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April 28, 2015

Mr. Robert Turner
Assistant Regional Administrator
National Marine Fisheries Service
510 Desmond Drive SE, Suite 103
Lacey, WA 98503

Dear Bob:

We are providing the following summary and enclosures as the basis for the 2015-2016 Puget Sound Chinook Harvest Plan (Table 1) to the National Marine Fisheries Service (NMFS) to initiate consultation and authorization of fisheries under Section 7 of the Endangered Species Act.

This plan will follow the guidance of the 2010 Puget Sound Chinook Harvest Management Plan and subsequent modifications developed for the 2014-2015 season for selected management units (Nooksack early, Skagit summer-fall, Nisqually, Skokomish, and Green River management units). The modified management objectives for 2015-16, are outlined in Attachment 1.

Co-managers have developed a report detailing recent fishery performance for four Chinook stocks highlighted by NMFS staff. That report is enclosed with this communication. The respective co-managers for Nisqually and Skokomish Chinook additionally enclose an outline of objectives, tasks, and timelines to be completed for each stock during the coming fishery season, in conjunction with NMFS.

We look forward to successful collaborative efforts with the NMFS in assuring conservation goals of the Endangered Species Act will be achieved.

Sincerely,

Mike Grayum, Director
Northwest Indian Fisheries Commission

Jim Unsworth, Director
Washington Department of Fish and Wildlife

Enclosures:

(1) Table 1. Exploitation Rates and Management Thresholds for listed Puget Sound Chinook Populations
(2) Summary of Modification to Management Objectives of the 2010 Puget Sound Chinook Harvest Management Plan for the 2015-2016 Season
(3) Addendum to the 2014 Plan for 'Management of Fall Chinook in the Skokomish River'
(4) Addendum to 2014 Plan for Nisqually Chinook Exploitation Rate Ceiling, Low Abundance Ceiling, Low Abundance Threshold, Critical Exploitation Rate Ceiling and Weir Evaluation
(5) Chinook Harvest Management Performance Assessment

Table 1. Exploitation rate ceilings, upper management thresholds, low abundance thresholds, and critical exploitation rate ceilings for Puget Sound Chinook Management Units for the 2015-2016 season.

Management Unit	Exploitation Rate Ceiling	Upper Management Threshold	Low Abundance Threshold	Critical Exploitation Rate Ceiling
Nooksack North Fork South Fork		4,000 2,000 2,000	 1,000 [1] 1,000 [1]	7% / 9% SUS [3]
Skagit summer / fall Upper Skagit summer Sauk summer Lower Skagit fall	50%	14,500	4,800 2,200 400 900	15% SUS even-years 17% SUS odd-years
Skagit spring Upper Sauk Upper Cascade Suiattle	38%	2,000	576 130 170 170	18% SUS
Stillaguamish North Fork South Fk & MS	25%	900 600 300	700 [1] 500 [1] 200 [1]	15% SUS
Snohomish Skykomish Snoqualmie	21%	4,600 3,600 1,000	2,800 [1] 1,745 [1] 521 [1]	15% SUS
Lake Washington Cedar River	20% SUS	 1,680	 200	10% PT SUS
Green	15% PT SUS	5,800	1,800	12% PT SUS
White River spring	20%	1,000	200	15% SUS
Puyallup fall	50%	500 (South Prairie Cr.)	500	12% PT SUS
Nisqually	52%		700	50% reduction of SUS ER[4]
Skokomish	50%	3,650	1,300 [2]	12% PT SUS
Mid-Hood Canal	15% PT SUS	750	400	12% PT SUS
Dungeness	10% SUS	925	500	6% SUS
Elwha	10% SUS	2,900	1,000	6% SUS
Western JDF	10% SUS	850	500	6% SUS

[1] Natural-origin spawners

[2] Skokomish LAT is escapement of 800 natural spawners and hatchery escapement of 500.

[3] SUS ER will not exceed 7% in 4 out of 5 years.

[4] 50% reduction in the difference between 52% and the expected northern fishery ER.

Attachment 1

SUMMARY OF MODIFICATIONS TO MANAGEMENT OBJECTIVES OF THE 2010 PUGET SOUND CHINOOK HARVEST MANAGEMENT PLAN FOR THE 2015-2016 SEASON

Following is a summary of modifications to fishery management objectives described in the Co-managers' 2010 Puget Sound Chinook Harvest Management Plan for the Nooksack Early, Skagit Summer-Fall, Nisqually, Skokomish Fall, and Green River management units applying to the 2015-2016 fishery management season. Fishery management objectives for other Puget Sound Chinook management units will not change from those stated in the 2010 Puget Sound Chinook Harvest Management Plan.

Nooksack Early

The management intent is to constrain fishery mortality of South Fork and North/Middle Fork natural origin (NOR) Chinook within a NOR Chinook SUS ER ceiling of 7%. This ER ceiling may be exceeded to a maximum of 9% once in 5 years as necessary to ensure full access to harvestable salmon in Pacific Salmon Treaty fisheries. The tribes have identified a minimum C&S requirement of 30 NOR Chinook to meet basic ceremonial and subsistence needs of their communities. Impaired habitat conditions in the watershed are the primary limiting factor for population productivity for the Nooksack populations.

Nooksack River tribal fisheries may take place from April through the end of June, and are managed in-season according to preseason projections and by monitoring NOR Chinook encounters in the tangle net fishery and a total harvest number, including NOR breakout, in the non-selective fishery. In 2015 the co-managers intend to manage the Nooksack River tribal fisheries as they have in recent years and expect that most or all the allowable impact or harvest of NOR Chinook will be taken before June 15, 2015. The tribe(s) may use tangle-net gear in a selective fishery to increase harvest of surplus hatchery fish. NOR Chinook caught in the selective fishery will be released and mortality accounted based on co-manager agreement on an assumed survival rate.

The total number of allowable NOR Chinook mortalities in the Nooksack River tribal fisheries will be projected during pre-season planning based on forecasted terminal area abundance by stock. Pre-season modeling assumptions will be adjusted using results from the most recent postseason estimates of performance, and on stock abundance and composition data collected from fisheries through 2014.

