin as habitat continues to limit success of this restoration program.

This hatchery program also faciliates implementation of the Treaty Right to fish in the face of continuing loss and alteration of salmon habitat and climate change. Until habitat conditions within the Nooksack River and adjacent watersheds are able to support abundant, naturally self-sustaining levels of salmon in sufficient numbers, hatchery programs such as this will be an integral and essential component of Co-Manager salmon management objectives.

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1.16) Indicate alternative actions considered for attaining program goals, and reasons why those actions are not being proposed.

As stated above, one of the primary objectives of this hatchery program is to allow the Lummi Nation and the Nooksack Indian Tribe to exercise their Treaty-reserved Rights to catch fish in their usual and accustomed places. Because habitat conditions within the Nooksack River basin cannot support abundance and productivity levels of Chinook salmon that reach viability levels, and more importantly, with enough surplus to allow for Treaty fisheries, this program is essential to the affected Tribes. Therefore, the following alternative actions were considered and rejected:

Reduction in terminal harvest levels
Harvest levels of early timed Chinook salmon were voluntarily restricted in the 1970s for Lummi Nation and Nooksack Tribal fishers to reduce harvest impacts to natural-origin early run Chinook salmon. There is no known evidence of increased productivity as a result of the voluntary restrictions. Today, tribal fisheries are conducted on an extremely limited and intensively monitored Ceremonial and subsistence basis. Further reduction in terminal harvest is not anticipated to increase viability, but more importantly, will diminish the Treaty-reserved fishing rights for Lummi Nation and the Nooksack Tribe.

Reduction in release levels
A premature reduction in this program's release levels, less than two full generations after the first release from this program (release year 2011), is likely to result in harm to the long-term viability of the South Fork Nooksack River Chinook salmon population. In addition, the purpose of this program is to enhance the abundance and potentially the productivity of the natural population ***over time***. Reducing the number of fish released prior to monitoring and evaluation of the hatchery program's effect on the natural-origin population will equate to a waste of monetary and fish resources.

There is precedence from other Puget Sound Chinook preservation and recovery programs where the program release levels were reduced too soon or were initially scaled too small to establish an adequately performing hatchery program. In addition, a program with a larger release level may minimize random genetic drift and the risk of inbreeding depression compared to a smaller release level.

Reduce or remove hatchery program because of habitat restoration
Another alternative is to reduce or eliminate the hatchery program because restoration and protection of key habitat in spawning and rearing areas may eventually allow for increased natural production to viability levels with a surplus that can be harvested. While habitat restoration is essential in the Nooksack River basin because of past legacy effects and current land use practices, a corresponding increase in natural production and abundance has not occurred and may not for many years. Judge (2011) concluded that Chinook salmon habitat in Puget Sound was still declining more than 10 years after the ESA listing. Waiting for increases in natural production is not considered an option for the Lummi Nation because it would eliminate current fisheries that are the reserved Right of the Tribe.

Habitat Protection and Restoration has not been able to increase abundance or productivity
Legacy and ongoing effects from timber harvest, agriculture, development, and flood control have degraded ecosystem processes needed for properly functioning habitat conditions. Major limiting factors in the South Fork include high temperature, fine sediment and poor habitat diversity (WRIA 1 SRB 2005).

A regular integrated program has not been possible to sustain
The abundance of natural-origin South Fork Chinook in the South Fork Nooksack River has been, and currently still is, too low to support a well-integrated hatchery program. Although the current program was founded from 100% natural-origin captive South Fork Chinook, the program is now sustained from returning anadromous hatchery-origin adults. It is anticipated that once natural-origin abundance consistently increases to levels above the low abundance threshold (LAT), natural-origin fish will be integrated into the broodstock at varying rates.

Section 2. Program Effects on NMFS ESA-Listed Salmonid Populations

2.1 List all ESA permits or authorizations in hand for the hatchery program

2.2.1 Description of NMFS ESA-listed salmonid population(s) affected by the program

2.2 Provide descriptions, status, and projected take actions and levels for NMFS ESA-Listed natural populations in the target area

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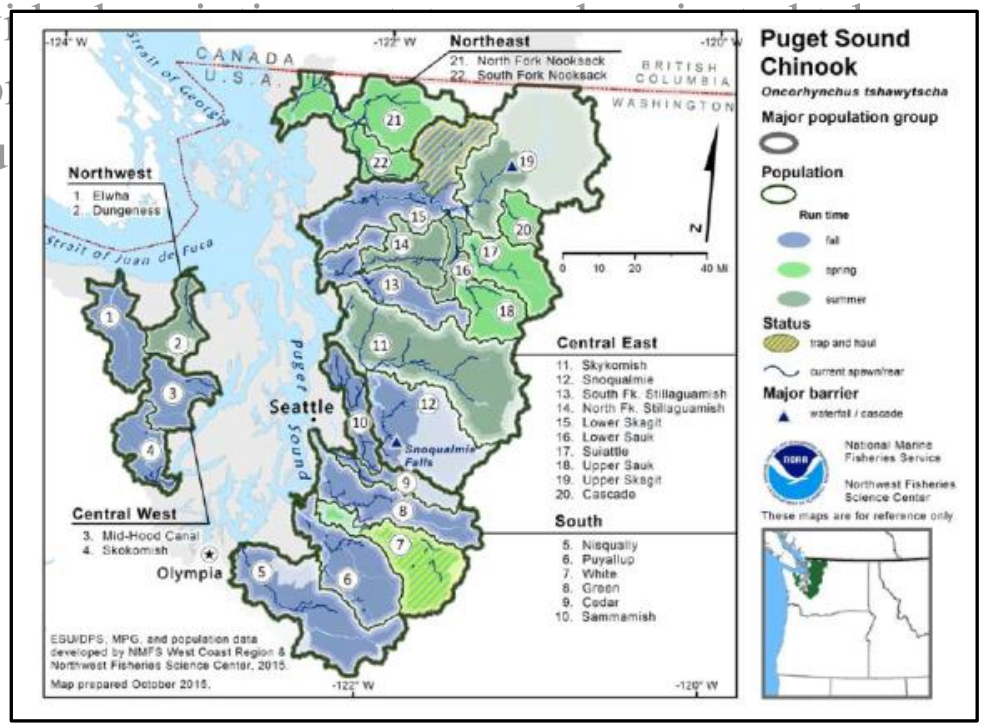
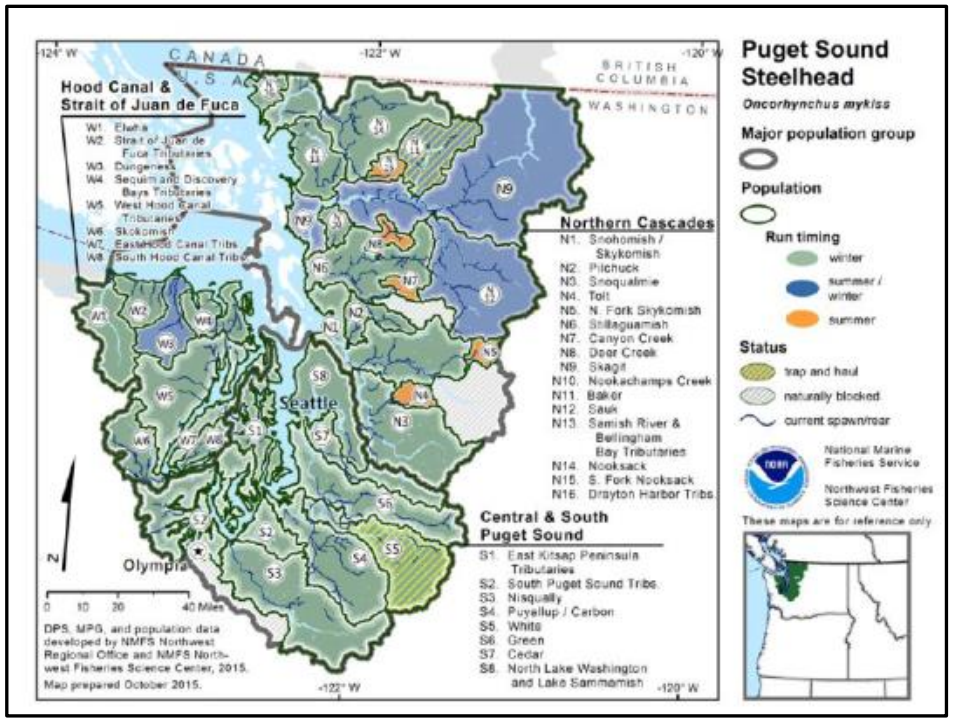
2.2 Provi... actio... popu...