If information available from monitoring indicates the total allowable NOR Chinook mortalities in the tangle net fishery or the harvest limit in the non-selective fishery is not expected to be taken by June 15th, the co-managers may propose to extend the Nooksack River tribal fisheries through the end of June. However, the co-managers will gain concurrence from NMFS that the fishery can proceed past June 15th before extending any fisheries. No later than June 7, the co-managers will provide key information necessary to NMFS' determination such as population-specific escapement estimates and fishery stock composition estimates for years through 2013, the assumed release mortality rate and an estimate of anticipated South Fork Nooksack Chinook and summer steelhead encounters anticipated in the proposed fishery extension. Post season, NOR Chinook and wild steelhead encounters and mortalities will be reported by population. This includes apparent summer run steelhead encounters and mortalities, and having tissues taken and analyzed for DNA from the 2014 fisheries. Other wild steelhead will be assumed to be winter runs, and while reported post season, do not require DNA analysis.

Skagit Summer – Fall

Tribal and WDFW staff updated the cohort reconstruction for Skagit summer – fall Chinook to include brood years 1981 – 2005, to estimate recruitment rates for fitting a production function. The harvest mortality components of cohorts were estimated from CWTs and using exploitation rates from the post-season FRAM runs. Methods for assessing harvest risk were similar to those used previously (Hayman 2008), to compare the probabilities of abundance falling to the critical threshold and increasing to the recovery threshold. These analyses concluded that exploitation rates up to 50% will achieve the jeopardy criteria.

The cohort reconstruction and harvest risk analyses were provided to NMFS' staff. The gaps in age data for some populations, and lack of alternative methods for calculating harvest mortality, precludes reconstructing cohorts for each population, or making a population-specific assessment of harvest risk. Low Abundance Thresholds specified in the Harvest Plan provide additional protection from fishery impacts for each population through implementation of the critical exploitation ceiling when critically low abundance is forecast.

Nisqually

Exploitation Rate Ceiling

The 2010 Puget Sound Chinook Harvest Plan identified a 5-year plan for lowering the Exploitation Rate Ceiling (ERC) on unmarked Nisqually Chinook to 47%. Although the 2010 plan was only approved by NMFS for four years (through April of 2014), the ERC was reduced as scheduled during those 4 years, to a rate of 65% in 2010 and 2011, and to 56% in 2012 and 2013.

Reduction of the total exploitation rate on Nisqually Chinook is one tool being used in the on-going experiment in the Nisqually River. The goal of this experiment is to establish, over time, a self-sustaining locally adapted fall Chinook population contributing to the recovery of the Puget Sound ESU. Other tools to achieve that goal include maintaining a minimum commercial terminal harvest rate of 25% on unmarked Chinook, implementation of an integrated stepping stone hatchery program, and helping control pHOS through weir and harvest management actions.

The reduction of the ERC was expected to coincide with full operation of the Nisqually weir, which is intended to limit pHOS in the Nisqually and allow capture of appropriate broodstock for the 'stepping stone' hatchery program. Both of these actions are expected to decrease hatchery domestication, leading to improvements in fitness and increases in abundance of natural origin-Chinook. While the weir was expected to be fully operational by 2011, design problems, flow regimes and large numbers of co-migrating pink salmon have limited its effectiveness at trapping Chinook during their upstream migration.

The timing and magnitude of changes in harvest strategy for Nisqually Chinook must be coordinated with other actions in the watershed, including habitat recovery, implementation of hatchery actions and management of pHOS through removal of hatchery Chinook in fisheries and at the weir. Due to the unexpected difficulties with operation of the weir, the control of hatchery-origin contribution on the spawning grounds and the transition to the stepping stone hatchery program have not progressed as anticipated since 2010.

An additional complication facing harvest management for Nisqually Chinook is the apparent discrepancy in exploitation rates estimated by FRAM validation modeling versus rates estimated using CWT data. For Nisqually Chinook, FRAM validation estimates of exploitation rates from 2003-2010 were significantly higher than rates estimated by CWT (Hagen-Breaux et al memo, 2013). This means that fisheries planned using the exploitation rates predicted by FRAM during pre-season modeling may result in rates that are lower than expected when estimated using actual CWT recoveries. The co-managers support the development of a contemporary FRAM base period data set from recent-year CWT recovery analysis to alleviate some or all of the bias between FRAM and CWT exploitation rates, and to provide a more reliable estimate of impacts for current fishing season structures. This should ensure that fishery exploitation rates as estimated by FRAM are comparable to CWT-based estimates and to biologically based ERC's. With a priority and collaborative engagement by tribal, WDFW and NOAA Fisheries staff, we expect this FRAM base period upgrade project can be completed and ready for application with the 2016 pre-season planning process.

Given the time needed for completion of a necessary FRAM upgrade, and because of the slower than expected pace of progress with improvements to hatchery and pHOS management, it is appropriate to modify the schedule for the final step of transition to the EDT-based ERC. In 2014, Nisqually Chinook was managed for an ERC of 52% and will again be managed to 52% in 2015. The ERC of 47% will be re-instated when the FRAM base-period upgrade is complete.

Information gathered from monitoring and presented at the Nisqually Annual Performance Review indicates the need for revising assumptions associated with the EDT method of ERC estimation. In addition, changes to estimated exploitation rates resulting from the FRAM upgrade may affect the calculations used in the development of the ERC. The co-managers, in collaboration with NOAA Fisheries, will review the EDT-based ERC identified in the 2010 Plan (47%) prior to completion of the FRAM upgrade process. This collaborative process will complement efforts already underway by providing additional technical resources and tools to the effort, fostering data exchange and a better understanding of the data and underlying analysis. Based upon outcomes of the FRAM upgrade and the ERC review, the co-managers may propose to revise the ERC. If the ERC has not been revised in time for the 2016 season, the ERC of 47% identified in the 2010 plan will remain in place until such time that the ERC is revised. Slowing the transition to the lower ERC is allowing time for implementation of the hatchery and weir components of the strategy, for needed updates to FRAM, and for revision of assumptions associated with EDT or other available information. A slower transition will also avoid excessive, sudden and unnecessary restrictions to fisheries, by allowing exploratory implementation and assessment of new fisheries regimes that meet the progressively smaller ERC's.