1. South Fork Nooksack Chinook
2. North Fork/Middle Fork Nooksack Chinook
3. Nooksack Winter Steelhead
4. Nooksack Summer Steelhead





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- Additional Section 10 coverage for handling and PIT-tagging juvenile chinook during trapping and seining
- Handling and/or spawning listed natural-origin adult Chinook entering Skookum Creek Hatchery
- Operating all aspects of a program involving the ESA-listed component of the South Fork Nooksack Chinook stock (per **81 FR 72759, 2016**)

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Salmon, Chinook (Puget Sound ESU)

We propose to revise this description to read: "Naturally spawned Chinook salmon originating from rivers flowing into Puget Sound from the Elwha River (inclusive) eastward, including rivers in Hood Canal, South Sound, North Sound and the Strait of Georgia. Also, Chinook salmon from the following artificial propagation programs: the Kendall Creek Hatchery Program; Marblemount Hatchery Program (spring subyearlings and summer-run); Brenner Creek Hatchery Program (summer-run and fall-run); Whitehorse Springs Pond Program; Wallace River Hatchery Program (yearlings and subyearlings); Issaquah Hatchery Program; White River Hatchery Program; White Acclimation Pond Program; Voights Creek Hatchery Program; Diru Creek Program; Clear Creek Program; Kalama Creek Program; George Adams Hatchery Program; Hamma Hatchery Program; Dungeness/ Hurd Creek Hatchery Program; Elwha Channel Hatchery Program; Skookum Creek Hatchery Spring-run Program; Bernie Kai-Kai Gobin (Tulalip) Hatchery-Cascade Program; North Fork Skokomish River Spring-run Program; the Soos Creek Hatchery Program (subyearlings and yearlings); the Fish Restoration Facility Program; the Bernie Kai-Kai Gobin (Tulalip) Hatchery-

(81 FR 72759, 2016)

Section 3. Relationship of Program to Other Management Objectives

3.1	Describe alignment of the hatchery program with any ESU-wide hatchery plan or other regionally accepted policies
3.2	List all existing cooperative agreements, memoranda of understanding, memoranda of agreement, or other management plans or court orders under which program operates
3.3	Relationship to harvest objectives
3.4	Relationship to habitat protection and recovery strategies
3.5	Ecological interactions

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3.3 Relationship to harvest objectives

3.4

3.5

3.1) Describe alignment of the hatchery program with any ESU-wide hatchery plan or other regionally accepted policies. Explain any proposed deviations from the plan or policies.

The Lummi Nation's hatchery programs in Puget Sound operate under and adhere to *U.S. v Washington* that provides the legal framework for coordinating these programs (PSSMP 1985).

This program is a priority early action item included in the WRIA 1 Salmonid Recovery Plan and it is required to restore of the South Fork Early Chinook population (WRIA 1 SRB 2005). The WRIA 1 plan is integrated into the regional salmon recovery plan (SSDC 2007).

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3.4 Relationship to habitat p
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3.5 Ecological interactions

5.3. Hatchery

5.3.1. Recovery Objectives

- Use hatcheries to aid in the recovery of WRIA 1 wild salmonid populations using integrated principles of genetic conservation, ecology, fish culture, and fisheries management.
- Hatchery production of chinook and other salmon will neither cause further decline nor inhibit recovery of WRIA 1 naturally spawning early chinook populations. Genetic diversity within and among stocks will be maintained. Hatchery programs will be managed, and adaptively managed, to minimize adverse genetic and ecological interactions between hatchery origin (HOR) and natural origin (NOR) early chinook, which can include interbreeding among different stocks or populations, loss of genetic diversity within populations, domestication, competition, predation, and disease transmission between hatchery and wild fish.

3.1) Describe alignment of the regionally accepted policie

The Lummi Nation's hatch
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WRIA 1 SRP p. 252
https://salmonwria1.org

Section 3. Relationship of Program to Other Management Objectives –WRIA 1 Salmon Recovery Plan Near-Term Actions

- Establishing the South Fork Chinook preservation program was a top Nooksack River watershed management priority
- All actions specified are led by Lummi Nation, Nooksack Tribe, and WDFW

Action #5: Establish a South Fork gene bank/supplementation program

- **Goal:** Preserve the unique genetic characteristics of the South Fork chinook population while stream habitat conditions critical to the recovery of the native chinook population improves.

- **Objectives:**
  - Develop and implement a native South Fork chinook brood stock program at the Skookum Creek Hatchery that increases the numbers of South Fork early-timed native chinook spawners in the South Fork (abundance) while minimizing to the extent possible, the effects of hatchery intervention on the genetic character of the stock.
  - Reduce North Fork early and late timed (fall) hatchery chinook strays into the South Fork to reduce risks to the South Fork chinook population which may arise from interbreeding between stocks, redd superimposition, and/or competition.

Appendix Page B-35 of WRIA 1 SRP
https://salmonwria1.org

Ultrasounding a SF chinook gene bank captive brood to evaluate maturation

Section 3. Relationship of Program to Other Management Objectives

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3.3	Relationship to harvest objectives
3.4	Relationship to habitat protection and recovery strategies
3.5	Ecological interactions

These other sections are critically important and highlight the program's context and alignment with:

- Treaty Rights
- Tribal and non-tribal fisheries
- Habitat protection and restoration agreements and objectives

Section 6. Broodstock Origin and Identity

6.1 Source

6.2 Supporting Information

6.2.1 History

6.2.2 Annual Size

6.2.3 Past and proposed level of natural fish in broodstock

6.2.4 Genetic or ecological differences

6.2.5 Reasons for choosing

6.3 Indicate risk aversion measures that will be applied to minimize the adverse genetic or ecological effects to listed natural fish that may occur as a result of broodstock selection practices

Section 6. Broodsto

Table 1.11.1.1. Natural-Origin Broodstock Integration by Abundance Range

Estimated Natural-Origin Spawner Abundance	Total Number of Adults Needed for Broodstock	Percentage of Natural-Origin Adult Broodstock	Maximum Number of Natural-Origin Broodstock*
≤ 200	1,000	0%	0
201 - 499	1,000	≤ 15%	150
500 - 800	1,000	≤ 30%	300
800 - 1,200	1,000	≤ 70%	700

* Based upon the maximum number of natural-origin spawner abundance specified for range

6.2.3) Past and proposed level of natural fish in broodstock.

This program was founded entirely by captive natural-origin broodstock but has recently transitioned to spawning returning hatchery-origin fish only. If natural-origin South Fork Chinook abundance is projected to exceed the established low abundance threshold (LAT) of 200 natural-origin spawners, the integration of natural-origin broodstock may occur. However, natural-origin brood will not be integrated if there is a possibility of reducing natural-origin abundance to a level that does not result in the LAT being met. On an interim basis, the proposed maximum percentage of natural-origin broodstock integrated into the program will range from 0-70%, which is dependent on the pre-season annual estimated abundance of natural-origin South Fork Nooksack Chinook adult spawners (Table 1.11.1.1). To ensure that natural-origin South Fork Chinook salmon are not integrated at a rate that will result in demographic harm to the natural-origin population, the graduated, or sliding scale shown in Table 1.11.1.1 may be used to establish broodstock integration rates.

Section 6. Broodstock Origin and Identity

6.1 Source

6.2 Supporting Information

6.2.1 History

6.2.2 Annual Size

6.2.3 Past and proposed level of natural fish in broodstock

6.2.4 Genetic

6.2.5 Reason

6.3 Indicat

6.2.3) Past and

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Chinook adult spawners (Table 1.11.1.1). To ensure that natural-origin South Fork Chinook salmon are not integrated at a rate that will result in demographic harm to the natural-origin population, the graduated, or sliding scale shown in Table 1.11.1.1 may be used to establish broodstock integration rates.

Table 1.11.1.1 Natural-Origin Broodstock Integration by Abundance Range

Natural-Origin Spawner Abundance	Total Number of Adults Needed for Broodstock	Percentage of Natural-Origin Adult Broodstock	Maximum Number of Natural-Origin Broodstock*
≤ 200	1,000	0%	0
201 - 499	1,000	≤ 15%	150
500 - 800	1,000	≤ 30%	300
800 - 1,200	1,000	≤ 70%	700

* Based upon the maximum number of natural-origin spawner abundance specified for range

This integration plan is structured to align with the **Nooksack Watershed's:**

- Established salmon forecasting methodology
- Harvest management structure
- Chinook population monitoring and evaluation structure
- Habitat function limitations
- Hatchery facility characteristics

No state-wide one-size-fits-all approach will work for this program, just as this approach cannot work for Elwha or Wenatchee River programs

Section 6. Broodstock Origin and Identity

6.1 Source

6.2 Supporting Information

6.2.1 History

6.2.2 Annual Size

6.2.3 Past and proposed level of natural fish in broodstock

6.2.4 Genetic or ecological differences

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Broodstock for this program were founded from over 4,000 natural-origin juveniles over more than a full brood cycle, representing a diversity of families identified through DNA analysis with a high probability of belonging to the native South Fork Nooksack Chinook population. Spawning and rearing protocols that promote genetic diversity and reduce genetic inbreeding will continue to be implemented indefinitely.

Section 7. Broodstock Collection

7.1	Life history to be collected (adults, eggs, or juveniles)
7.2	Collection or sampling design
7.3	Identity
7.4	Proposed number to be collection
7.5	Disposition of hatchery-origin fish collected in surplus of broodstock needs
7.6	Fish transportation and holding methods
7.7	Describe fish health maintenance and sanitation procedures applied
7.8	Disposition of carcasses
7.9	Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish resulting from the broodstock collection program

Section 7. Broodstock Collection

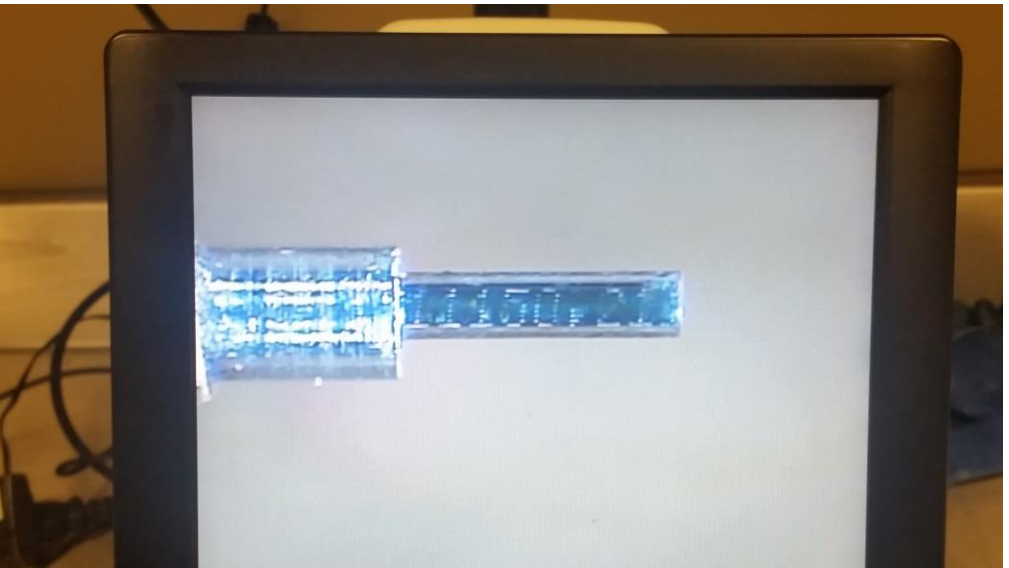
7.3) Identity.