Low Abundance Threshold and Critical Exploitation Rate Ceiling

The 2010 Puget Sound Chinook Harvest Plan stated that "An LAT will be developed by co-managers in consultation with NOAA Fisheries as information derived from initial implementation of the weir is available. Management to achieve the LAT will ensure that the burden of a conservation response to critical status is not disproportionately placed on terminal area fisheries." While substantial progress has been made with installation and operation of the weir, information collected to date is not sufficient for calculating an appropriate LAT specific to Nisqually Chinook.

Until sufficient information is collected to develop an LAT specific to Nisqually Chinook, the LAT for Nisqually Chinook will mirror the minimum threshold identified in the weir operations plan. That plan specifies that if there are insufficient natural-origin Chinook returning to the weir in-season to reach 500 spawners upstream, hatchery fish will be passed upstream to minimize the risk of losing genetic diversity. Because 20-30% of the population spawns downstream of the weir, a total weir escapement of 500 would represent a total system escapement of around 700. The LAT for Nisqually Chinook will be an escapement of 700 total natural spawners (natural and hatchery origin). This number is in the range of values that should maintain sufficient genetic diversity to ensure long-term persistence of the population (McElhaney et al, 2000).

We expect that with current levels of hatchery production and fisheries designed to meet the ERC for Nisqually Chinook, total escapement will remain well above the LAT for the foreseeable future. Should the pre-season FRAM projection of natural escapement to the Nisqually (natural-origin escapement plus hatchery-origin fish expected to spawn naturally), after accounting for anticipated removals of fish for the hatchery program at the weir, fall below the LAT of 700, the co-managers will modify pre-terminal and terminal fisheries in an attempt to reduce the exploitation rate to the point that escapement will exceed the LAT. If the projected escapement remains below the LAT, impacts in southern U.S. (SUS) fisheries will be limited by proportionally reducing the allowable exploitation rate in the SUS by a minimum of 50%, with the goal of achieving escapement above the LAT. The Critical Exploitation Rate Ceiling (CERC) will be defined as a 50% proportional reduction of the exploitation rate remaining for SUS fisheries under the total ERC after subtracting the expected rate in northern fisheries. For example, in 2013 the ERC for Nisqually Chinook was 56%, and the expected rate in northern fisheries was 15.4%, leaving 40.6% allowable in SUS fisheries. If projected escapement were less than 700, SUS fisheries would be modified in an attempt to increase escapement above the LAT. If escapement was not increased to above 700, the ER in SUS fisheries would be reduced by a minimum of 20.3%, leaving up to 20.3% potentially allowable in SUS fisheries under the critical response.

In addition, should total natural spawning escapement be projected as less than 700 after accounting for anticipated removals of fish for the hatchery program at the weir, the co-managers will allow all Chinook, regardless of origin, to pass the weir from the beginning of that year's return. Allowing all fish to pass during a year when abundance is expected to be very low will minimize demographic risk that could occur if upstream access was limited to small numbers of natural-origin fish until September 27th. Should in-season returns to the weir exceed the low-preseason expectations, hatchery-origin fish returning to the weir would be removed once the minimum of 500 fish (hatchery or natural origin) above the weir was assured.

Skokomish

A new management plan for Skokomish fall Chinook includes new strategies for managing harvest and hatchery production, and provides an update of the ongoing habitat protection and restoration programs. But recovery efforts will continue to focus on restoration of a spring population, pursuant the Skokomish Chinook Recovery Plan.

Exploitation rate ceilings and escapement thresholds specified in the 2010 Harvest Plan will remain in effect for 2015 and future years. The 50% ER ceiling will continue to achieve the primary objective of maintain adequate natural escapement. Due to dynamic abundance and evolving terminal fishing regimes additional attention will be applied during pre-season planning to improve the accuracy of harvest modeling and reduce the risk of exceeding of the ER ceiling.

Managers will begin to implement an experimental strategy to improve the potential for recovery of a true fall Chinook population. A portion of production at George Adams Hatchery will utilize the latest returns as broodstock. The hypothesis is that recruits from this component will spawn naturally, with improved productivity because they are more suited to the local flow regime.

Early-timed production at George Adams Hatchery will be reduced, with intent to reduce their contribution to natural spawning.

Green River

No changes have been made to the management objectives for Green River Chinook for 2015. Even if recruitment from the recent low escapements improves, abundance is unlikely to achieve harvestable surplus in the near term. No directed terminal fisheries will occur in 2015 and pre-terminal impacts will be constrained to the level associated with the critical abundance status.

Addendum to 2014 Plan for

Management of Fall Chinook in the Skokomish River

Draft March 25, 2015

Introduction

In 2014 the co-managers developed a Management Plan for Fall Chinook in the Skokomish River (Plan) as a component of the Puget Sound Chinook Harvest Management Plan. The co-managers stated:

> "This plan for management of fall-timed Chinook in the Skokomish River specifies objectives and measures to benefit the extant population and thereby improve its potential to recover. It will function as an amendment to the Skokomish Chinook Recovery Plan (2010) by advancing implementation of a sequence of measures that could ultimately increase natural production of fall-timed Chinook. It is entirely consistent with the primary assumption of the Recovery Plan that significantly improved natural production is contingent on restoration of habitat function. This Plan does not change the primary focus of recovery on restoring spring Chinook."

The Plan identified three goals:

1) Increase natural production potential of fall-timed Chinook salmon.
2) Maintain at current levels or increase tribal and recreational fishing opportunity based on hatchery production.
3) Minimize potential conflicts between recovery of all salmon and steelhead populations in the Skokomish River and among harvest objectives.

For late-fall Chinook salmon, the Plan identified an objective "to develop a late mode that exhibits peak sexual maturity in late-October (i.e., five to six weeks later than the current peak)….A distinct later mode is expected to emerge by the time five brood years of production are recruited". The Plan identified an initial production objective of 200,000 subyearlings, and it was expected that approximately 10% of natural spawners would recruit from later-timed hatchery releases. The co-managers and National Marine Fisheries Service (NMFS) also agreed in 2014 to review the overall strategy to develop late-timed hatchery production and its effects on the behavior of natural spawners, including facility adequacy, size of the program, harvest management implications, monitoring requirements, and costs with the intent to optimize the potential for achieving its stated objectives. Sections 7.2 and 8 of the Plan provide further context for expectations for the late-timed program and how it will be assessed.

The co-managers developed the Plan recognizing that significant challenges would exist in establishing late-fall Chinook salmon in the Skokomish River, and that adaptive management will be essential to reconciling the multiple goals and objectives. The Plan was successfully initiated in 2014 with the collection of eggs from late-returning Chinook salmon. Tasks and products associated with implementation of the program and its review in 2015 and beyond will be described as part of future Puget Sound Chinook harvest management plans and/or in a Hatchery Genetic Management Plan.

This Addendum to the 2014 Plan provides a description of the tasks and products associated with the implementation of the late-fall hatchery program in 2015 and the associated review. It also provides a progressive series of checkpoints to ensure that any necessary and feasible improvements to broodstock collection, monitoring, or facilities are made prior to the return of late-fall Chinook salmon in September 2015, and that the program is successfully implemented in 2015-2016. The Addendum also sets the stage for potential future phases of the late-fall Chinook program.

2015 Tasks and Products

Phase 1

Phase 1 of the project (2014- 2023; brood year releases in 2014 - 2018) will test our ability to create a late-spawn timing population component from returns to the George Adams Hatchery.

Question 1: Do the adult progeny from late-maturing returns to the George Adams Hatchery spawn in late-October?

The following tasks will be completed in 2015-2016 to address this question. Examples are provided to illustrate the tasks and potential products. The examples are not intended to limit further discussion of the benchmarks or concepts, and it is recognized that additional details on monitoring will be required to fully address each task.

Task 1-1. Identify the protocol for the collection of broodstock at the George Adams Hatchery for the late-fall hatchery program. For example, the protocol could be "Eggs will be taken only from adult Chinook salmon that mature after October 1. If there are sufficient numbers of adults returning after October 1, priority will be given to spawning only those individuals tagged as part of the late-fall program."

Task 1-2. Identify the benchmark value(s) that would indicate a successful test of our ability to create a late-spawning component from returns to the George Adams Hatchery. For example, a benchmark could be "80% of the adult progeny from the late-fall program that return to George Adams Hatchery mature after October 7."

Task 1-3. Identify what must be monitored to assess the benchmark(s) for fidelity of spawn timing. For example, it could be "Juveniles released will have a coded-wire-tag (CWT) unique to the late-fall hatchery program. All adults spawned at the hatchery will be checked for a CWT and, if a CWT from the late-fall program is recovered, the date of spawning will be recorded."

Task 1-4. Consistent with the Plan objective of maintaining harvest opportunities and the monitoring plans developed for tasks 1-3 and 2-3, identify the number of juveniles that will be released from the late-fall Chinook salmon program at George Adams Hatchery in 2016.

Task 1-5. Identify any necessary and feasible facility modifications to implement the monitoring, broodstock spawning, rearing, and release strategies for the late-fall hatchery program.

Task 1-6. Implement, within budget and resource constraints, the late-fall program at George Adams Hatchery consistent with the protocols and monitoring defined in tasks 1-1 through 1-5.

Task 1-7. Document results from tasks 1-1 through 1-6 and provide to NMFS by August 15, 2015.

Phase 2

If in Phase 1 we are able to successfully create a late-spawning component at the George Adams Hatchery, Phase 2 of the project (brood years 2018 – 2023; return years 2019 - 2024) will test our ability to maintain a late-spawn timing population component in the Skokomish River under extant habitat conditions.

Question 2: Do hatchery-origin Chinook salmon spawning in the Skokomish River after mid-October have sufficient productivity to replace themselves in the subsequent generation?

The following tasks will be completed in 2015-2016 to address this question. Examples are provided to illustrate the tasks and potential products. The examples are not intended to limit further discussion of the benchmarks or concepts, and it is recognized that additional details on monitoring will be required to fully address each task.

Task 2-1. Describe the existing monitoring programs for naturally spawning Chinook salmon and resulting juvenile production in the Skokomish River. Identify any necessary and feasible improvements to monitor the spatial distribution and abundance of Chinook salmon spawners in the Skokomish River.

Task 2-2. Identify the benchmark value(s) that would indicate a successful test of our ability to create a late-timed, naturally spawning component of the Chinook salmon return to the Skokomish River. For example, a benchmark could be "The egg-fry survival of late-spawning Chinook salmon in the Skokomish River is 50% greater than the survival of early-timed spawners."

Task 2-3. Identify what must be monitored to assess the benchmark(s) for the productivity of late-timed natural spawners in the Skokomish River. For example, it could be "The distribution and projected egg to fry survival will be monitored for early and late-timed spawners in the Skokomish River."

Task 2-4. Identify the number of juveniles that must be released from the late-fall Chinook salmon program at George Adams Hatchery to implement the monitoring plan developed in Task 2-3.

Task 2-5. Document results from tasks 2-1 through 2-4 and provide to NMFS by August 15, 2015.

Future Phases

The Plan describes a potential sequence of measures to improve the productivity of fall Chinook salmon as habitat function is restored. Given current habitat conditions in the Skokomish River, we recognize that late-timed Chinook salmon may not immediately have sufficient productivity to replace themselves in the subsequent generation. It will be appropriate at the end of Phase 2 to evaluate the success of the program relative to Question 2 and, if not successful, what habitat, hatchery, or fishery factors may be contributing to this result. Results from Phase 1 and 2 and other relevant information will be used to adaptively manage the late-fall Chinook salmon program and inform decisions on future strategies.

2015-2016 Checkpoints

The comanagers have identified the following checkpoints to ensure that any necessary and feasible improvements to broodstock collection, monitoring, or facilities are made prior to the return of late-fall Chinook salmon in September 2015, and that the program is successfully implemented in 2015-2016.