Currently, returning hatchery-origin adults are selected for brood if they meet coded-wire tag and intact adipose fin criteria (i.e. CWT-only). At present, the South Fork Nooksack River hatchery Chinook program is the only regional program releasing CWT-only juveniles. Selecting these as broodstock minimizes the risk of inadvertent incorporation of NF/MF Nooksack River Chinook, or out-of-basin Chinook adults into the program. All brood selected for spawning will be verified for identity by CWT analysis. In addition, all hatchery-origin South Fork Chinook will be thermal otolith marked as an additional capability for stock and origin identity.

Although a portion of South Fork hatchery-origin juveniles have begun receiving adipose fin clips annually (since BY17) as a means of evaluating pre-terminal harvest or off-station release groups, all adipose-marked returning adults will be lethally surplused (because they may not be South Fork hatchery-origin Chinook) unless a shortage of CWT-only broodstock have recruited to the hatchery. In this case, adipose-clipped brood will be isolated or tracked separately until their identity is verified by CWT, otolith pattern, or genetic stock assignment after they are spawned. Identity of hatchery-origin broodstock using these methods will be verified during incubation and non-South Fork Hatchery eggs or fry will be culled from the program prior to ponding. At a minimum, all spawned brood are sampled for CWTs, DNA tissue samples, fork length, and external research tags. Otoliths and scales are collected on an as-needed or opportunistic basis.

Broodstock Identity using Coded-Wire Tags (CWTs)

- Intensive program CWT history
- Lummi-operated CWT lab conducts rapid stock verification
- CWTs effective for ID in this program due to number used
  - 5,007,408 tagged fish released just from 2019-2023



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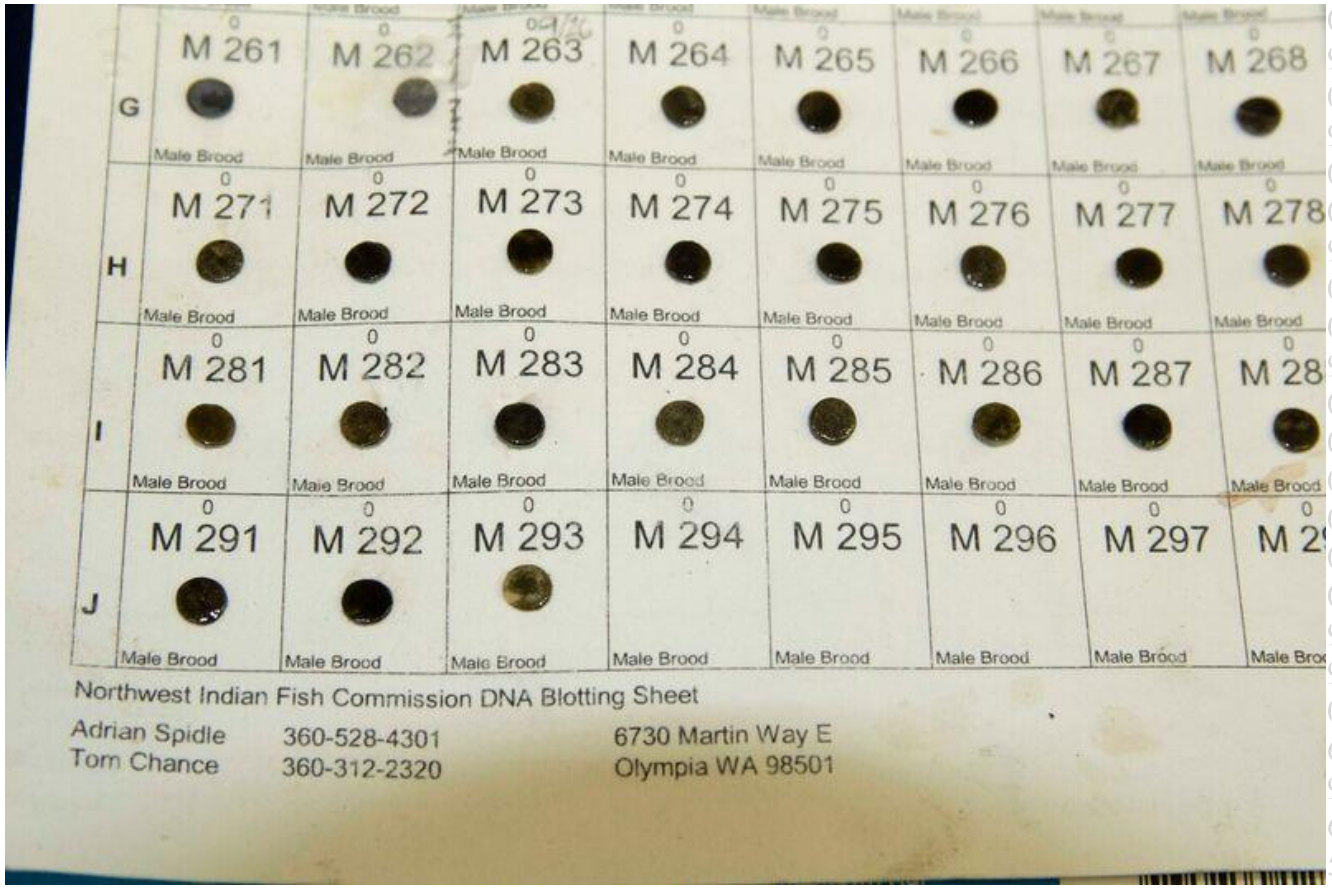
WDFW ID	WDFW code	Lummi ID	sex	mark	CWT	Mark/Tag Origin	NFMF_springs posterior prob.	Samish_falls posterior prob.	SF_springs posterior prob.	Best Assignment	Best posterior probability	odds	FatherID	MotherID
22MP0016	22MP	F 016	F	Yes	No	H	0.213613847	3.73697E-11	0.78638	SF_springs	0.786	3.681344	*2	#2
22MP0019	22MP	F 019	F	No	No	N	0.00000	0.00000	1.00000	SF_springs	1.000	921539.1	18OF0095	18OE0095
22MP0037	22MP	F 037	F	Yes	No	H	0.00003	0.00000	0.99997	SF_springs	1.000	29552.36	18OF0009	18OE0009
22MP0057	22MP	F 057	F	No	No	N	0.00000	0.00000	1.00000	SF_springs	1.000	962891.5	18OF0005	18OE0005
									000	SF_springs	1.000	778341.1	18OF0212	18OE0212
									954	SF_springs	1.000	2194.074	19QO0241	19QO0041
									000	SF_springs	1.000	7.78E+09	18OF0114	18OE0113
									902	SF_springs	0.989	90.1126	18OF0019	18OE0019
									000	SF_springs	1.000	309255	18OF0124	18OE0124
									000	SF_springs	1.000	1.85E+10	18OF0393	18OE0393
									999	SF_springs	1.000	80823.59	18OF0051	18OE0051
									000	SF_springs	1.000	4651173	18OF0125	18OE0125
									000	SF_springs	1.000	2.19E+10	18OF0079	18OE0079
									997	SF_springs	1.000	29729.43	18OF0021	18OE0021
									000	SF_springs	1.000	3.88E+08	18OF0026	18OE0026
									000	SF_springs	1.000	30482940	18OF0065	18OE0065
									000	SF_springs	1.000	2.84E+12	18OF0363	18OE0363
									000	SF_springs	1.000	18154361	18OF0094	18OE0094
									000	SF_springs	1.000	2889428	18OF0419	18OE0419
									000	SF_springs	1.000	19649210	18OF0110	18OE0110
									997	SF_springs	1.000	36427.7	19QO0288	19QO0088
									999	SF_springs	1.000	123780.2	18OF0379	18OE0379
									000	SF_springs	1.000	538230.3	18OF0111	18OE0112
									642	SF_springs	0.886	7.829496	19QO0327	19QO0127
									955	SF_springs	1.000	2234.515	18OF0315	18OE0315
									698	SF_springs	0.977	42.43201	19QO0680	19QO0629
									523	Samish_falls	0.995	190.0509	*3	#3
22MP0377	22MP	F 377	F	Yes	No	H	0.00000	1.00000	0.00000	Samish_falls	1.000	8.54E+08	*4	#4
22MP0390	22MP	F 390	F	Yes	No	H	0.00000	1.00000	0.00000	Samish_falls	1.000	1232291	*5	#5
22MP0393	22MP	F 393	F	No	No	N	0.00001	0.00000	0.99999	SF_springs	1.000	142916.9	*6	#6
22MP0398	22MP	F 398	F	No	No	N	0.00000	0.00001	0.99999	SF_springs	1.000	122884.6	18OF0136	18OE0136



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22MP0073	22MP	F 073	F	Yes	No	H	0.00000	0.00000	1.00000	SF_springs	1.000	778341.1	18OF0212	18OE0212
22MP0091	22MP	F 091	F	Yes	No	H	0.00000	0.00046	0.99954	SF_springs	1.000	2194.074	19QO0241	19QO0041
22MP0104	22MP	F 104	F	No	No	N	0.00000	0.00000	1.00000	SF_springs	1.000	7.78E+09	18OF0114	18OE0113
22MP0151	22MP	F 151	F	Yes	Yes	H	0.01098	0.00000	0.98902	SF_springs	0.989	90.1126	18OF0019	18OE0019
22MP0152	22MP	F 152	F	Yes	Yes	H	0.00000	0.00000	1.00000	SF_springs	1.000	309255	18OF0124	18OE0124
22MP0154	22MP	F 154	F	No	No	N	0.00000	0.00000	1.00000	SF_springs	1.000	1.85E+10	18OF0393	18OE0393
22MP0157	22MP	F 157	F	Yes	Yes	H	0.00001	0.00000	0.99999	SF_springs	1.000	80823.59	18OF0051	18OE0051
22MP0159	22MP	F 159	F	No	No	N	0.00000	0.00000	1.00000	SF_springs	1.000	4651173	18OF0125	18OE0125
22MP0162	22MP	F 162	F	No	No	N	0.00000	0.00000	1.00000	SF_springs	1.000	2.19E+10	18OF0079	18OE0079
22MP0167	22MP	F 167	F	Yes	Yes	H	0.00003	0.00000	0.99997	SF_springs	1.000	29729.43	18OF0021	18OE0021
22MP0169	22MP	F 169	F	Yes	Yes	H	0.00000	0.00000	1.00000	SF_springs	1.000	3.88E+08	18OF0026	18OE0026
22MP0208	22MP	F 208	F	No	No	N	0.00000	0.00000	1.00000	SF_springs	1.000	30482940	18OF0065	18OE0065
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22MP0286	22MP	F 286	F	No	No	N	0.00000	0.00000	1.00000	SF_springs	1.000	18154361	18OF0094	18OE0094
22MP0302	22MP	F 302	F	No	No	N	0.00000	0.00000	1.00000	SF_springs	1.000	2889428	18OF0419	18OE0419
22MP0321	22MP	F 321	F	No	No	N	0.00000	0.00000	1.00000	SF_springs	1.000	19649210	18OF0110	18OE0110
22MP0327	22MP	F 327	F	No									19QO0288	19QO0088
22MP0333	22MP	F 333	F	No									18OF0379	18OE0379
22MP0339	22MP	F 339	F	No									18OF0111	18OE0112
22MP0341	22MP	F 341	F	No									19QO0327	19QO0127
22MP0345	22MP	F 345	F	No									18OF0315	18OE0315
22MP0352	22MP	F 352	F	No									19QO0680	19QO0629
22MP0374	22MP	F 374	F	Yes									*3	#3
22MP0377	22MP	F 377	F	Yes									*4	#4
22MP0390	22MP	F 390	F	Yes									*5	#5
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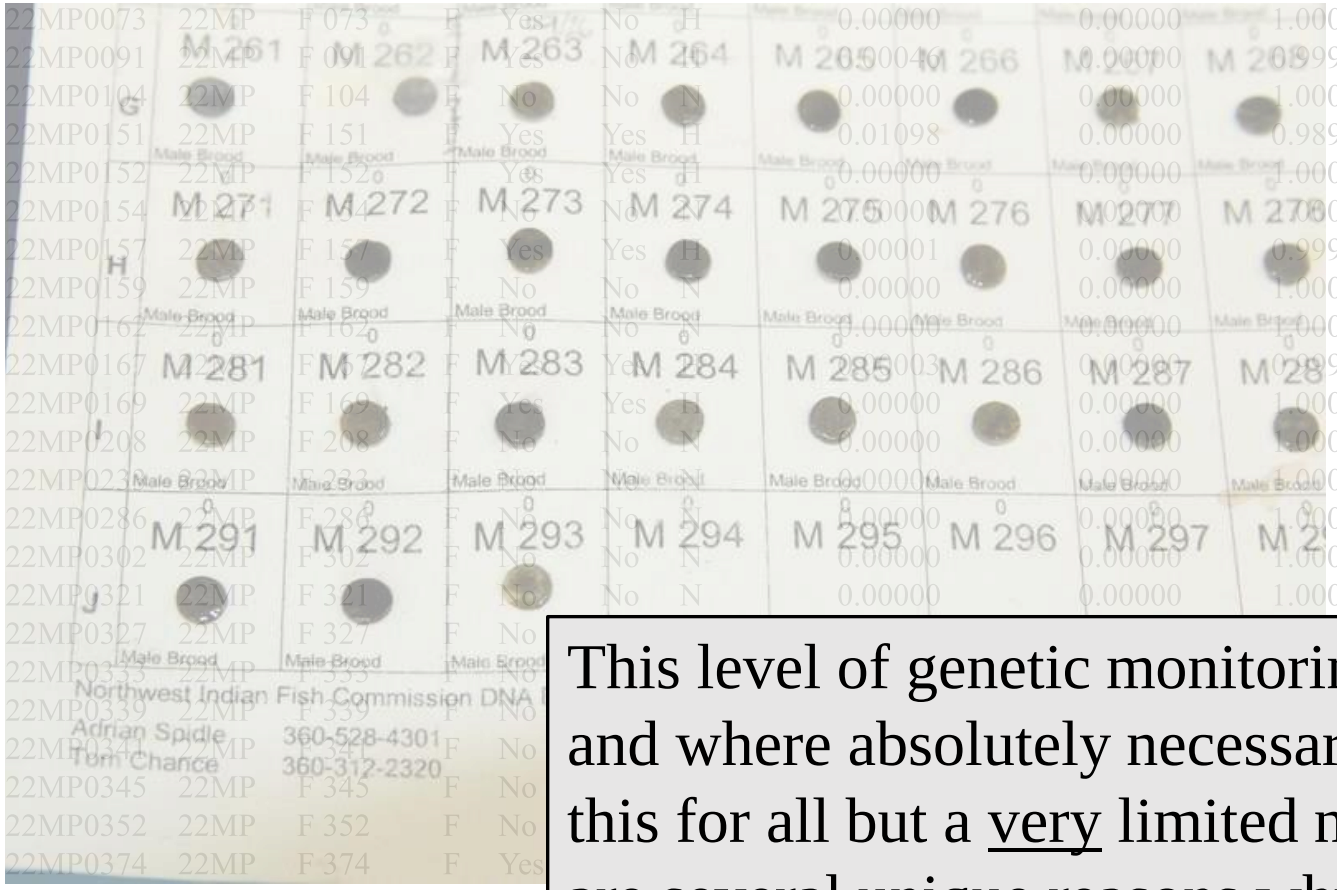

This level of genetic monitoring should only be done when and where absolutely necessary. It is unrealistic to expect this for all but a very limited number of programs. There are several unique reasons why we go to these lengths.

7.7) Describe fish health maintenance and sanitation procedures applied.

All accepted and standard operating protocols and procedures for maintaining brood health are followed. In the event pathogens pose a risk to brood or risk achieving egg take objectives, Chinook brood may be treated accordingly under the direction of the NWIFC veterinarian. Disease treatment and prevention and sanitation are performed under the most recently approved *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* and Food and Drug Administration guidelines and regulations.

7.1 Life history to be collected (adults, eggs, or juveniles)
7.2 Collection or sampling design
7.3 Identity
7.4 Proposed number to be collection
7.5 Disposition of hatchery-origin fish collected in surplus of broodstock needs
7.6 Fish transportation and holding methods
7.7 Describe fish health maintenance and sanitation procedures applied
7.8 Disposition of carcasses
7.9 Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish resulting from the broodstock collection program

Section 7. Broodstock Collection

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7.8) Disposition of carcasses.

Efforts to conduct nutrient enhancement throughout the South Fork Nooksack River sub-basin with carcasses continues to be a priority, and therefore, carcasses from this program will be distributed into the South Fork Nooksack River basin, and will be consistent with the *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State, 2006* guidelines (or more recent Policy if approved).

Section 7. Broodstock Collection

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Hatchery program plans should support ecosystem function, such as providing prey for Southern Resident Killer Whales, buffering pinniped and avian predation, and providing nutrients that cycle between freshwater and marine environments.

Co-manager Hatchery Policy Principle 4, Bullet 1

Section 8. Mating

8.1	Selection method
8.2	Males
8.3	Fertilization
8.4	Cryopreserved gametes
8.5	Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish resulting from the mating scheme

Section 8. Mating

8.1) Selection method.

Spawners are selected as they ripen with an emphasis on the widest temporal sexual maturation distribution possible to ensure the run timing of the broodstock is similar to the natural-origin component of the population. All male and female brood are strictly mated using a 1x1 spawning cross. If feasible, a male and female of suspected differing ages (based upon fork length) are paired as a measure to increase the effective population size (N_e) of the hatchery-origin segment.

BY18 Skookum Creek Hatchery Chinook Mating Crosses by Age Difference

	Same-Age Pairs Spawned	Different-Age Pairs Spawned	1 Year Age Difference	2 year Age Difference	3 Year Age Difference
Number	**146**	**255**	197	57	1
Percent	**36.41%**	**63.59%**	49.13%	14.21%	0.25%

Section 8. Mating

8.1 Selection method

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Co-manager Hatchery Policy Principle 4, Bullet 4

- Hatchery plans should consider how hatchery operations can maintain or enhance the genetic diversity and adaptability of hatchery broodstock.

	Same-Age Pairs Spawned	Different-Age Pairs Spawned	1 Year Age Difference	2 year Age Difference	3 Year Age Difference
Number	**146**	**255**	197	57	1
Percent	**36.41%**	**63.59%**	49.13%	14.21%	0.25%

Section 8. Mating

8.5) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish resulting from the mating scheme.