May 15, 2015	Co-managers provide preliminary document to NMFS with concepts addressing tasks 1-1 through 1-6 and 2-1 through 2-4
June 1, 2015	Co-managers and NMFS will meet no later than this date to discuss concepts described in May 15 document.
July 1, 2015	Comanagers provide draft document to NOAA Fisheries addressing tasks 1-1 through 1-5 and 2-1 through 2-3.
July 15, 2015	NMFS provides co-managers with comments on draft document.
August 15, 2015	Co-managers provide final document to NMFS as an addendum to the previously submitted to George Adams HGMP.
November 15, 2015	Egg-take completed for late-fall program at George Adams Hatchery.
June 30, 2016	Tagged juveniles released from George Adams Hatchery.

Addendum to 2014 Plan for

Nisqually Chinook Exploitation Rate Ceiling, Low Abundance Ceiling, Low Abundance Threshold, Critical Exploitation Rate Ceiling and Weir Evaluation

Draft March 25, 2015

w/ NMFS Comments April 1, 2015

Introduction

In 2014 the co-managers provided to the National Marine Fisheries Service (NMFS) a document describing the exploitation rate ceilings and low abundance rate threshold for natural-origin Chinook salmon in the Nisqually River (2014 Nisqually Plan). The document also described the annual adaptive management process that evaluates all recovery actions, including those associated with harvest management and weir operation, research findings, and proposes an action plan for the next year. The co-managers stated that this process would continue "with a particular focus in 2014 on a critical evaluation of the weir program including the following: 1) how well the weir is working; 2) if it is not working as intended, what additional action can be taken to fix it; 3) what benchmarks should be used to measure effectiveness; 4) the long term prospects for successful operation of the weir."

The co-managers implementation of the annual adaptive management process in 2014-2015 included the following actions:

1) The annual Nisqually Adaptive Management workshop was held on May 28-29, 2014. Agenda topics included: a) 2013 monitoring of escapement and catch; b) weir operations; and c) monitoring priorities for 2014.

2) The Nisqually Tribe completed a report describing the operation of the weir from 2011 through 2014 and actions taken each year to increase weir effectiveness.

3) The Nisqually Tribe, Washington Department of Fish and Wildlife (WDFW), and the NMFS convened a facilitated workshop on February 24, 2015 to seek expert advice (Science Team) on refining the Nisqually River monitoring program and developing measurable benchmarks for assessing the effectiveness of the weir program in meeting its objectives. The co-managers and NOAA will use the results of this workshop to complete a monitoring plan for the weir, and to develop an associated adaptive management plan to guide implementation of the weir. The report from the workshop includes: a) a results chain linking operation of the weir to short- and long-term objectives for Nisqually River Chinook salmon; b) draft indicators related to the objectives in the results chain; c) draft objectives for the indicators; and d) potential monitoring activities. The objectives of the weir program are as follows (NIT 2010, NMFS 2011):

- Complement existing adult salmonid monitoring efforts in the Nisqually River in developing accurate and precise estimates of total Chinook salmon population abundance through the collection of demographic, biological, and genetic data;
- Promote recovery of a naturally producing Nisqually River fall Chinook population through removal of escaping Nisqually hatchery-origin Chinook salmon adults, to increase natural population productivity and intra-population diversity and promote local adaptation; and
- Use Chinook salmon demographic, biological, and genetic data collected through the weir operation to evaluate the effects of hatchery-origin Chinook salmon removal on natural Chinook productivity and develop an adaptive management-based terminal area management plan for the species.

2015 Tasks and Products

The co-managers will build on the results from the February workshop by completing the following tasks in 2015:

Task 1. A workgroup of the Science Team consisting of Joe Anderson, Bruce Crawford, Ken Currens, Ken Warheit, and any other interested parties will create a monitoring proposal with a completed results chain (Next steps 1-4 of weir workshop report). The monitoring proposal will be provided to the full Science Team for review and adoption of final recommendations. The Science Team will document and provide final recommendations.

Task 2. Preliminary recommendations documented and presented for review by the NMFS, the Nisqually Tribe, and the WDFW (Policy Team). Working with the Science Team, the Policy Team will finalize a report describing the results chain, priority indicators and monitoring, and benchmarks for successful operation of the weir.

Task 3. The Policy Team will use the final report from Task 2 to finalize the monitoring plan and create the adaptive management system to guide implementation of the weir program. This step includes incorporating the benchmarks or triggers at which the parties will re-evaluate operation of the weir and/or the program to monitor it, as well as desired future status for important indicators (if not already specified in the objectives). It will also include agreement on the process used for reviewing the results of monitoring data on a regular basis.

2015 Checkpoints

The comanagers have identified the following checkpoints to promote improvements in the operation and monitoring of the weir in 2015.

May 15, 2015 — Co-managers and the NMFS provided with Science Team results for Task 1.

June 1, 2015	Co-managers and the NMFS will meet no later than this date to review the May 15 workgroup recommendations.
July 1, 2015	Co-managers provide draft monitoring and adaptive management plans to the NMFS addressing Task 2.
July 15, 2015	NMFS provides co-managers with comments on draft plan documents.
August 15, 2015	Co-managers provide final documents to the NMFS.

Chinook Harvest Management Performance Assessment
Draft 4-24-2015

This report assesses fishery management actions affecting achievement of objectives specified by the Puget Sound Chinook Harvest Plan for the Skagit summer-fall, Puyallup, Nisqually, and Skokomish management units, updating the previous 2004 – 2010 season assessment (PSIT and WDFW 2013) with recently available information for the 2011 and 2012 seasons. This assessment compares pre-season forecasts of exploitation rates with post-season ('validation') FRAM model runs and estimates of the actual spawning escapement for these management units. The report identifies likely fishery management and other causative factors contributing to failures to achieve management objectives. It should be noted that FRAM was not intended to be a fishery performance assessment tool and FRAM validation results are more appropriate for assessing FRAM model performance. This distinction should be kept in mind when other applications of validation runs are inspected.

The FRAM, and TAMM modules in particular, are being continually refined to improve the accuracy of projecting and retrospectively estimating fisheries mortality. These improvements are driven by information collected from monitoring efforts of catch and incidental mortalities of fisheries including newly developed fishery approaches recently undertaken since 2010 to reduce impacts on natural populations. This report discusses these fishery changes and how they may affect future model performance.