A recent analysis of temporal variance in allele frequency has indicated that the effective population size (N_e) of returning South Fork Hatchery Chinook captive brood progeny adults has increased from 94.3 to 363.5 based upon a multi-decade time series genetic baseline comparison (NWIFC, unpublished 2018). The estimated N_e increase is primarily attributed to the significant emphasis placed on mating captive brood based upon the least amount of genetic relatedness.

All efforts are made, and will be made, to minimize the likelihood for adverse genetic or ecological effects on natural-origin South Fork Nooksack River Chinook salmon. Hatchery practices focus on maximizing the genetic diversity of the hatchery and natural population components.

Section 9. Incubation and Rearing

9.1 Incubation

9.1.1 Number of eggs taken and survival rares to eye-up and/or ponding

9.1.2 Cause for, and disposition of surplus egg takes

9.1.3 Loading densities applied during incubation

9.1.4 Incubation conditions

9.1.5 Ponding

9.1.6 Fish health maintenance and monitoring

9.1.7 Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed fish during incubation

9.2 Rearing

9.2.1 Provide survival rate data by hatchery life stage for the most recent twelve years

9.2.2 Density and loading criteria (goals and actual levels)

9.2.3 Fish rearing conditions

9.2.4 Indicate biweekly or monthly fish growth information

9.2.5 Indicate monthly fish growth rate and energy reserve data

9.2.6 Indicate food type used, daily application schedule, feeding rate, and estimates of food conversion efficiency

9.2.7 Fish health monitoring, disease treatment, and sanitation procedures

9.2.8 Smolt development indices

9.2.9 Indicate the use of "natural" rearing methods as applied in the program

9.2.10 Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed fish during propagation

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9.2.10 Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed fish during propagation

9.2.7) Fish health monitoring, disease treatment, and sanitation procedures.

Fish health is visually inspected daily by hatchery staff. Fish pathology assessment is performed at least twice a month by NWIFC fish health personnel. Bi-monthly necropsies are performed by fish health personnel for the detection and prevention of disease and parasites. Disease treatment and prevention and sanitation are performed under the *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* and Food and Drug Administration guidelines and regulations.

Section 10. Release

10.1	Proposed fish release levels
10.2	Specific location(s) of proposed release(s)
10.3	Actual numbers and sizes of fish released by age class through the program
10.4	Actual dates of release and description of release protocols
10.5	Fish transportation procedures, if applicable
10.6	Acclimation procedures
10.7	Marks applied, and proportions of the total hatchery population marked, to identify hatchery adults
10.8	Disposition plans for fish identified at the time of release as surplus to programmed or approved levels
10.9	Fish health certification procedures applied pre-release
10.10	Emergency release procedures in response to flooding or water system failure
10.11	Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed fish resulting from fish releases

Section 10. Release

Upper South Fork Release Group Objectives:

- Expand Chinook spawning spatial distribution
- Increase natural productivity

10.1 Proposed fish release levels

10.2 Specific location(s) of proposed release(s)

10.3 Actual numbers and sizes of fish released by age class through the program

10.4 Actual dates

10.5 Fish transport

10.6 Acclimation p

10.7 Marks applied identify hatch

10.8 Disposition pl programmed

10.9 Fish health ce

10.10 Emergency re failure

10.11 Indicate risk a likelihood for from fish relea

10.1) Proposed fish release levels.

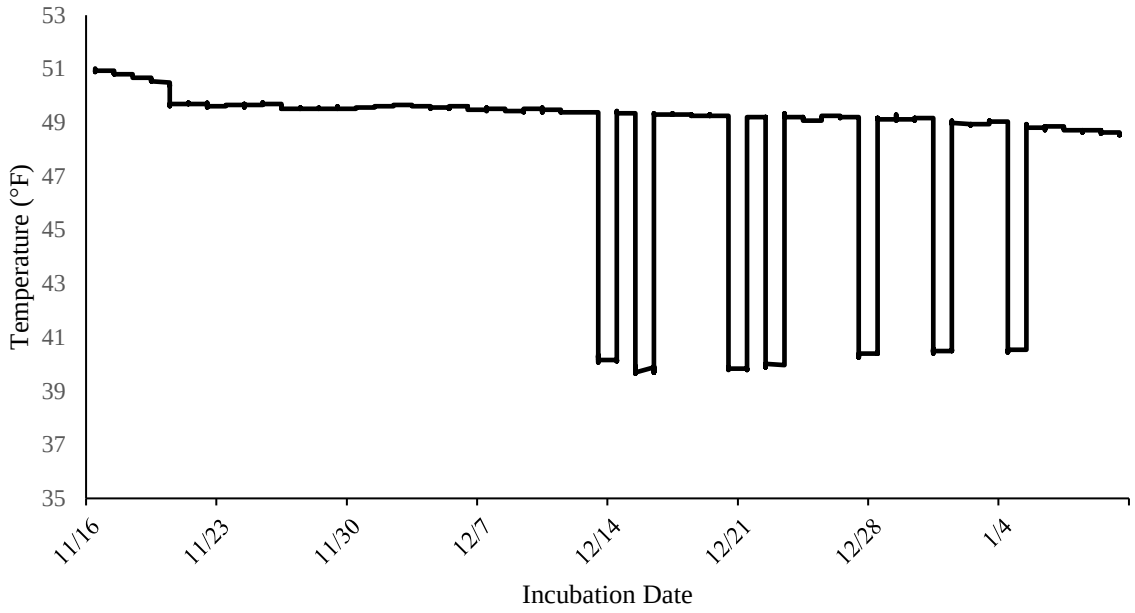
Table 10.1.1: Proposed fish release levels.

Life Stage	Release Location	Annual Release Level	Projected Release Size (fpp)	Projected Release Date Range
Subyearling Smolt (Fingerling)	Skookum Creek Hatchery (RM 14.3 SF Nooksack River)	1,500,000*-2,000,000	50 - 85	May 1 - June 20
Subyearling Pre-Smolt (Parr)	Upper South Fork Watershed (RM 18 - 31.1)	Up to 500,000	120 - 200	April 1 - April 30

* 1,500,000 if the full Upper South Fork off-station release group of 500,000 pre-smolts is realized.

It is hypothesized that the off-station parr release group will contribute to natural production when returning as adults. In the future, if there is insufficient evidence indicating a contribution to natural production, the off-station release group may be discontinued and the 500,000 parr will be released directly from Skookum Creek Hatchery as fully smolted fingerlings for a maximum release size of up to 2.0 million subyearling smolts.

Section 10. Release



10.1 Proposed fish release levels

10.2 Specific location(s) of proposed release(s)

10.3 Actual numbers and sizes of fish released by age class through

10.4 Actual dates of release and description of release protocols

10.5 Fish transportation procedures, if applicable

10.6 Acclimation procedures

10.7 Marks applied, and proportions of the total hatchery population marked, to identify hatchery adults

10.8 Disposition plans for fish identified at the time of release as surplus to

10.9

10.1

10.1

10.7) Marks applied, and proportions of the total hatchery population marked, to identify hatchery adults.

Since release year 2011, all juveniles have been identifiable by a coded-wire tag (CWT), adipose mark (AD), or both. From release year 2011-2017, all juveniles were tagged without an adipose mark (CWT-only) to reduce mark-selective fishery impacts. Starting in release year 2018, a harvest indicator group (AD+CWT) was initiated and it is projected that this will continue indefinitely to inform harvest management. As of release year 2018 (BY17), all juveniles regardless of release location, mark, or tag status will be thermal otolith marked to improve identification of origin for natural escapement estimate purposes and improve brood identity verification capability at Skookum Creek Hatchery.

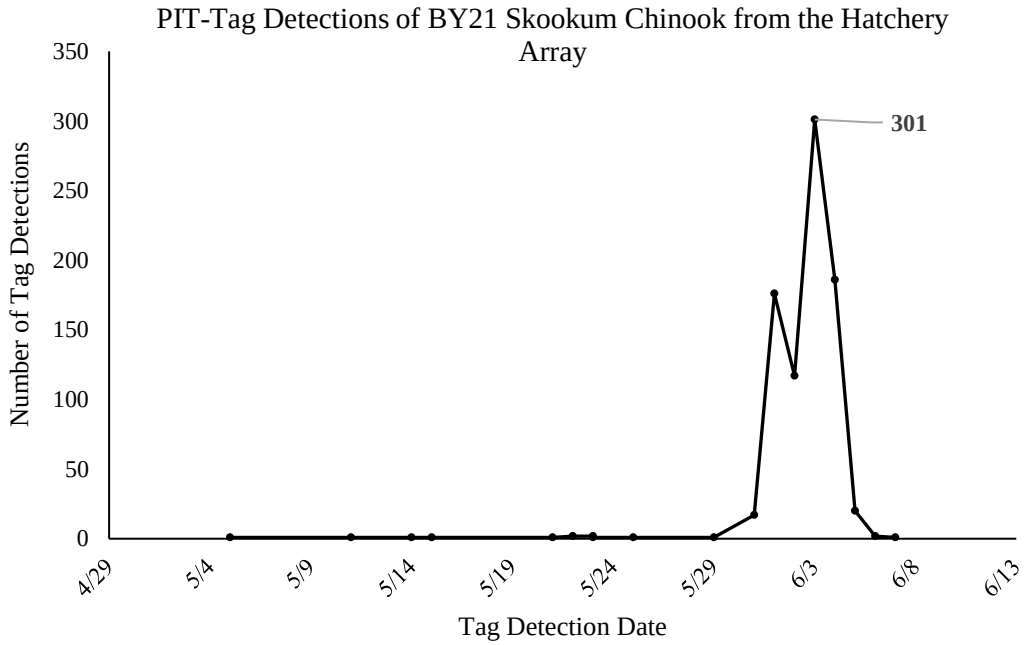
Section 10. Release

10.1	Proposed fish release levels
10.2	Specifi
10.3	Actual
10.4	Actual
10.5	Fish tra
10.6	Acclim
10.7	Marks identify hatchery adults
10.8	Disposition plans for fish identified at the time of release as surplus to programmed or approved levels
10.9	**Fish health certification procedures applied pre-release**
10.10	Emergency release procedures in response to flooding or water system failure
10.11	Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed fish resulting from fish releases

10.9) Fish health certification procedures applied pre-release.