The report also discusses the effect of uncertainty in estimating annual abundance used as an input to the FRAM and its potential effect on pre-season forecasted exploitation rates. Presently, there is uncertainty amongst co-managers in regards to how forecast error and pre-terminal fishery performance affects the marked-to-unmarked ratio of fish in the terminal area and consequently the observed exploitation rate in terminal fisheries.

1. Skagit Summer Fall

For years 2003 to 2012, the post-season estimates of the total exploitation rate for Skagit summer-fall Chinook exceeded the exploitation rate ceiling of 50% in 2007, 2009, and 2011 (Table 1-2). To explore the relative contribution of forecast error versus in-season management error on deviation in projected versus observed fishery exploitation rates on Skagit summer/fall Chinook, we calculated relative error of abundance forecasts compared to projections of fishery specific impacts (pre-terminal and terminal) using the following equation:

$$relative\ error = (observed - predicted)/observed$$

Negative deviations in relative error indicate over projection whereas positive deviations indicate under projection relative to the post-season observation of abundance and fishery specific impacts.

Comparison of percent error between the terminal abundance forecast and fishery specific impacts for years 2003-2012 revealed that the significant exceedances of the 50% exploitation rate ceiling observed in 2009 and 2011 were due in large part to shaping pre-terminal and terminal fisheries based on much stronger forecast than was actually observed (Table 1-1) and fishing to the pre-season expectation of impacts in specific fisheries including pre-terminal northern fisheries (AK + CAN) and terminal fisheries (Figure 1-1). The over-prediction of abundance combined with fishing to the pre-season expectation of impacts lead to the significant exceedance of the 50% exploitation rate ceiling for Skagit summer/fall Chinook during years 2009 and 2011 (Figure1- 2). Because there are numerous terminal fisheries implemented by three separate treaty tribes, terminal fisheries are managed to an expected pre-season catch in each fishery and not by a harvest rate estimate. Therefore, when abundance is lower than forecasted eventual ERs will be higher than expected. Pre-season expected and post-season observed catch is reported in annual reports submitted to the NMFS. The post-season ER for freshwater sport fisheries was equal to, or less than, the pre-season predicted ERs for 2009 and 2011.

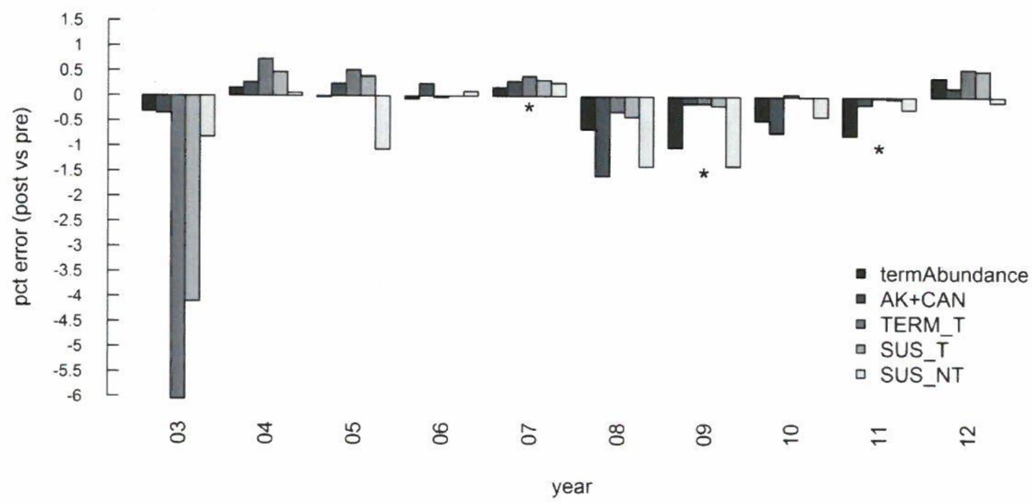


Figure 1-1. Relative error between observed versus predicted terminal abundance and fishery specific impacts including pre-terminal and terminal area fisheries for 2003 - 2012. Asterisks denote years when the total exploitation rate was exceeded. Negative values indicate instances of overprojection of abundance and fishery specific impacts preseason relative to post-season observations whereas positive values indicate under projection.

Table 1-1. Forecasting performance of Skagit River summer/fall Chinook terminal abundance, 2003-2012. Preliminary estimates for 2013 and 2014 are included but may not contain a full accounting.

	Expected	Observed	% Error
2003	13,562	10,326	-31.3%
2004	20,304	24,232	16.2%
2005	24,209	n/a	n/a
2006	24,203	22,800	-6.2%
2007	10,501	12,797	17.9%
2008	24,783	14,936	-65.9%
2009	24,575	12,183	-101.7%
2010	14,558	9,841	-47.9%
2011	15,978	9,019	-77.2%
2012	9,716	15,809	38.5%
2013[a]	*13,943*	*13,305*	*-4.8%*
2014[a]	*18,648*	*11,648*	*-60.1%*

[a] 2013 and 2014 data are preliminary.

Table 1-2. Differences between post-season (validation) minus pre-season estimates of exploitation rates on Skagit summer-fall Chinook.

	2007	2009	2011
Alaska	0.023	0.016	0.000
Canada	0.011	0.101	0.088
S. Of Falcon Ocean	0.000	0.000	0.000
NOF Ocean Troll: NT	-0.001	-0.001	0.000
Tr	-0.001	-0.003	0.000
NOF& Buoy10 Spt	-0.001	0.000	0.001
Pgt Snd Trty Troll	0.000	0.003	0.000
Puget Sound 6 Spt	0.000	0.000	0.001
Pgt Snd 5,6 Sport	-0.001	0.000	0.000
Pgt Snd 7 Sport	0.004	-0.004	0.005
Pgt Snd 8-13 Sport	0.001	0.001	-0.002
Out-of-Region net: NT	-0.004	-0.005	0.002
Tr	-0.006	-0.003	0.001
Local Terminal Net: NT	0.000	0.001	-0.001
Tr	0.000	-0.003	-0.004
Freshwater Sport	0.003	-0.009	0.000
Freshwater Net	-0.002	0.079	0.079

Conversely, during year 2007 when the total 50% exploitation rate ceiling was exceeded by 5%, southern US (SUS) fisheries were shaped with a management expectation not to exceed the 17% (SUS ER) critical exploitation rate ceiling for Skagit summer/fall Chinook. However, despite slightly under forecasting abundance, relative to the post-season observation, significant under projections in fishery impacts relative to the post-season observation, especially in pre-terminal northern fisheries, lead to exceedence of the total 50% exploitation rate. Nonetheless, southern US fisheries were managed such that SUS fishery exploitation rate on Skagit summer/fall Chinook was 12.6%, well below the target 17% critical exploitation rate ceiling and below the pre-season expectation of 14% (Table 1-3).