The release group receives a fish health determination within one week of release by NWIFC fish health personnel. In the event fish health staff or veterinarians recommend release of the on-station groups prior to May 1st if fish health concerns arise, their recommendation for early release may result in implementing release of a portion or all on-station fish. Co-Managers and NOAA Fisheries will be notified of early releases resulting from fish health concerns.

Section 10. Release



10.1	Proposed fish release levels
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10.8	Dispositi programm
10.9	Fish healt
10.10	Emergenc failure
10.11	**Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed fish resulting from fish releases**

10.11) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish resulting from fish releases.

Program fish are intended to be as representative of the listed South Fork Nooksack River Chinook population as possible. Subyearling Chinook are volitionally released from the hatchery to promote rapid outmigration to the marine area at a size and condition that may minimize exposure to poor freshwater habitat conditions and reduce potential ecological impacts to natural-origin fish.

Section 11. Monitoring and Evaluation of Performance Indicators

This is where stated objectives and standards associate with monitoring and evaluation actions within the context of…

Table 11.1.1. Performance standards and associated indicators, metrics, and general methodologies proposed for the Skookum Creek Chinook hatchery program.

Category	Performance Standard	Indicator	Potential Metrics Collected or Derived	General Monitoring Strategy
Legal Mandates	Program contributes to fulfilling tribal trust responsibility mandates and Treaty Rights, as described in applicable agreements such as under *U.S. v. Washington*.	• Total number of program fish harvested in Tribal fisheries. • Total fisher days or proportion of harvestable returns taken in Tribal fisheries, by fishery. • Tribal acknowledgement regarding fulfillment of tribal treaty rights.	• Estimate of fish harvest • Number of days of harvest opportunity	• Conduct harvest sampling • Commercial catch accounting system
	Restore and maintain Treaty-Reserved tribal fisheries in alignment with a moderate living, and non-treaty fisheries.	• Hatchery and natural-origin adult returns can be adequately forecasted to guide harvest opportunities. • Hatchery adult returns are produced at a level of abundance adequate to contribute to terminal harvest objectives.	• Pre-season forecasting • Estimate of terminal area runsize	• Modeling • Survey, counts of fish in fisheries, returning to the hatchery, spawning grounds and other areas
Compliance	Hatchery incubation, rearing, and release practices are consistent with current best management practices for the program type.	• Juvenile rearing densities and growth rates are monitored and reported. • Number of fish per release group are known and reported. • Average size, weight and condition of fish per release group are known and reported. • Date and release location of each release group are known and reported.	• Number of juveniles rearing per month • Growth rate • Number of fish released • Fish condition upon release • When and where fish are released	• Standard hatchery monitoring protocols
	Water withdrawals and in-stream water diversion structures for hatchery operation will not prevent access to natural spawning areas, affect spawning behavior of natural-origin fish populations, or impact juvenile rearing environment.	• Water right(s) and passage and screening criteria.	• Number of fish affected by water withdrawals	• General observations and reporting
	Program addresses ESA responsibilities	• Section 7, Section 10, 4d rule and annual consultation.	• Compliance monitoring	
	Effluent from artificial production facility will not detrimentally affect natural populations.	• Discharge water quality compared to applicable water quality standards and guidelines, such as those described or required by NPDES, *The Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* (2006), and tribal water quality plans, including those	• Compliance monitoring	

		relating to temperature, nutrient loading, chemicals, etc.		
	Any distribution of carcasses or other products for nutrient enhancement is accomplished in compliance with appropriate Co-Manager disease control regulations and guidelines	• Compliance with regulations and guidelines	• Number and location(s) of carcasses or other products distributed for nutrient enrichment.	• Compliance monitoring
Harvest	Fish for harvest are produced and released in a manner enabling effective harvest opportunity, as described in all applicable agreements and fisheries management plans.	• Number of fish release by location estimated and in compliance with annual operating plans or other management agreement(s). • Estimate of terminal area adult returns by release group harvested.	• Number of fish released • Number of fish harvested by location	• Standard hatchery monitoring protocols • Conduct harvest sampling • Commercial catch accounting system
	Hatchery-origin Chinook are sufficiently identifiable to allow statistically significant evaluation of program performance and contribution to fisheries.	• Implement adipose fin mass marking with a 100% mark rate objective (for applicable release groups). • Implement coded-wire tagging on a statistically significant subset. • Effective mark rate and tag retention rate are known and reported.	• Percentage of release estimated to be marked and/or tagged	• Standard hatchery monitoring protocols
	Hatchery adult Chinook salmon return in a multitude of areas and over an extended period that will maximize harvest opportunity.	• Spatial and temporal fishery opportunity is extended over a specified time frame and areas in the terminal area.	• Number of fish harvest by location	• Conduct harvest sampling • Commercial catch accounting system
Conservation	Natural production of target population is maintained or enhanced by supplementation.	• Adult progeny per parent (P:P) ratios for hatchery-produced fish significantly exceed those of natural-origin fish. • Natural spawning success of hatchery-origin fish are similar to that of natural-origin fish. • Temporal and spatial distribution of hatchery-origin spawners in nature is similar to that of natural-origin fish. • Productivity of a supplemented population is similar to the natural productivity of the population had it not been supplemented (adjusted for density dependence). • Post-release life stage-specific survival is similar between hatchery and natural-origin population components.	• Number and location of natural spawners • Hatchery-origin smolt-to-adult survival estimates • Productivity and abundance estimates	• Spawning ground surveys • Juvenile and outmigrant monitoring and evaluation • Genetic population monitoring and evaluation

Ecological Interactions	Releases do not introduce pathogens not already existing in the local populations, and do not significantly increase the levels of existing pathogens.	• Certification of juvenile fish health immediately prior to release, including pathogens present and their virulence.	• Percentage of fish released that are considered healthy	• Standard hatchery monitoring protocols
	Release groups are marked in a manner consistent with information needs and protocols for monitoring impacts to natural- and hatchery-origin fish at the targeted life stage(s) (e.g. in juvenile migration corridor, in fisheries, etc.). (This performance standard could also be categorized under "Harvest," but is not repeated there for brevity)	• All hatchery-origin fish recognizable by mark or tag and representative known fraction of each release group marked or tagged uniquely. • Number of unique marks recovered per monitoring stratum sufficient to estimate number of unmarked fish from each release group with desired accuracy and precision.	• Percentage of release estimated to be marked and/or tagged	• Standard hatchery monitoring protocols • Spawning ground surveys • Juvenile and outmigrant monitoring and evaluation
Facility Operations	Adult broodstock collection operation does not significantly alter spatial and temporal distribution of any naturally produced population.	• Spatial and temporal spawning distribution of natural population above and below trap, currently and compared to historic distribution.	• Number and location of natural spawners	• Spawning ground surveys
	Trap operations do not result in significant stress, injury, or mortality in natural populations.	• Mortality rates in trap. • Pre-spawning mortality rate of trapped fish in hatchery or after release.	• Number of dead fish in traps • Number of pre-spawn mortalities encountered on spawning ground surveys	• Observation in the trap • Spawning ground surveys
	Hatchery facilities are operated in compliance with all applicable fish health guidelines and facility operation standards and protocols such as those described by PSTT/WDFW Co-Manager Disease Policy 2006 and LNR Hatchery Operations Manual.	• Annual reports indicating level of compliance with applicable standards and criteria. • Periodic audits indicating level of compliance with applicable standards and criteria.	• Compliance monitoring	

Section 11. Monitoring and Evaluation of Performance Indicators

11.2) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish resulting from monitoring and evaluation activities.

The operation of the Lummi smolt trap in the lower river is monitored in variable time periods related to the expected abundance of juveniles passing the site to minimize the duration of holding and risk of harm to ESA listed Chinook and steelhead. Monitoring at the smolt trap allows estimates of abundance by species, origin, and age, which provides needed information for evaluating production per spawner and marine survival for hatchery- and natural-origin fish. For the lower mainstem smolt trap, ESA coverage was permitted by NMFS in 2017 (NMFS 2017).

The operation of an additional smolt trap in the South Fork Nooksack River sub-basin is scheduled to be funded in April 2020. The intent of this smolt trap is to monitor and evaluate South Fork Nooksack River Chinook productivity and abundance in response to the hatchery supplementation activities previously described. Standard, non-lethal juvenile Chinook and steelhead biological data collection from most or all captured natural-origin fish and sub-samples of hatchery-origin chinook will occur. There are no steelhead releases in the South Fork. PIT-tags will be inserted into natural- and hatchery-origin juveniles with fork lengths greater than or equal to 60mm to minimize tagging-related mortality. Accepted protocols for anesthetizing and PIT-tagging juveniles will be followed. PIT-tagging will not occur when South Fork Nooksack River temperature exceeds 17.0°C at the immediate collection site, and all smolt trap operations and beach seine collection events will cease when the South Fork Nooksack temperature exceeds 19.0°C at the immediate collection site.