As a contrast to years where the exploitation rate ceiling was exceeded, in years such as 2003, relatively minor forecast error of abundance combined with substantial over projections in fishery specific impacts compared to post season estimates resulted in a substantially lower fishery exploitation rate than was projected pre-season (38.7% versus 47.9%; Table 1-3).

Table 1-3. Pre-season projected and post-season (validation) estimates of exploitation rates for Skagit summer-fall Chinook.

Year	Total ER			SUS ER		
	Pre-season	Valid	Deviation	Pre-season	Valid	Deviation
2003	47.9%	38.7%	-9.2%	17.6%	8.1%	-9.5%
2004	38.1%	40.7%	2.6%	6.1%	5.6%	-0.6%
2005	39.1%	46.3%	7.2%	9.6%	9.1%	-0.4%
2006	30.0%	35.1%	5.2%	10.3%	9.5%	-0.7%
2007	51.6%	55.0%	3.4%	14.0%	12.6%	-1.3%
2008	47.1%	41.6%	-5.5%	15.8%	18.6%	2.8%
2009	48.6%	65.9%	17.3%	25.5%	31.2%	5.7%
2010	43.9%	44.6%	0.6%	13.1%	16.4%	3.4%
2011	49.9%	65.6%	15.7%	21.6%	28.5%	6.9%
2012	40.4%	34.0%	-6.4%	14.3%	12.4%	-1.9%

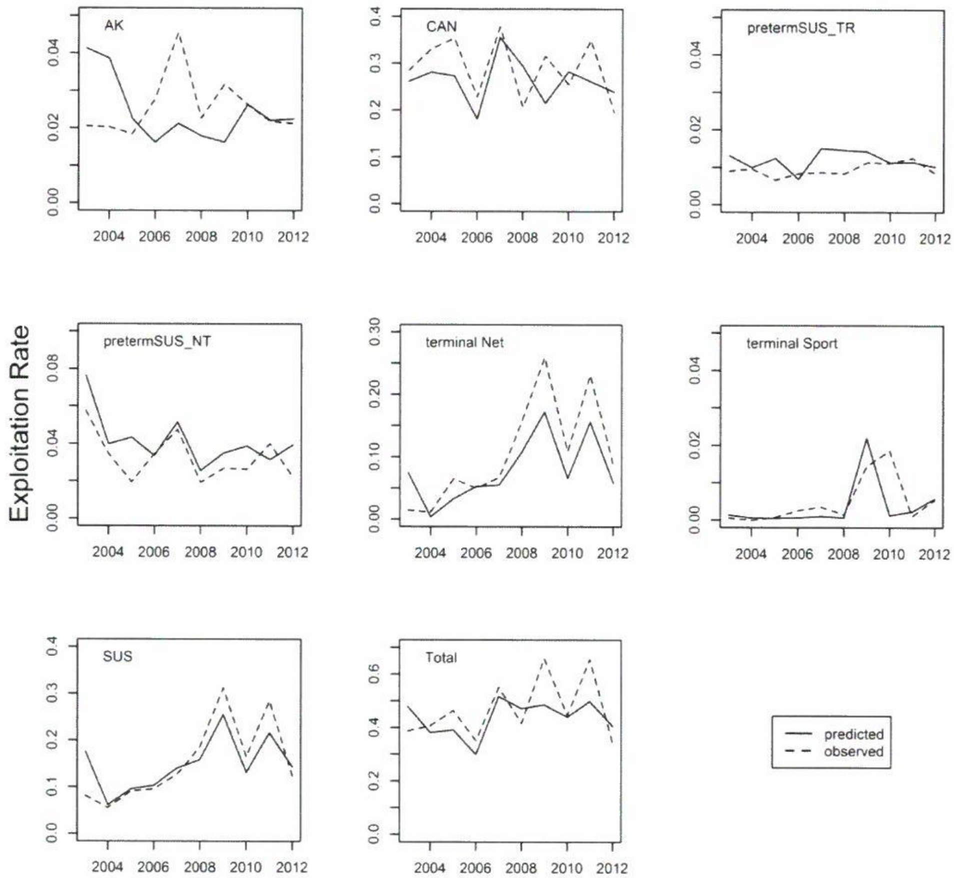


Figure 1-2. Differences between pre- and post-season (validation) estimates of fishery specific exploitation rates for Skagit summer fall Chinook.

Observed catches of Skagit summer-fall Chinook in terminal net commercial and C&S fisheries since 2010 have only been exceeded once (Table 1-4). In general terminal net fisheries have been managed such that observed catch has generally been lower than expected with recent years (2013 and 2014) being substantially lower (Table 1-4). Fisheries this year (2015) are expected to be managed as they have been in years past.

Table 1-4. Projected and actual landed catches of Summer/Fall Chinook in Skagit terminal area commercial and C&S fisheries, 2010- 2014.

	Expected	Observed	Difference	% Difference
2010	1,343	905	-438	-32.6%
2011	3,725	3,393	-332	-8.9%
2012	875	1,015	140	16.0%
2013	3,470	2,306	-1,164	-33.5%
2014[a]	*3,123*	*938*	*-2,185*	*-70.0%*

[a] 2014 catch data is still being reviewed by resource staff and should be considered preliminary at this point.