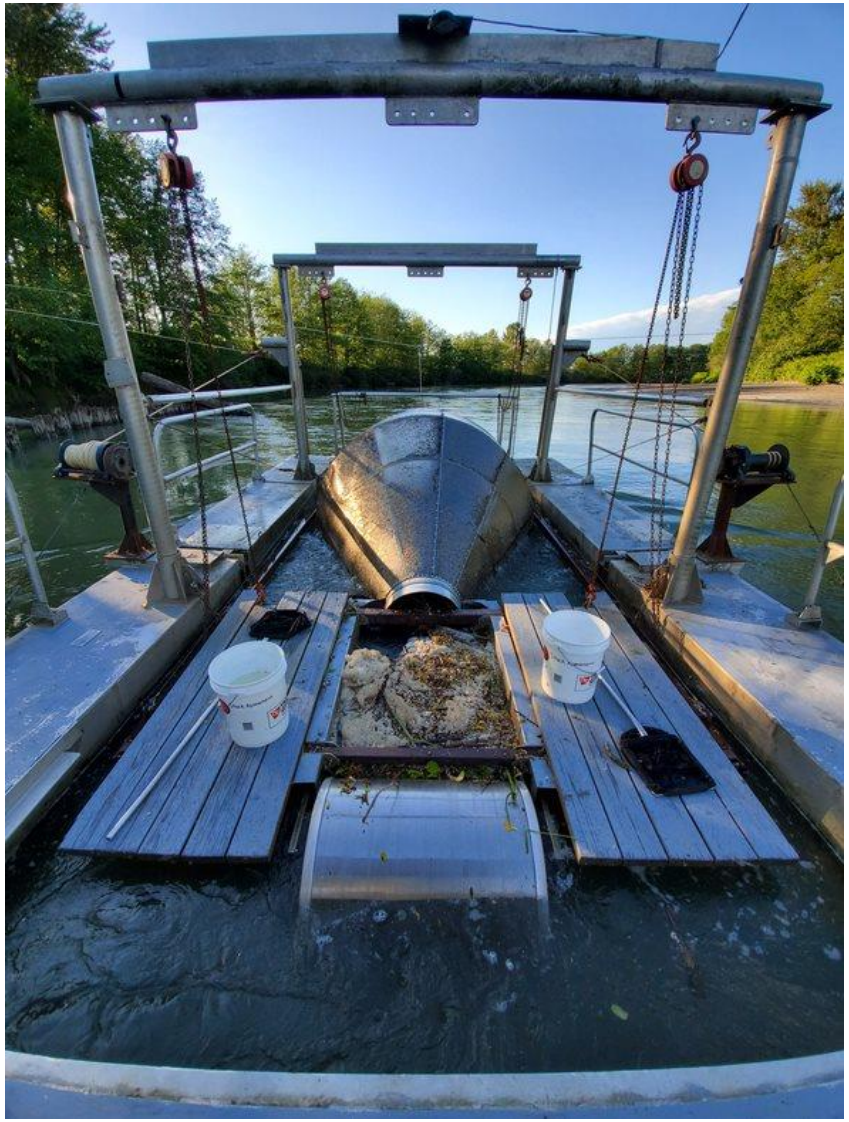
Much information in two paragraphs:

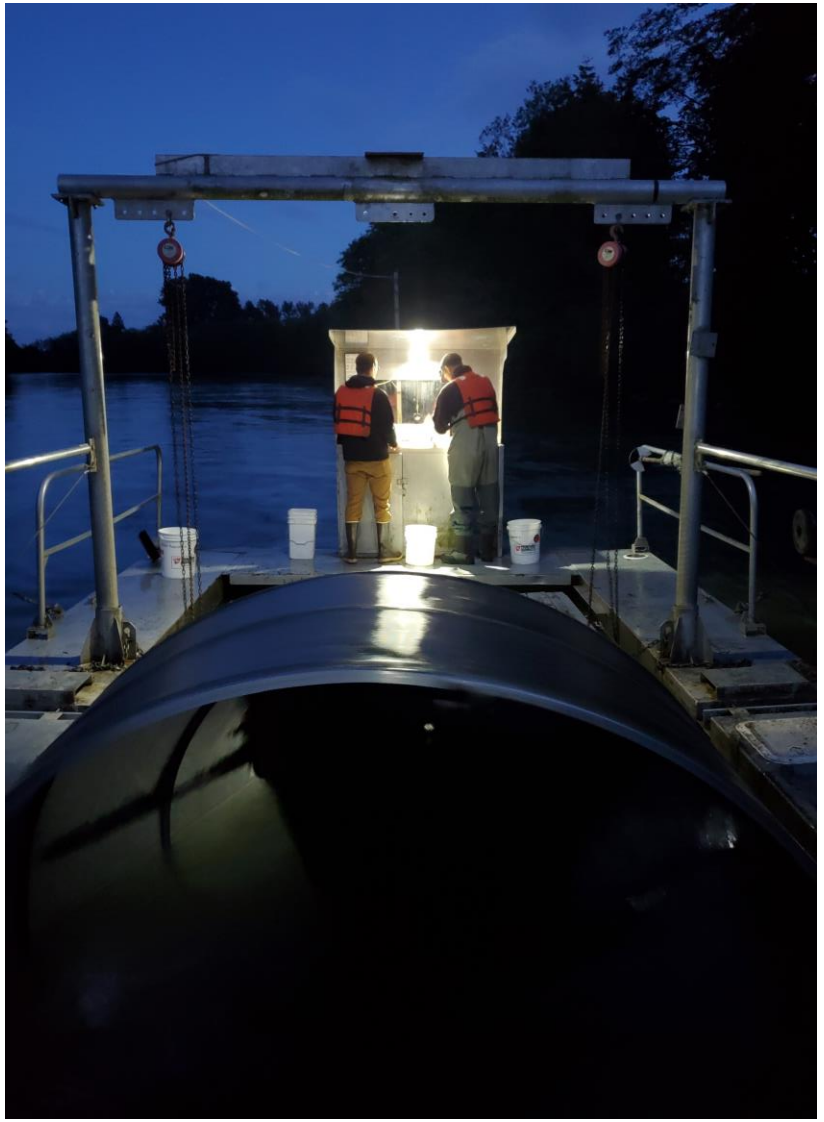
- Mainstem smolt trap
- South Fork smolt trap
- Beach seining
- PIT-tagging
- Abundance and productivity
- Supplementation

Keep in mind that this is concisely describing *risk aversion* during monitoring and evaluation for just one program

Mainstem Nooksack River Rotary Smolt Trap

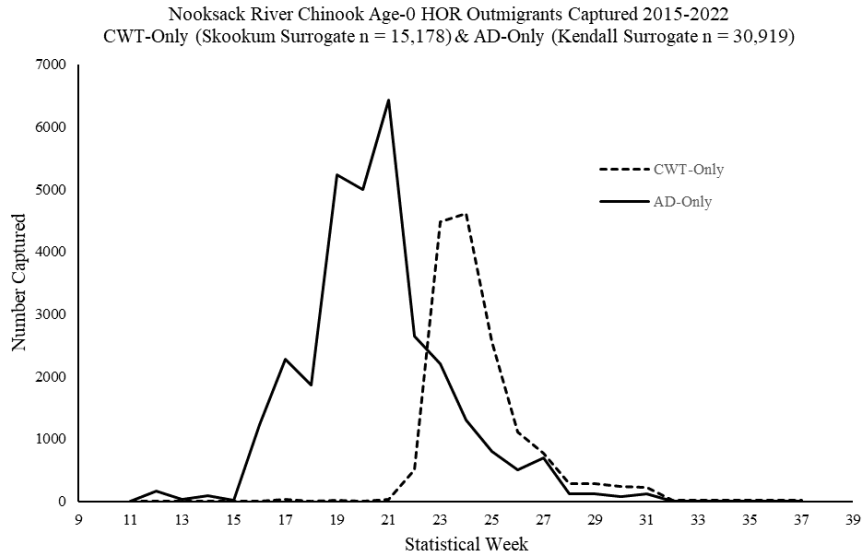
- In operation by Lummi Nation since 1994
- Entirely grant funded
- Operates approximately 6 months per year
- Location for collecting DNA tissue samples to meet WDFW's Kendall Creek Hatchery's early steelhead program T&C

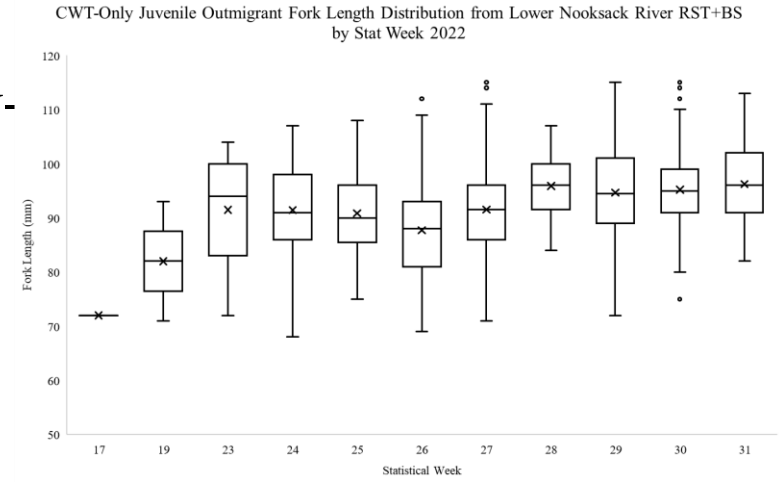


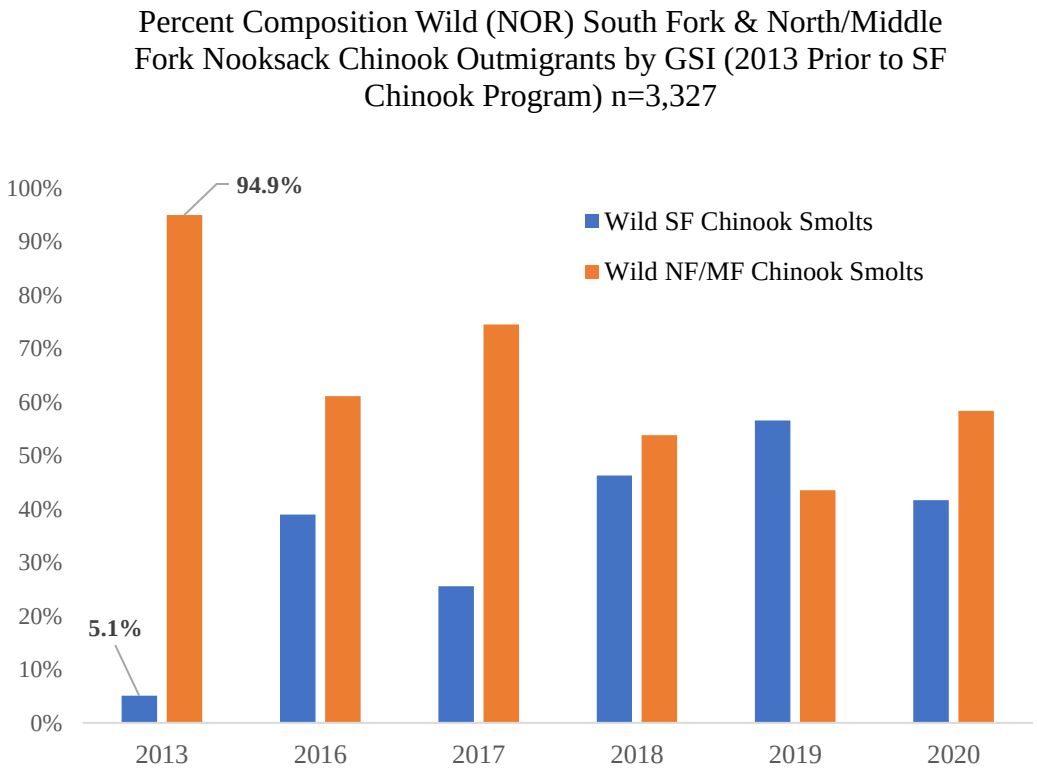


Mainstem Nooksack River Rotary Smolt Trap

- General use of smolt trap data includes monitoring Chinook stock composition (genetic analysis), relative abundance
- Fish productivity monitoring
- Monitoring temporal distribution of hatchery- and natural-origin smolts
- Short- and long-term trend analyses







South Fork Nooksack River Rotary Smolt Trap

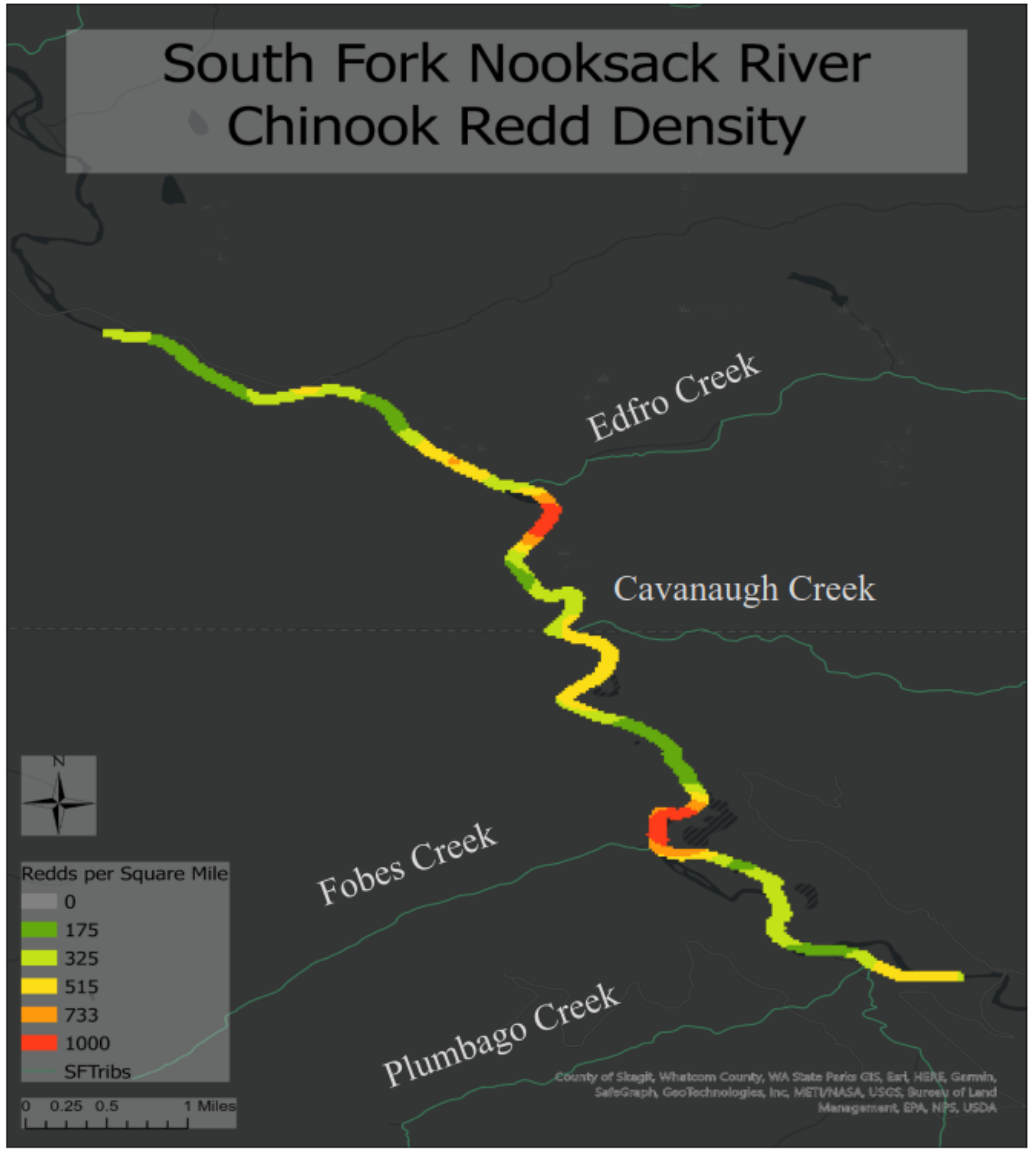
- Began operation in 2021
- Operated and funded by Lummi Nation
- Entirely grant funded
- Operated specifically to monitor the demographic and genetic response from the South Fork Nooksack Chinook Program

Passive Integrated Transponder (PIT) Tag Monitoring

- Funded an operated by Lummi Nation
- Rare and unusual in the Salish Sea
- PIT-tag program implemented primarily to monitor spatial and temporal characteristics of hatchery salmonids
- Includes channel-spanning array and hatchery outlet array
- Compromised flow regime in South Fork makes array very prone to damage and in need of frequent repair

Chinook Spawning Ground Surveys – Escapement Estimates

- Significant annual effort
- All three Co-Managers involved
- Significant volume of biological samples and data collected
- Critical importance, methods, results, etc. too great to cover



Benefits of Genetic Work

- Ongoing Chinook genetic projects have yielded important findings (mainly from smolt parentage)
- Of importance is the relationship between geographic spawning location in the SF and reproductive success of Chinook
- A disproportionate number of reproductively successful Chinook spawn where the majority of habitat restoration has been completed (~1.9 RM)

All 2018 HOS+NOS SS (LNR Reaches)

Basin Fork	SF
Successful Spawner	Yes
Sex_Code	(All)
CWT Detect Id	(All)
Ad Clip Status ID	(All)
Reach Category	(Multiple Items)
Stream	(All)
Row Labels	Count of LNR DNA#
Bottom of Dyes Canyon - 13.2	5
Bottom of Dyes Canyon - Skookum Cr	1
Bottom of Dyes to Saxon	4
Cable Crossing - Dyes Canyon	2
Cable to Dyes	5
Elk Field - Cable Crossing	1
Larson's Bridge - Cable Crossing	37
Mouth - Bedrock Chute	1
Mouth - Cascade	1
Mouth to 0.2	1
Mouth to Waterfall	3
Grand Total	61

Why Are We Doing All of This?

- Everything supports regional Co-Managers reaching their objectives
- Lummi Nation must go to disproportionate lengths to maintain a limited terminal area tribal early Chinook C&S fishery
  - Efforts equally benefit Co-Manager terminal area fisheries (Nooksack Tribe's C&S, recent spring Chinook sport fisheries in Nooksack)
- No scientifically defensible hatchery operations and monitoring via HGMPs = no tribal and non-tribal fisheries

Some Final Conclusions and Considerations

- Management decisions rely upon a cooperative and objective Co-Manager relationship
- Existing hatchery monitoring and evaluation programs are far more robust throughout Washington State than most realize
- Most hatchery M&E programs and accountability measures pre-date ESA authorization
- The Co-Manager Hatchery Policy will ensure essential ongoing M&E efforts will continue in Co-Manager partnership

Some Final Conclusions and Considerations

- The Co-Manager Hatchery Policy may appear broad and non-specific, but for good reason:
  - A highly specific, prescriptive, one-size-fits-all policy will **not** work
  - Every single hatchery program in Washington State is unique, therefore we require unique operational, management, and M&E approaches
  - Specificity is possible only through watershed-level planning and management
- The HGMP process is robust and defensible

Thank You For Your Time