Exceedence of the total fishery exploitation rate ceiling on Skagit summer/fall Chinook in years 2007, 2009, and 2011, has primarily caused the lower Sauk summer Chinook population to not meet the low abundance escapement threshold of 400. In general, there appears to be a greater risk to not meeting the low abundance threshold for the lower Sauk summers than for the other two populations (Table 1-5, Figure 1-3).

Predicting recruitment strength of a specific Skagit Chinook population is difficult especially for the lower Sauk summer Chinook stock where the Skagit Chinook Recovery Plan (2005) identified 'egg-to-fry survival due to turbidity' as a limiting factor for this population. However, sediment load events are not always linked to peak flows in the Sauk River; a combination of exposed glacial till from receding glaciers and slope failures have caused high turbidity events even during normal incubation flow periods. The Chinook outmigration estimates generated at the mainstem smolt trap do not differentiate between the three summer/fall populations, further hindering our ability to estimate starting cohort abundance by population. Adult return timing of the through the terminal fishery grounds is not known. Even if there was increased confidence of run strength for the lower Sauk summer Chinook population and there was sufficient data to determine respective return timing for the three populations, shaping terminal fisheries to reduce impacts would be difficult considering Skagit Chinook terminal catch is predominately incidental take in other species targeted fisheries.

Table 1-5. Annual observed estimates of escapement for the three populations within the Skagit summer-fall management unit.

Year	Lower Skagit Fall	Lower Sauk Summer	Upper Skagit Summer
1991	1,510	658	3,656
1992	1,331	469	5,548
1993	942	205	4,654
1994	884	112	4,565
1995	666	278	5,948
1996	1,521	1,103	7,989
1997	409	295	4,168
1998	2,388	460	11,761
1999	1,043	295	3,586
2000	3,262	576	13,092
2001	2,606	1,103	10,084
2002	4,866	910	13,815
2003	1,161	1,493	7,123
2004	3,070	443	20,040
2005	3,320	875	16,608
2006	3,508	1,095	16,165
2007	1,053	383	9,845
2008	2,685	538	8,441
2009	1,439	250	5,290
2010	1,017	356	6,644
2011	820	210	4,480
2012	3,295	715	9,808
2013	1,551	530	8,801
2014	1,808	364	8,308

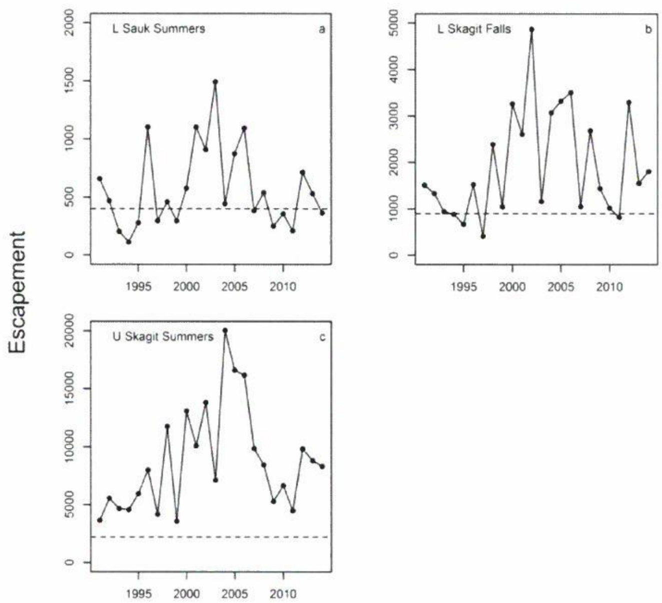


Figure 1-3. Annual observed estimates of escapement for the three populations within the Skagit summer-fall management unit.

Forecast methodology for wild Skagit summer-fall Chinook has varied from year to year. Specifically, during years 2003 to 2006 and 2010 to 2012, a flow adjusted average return rate forecast was used to predict the terminal run size of each age class (ages 2 – 5). This terminal abundance would then be run through backwards FRAM to produce a starting cohort of recruitment by age. A lifecycle based methodology that employed multiple regression models with life stage specific flow and marine environmental predictors to predict age specific FRAM recruitment scalars was employed for forecasting the 2007 to 2009, 2013, and 2014 returns. Specific steps for choosing a forecast usually entail comparing a suite of candidate models by hind-casting and choosing the model (lowest AIC) which performs best or taking a weighted average forecast produced by each model based on model fit to the data. With the exception of 2009 and 2011 when abundance forecasts were significantly higher than observed estimates of abundance, forecasts for the remaining years from 2003 – 2012 have performed reasonably well (Figure 1-1). For 2015, a weighted average of a sibling adjusted model was used to forecast age 3-5 returns and an Age-2 from 3 method used to forecast age-2 cohort.

Significant efforts have been devoted to identifying a viable methodology to assess terminal run strength of Skagit summer/fall Chinook in-season using a standardized in-river test fishery that have been operating in the lower Skagit River since 1989 (Conrad

2013). Specifically, a total of 7 candidate models including co-variates for cumulative test fishery catch per unit effort (CPUE) of Chinook and additional test-fishery co-variates (e.g. % male and mean male length) were evaluated. Thus far, 3 candidate models have been identified based on long term performance, as "best" predictors of relative terminal run strength. Specifically, a model including co-variates for cumulative Chinook test fishery CPUE during management weeks 27 – 34 and percent male for management weeks 30-32 was the best performing model. However, none of the models are useful in predicting a reliable point estimate of run size. Rather, they are used to assess whether or not the run may be above or below a define breakpoint. The co-managers are still evaluating the potential of using this run size update methodology for the purposes of making in season changes to terminal area fisheries so as to not exceed the pre-season projection of exploitation rate by terminal area fisheries.

References

Conrad, R. 2013. Skagit Summer/Fall Chinook ISU development. January 2, 2013. 14 pgs.

2. Puyallup

The post-season estimate of total exploitation rate for Puyallup Chinook exceeded the exploitation rate ceiling of 50% in 2003 – 2010, and 2012. The difference between the pre-season projected total ER and the post-season estimates range from less than 1% to 21% (Table 2-1). Fisheries contributing to these exceedences in the period 2003 – 2010 were previously assessed (PSIT and WDFW 2013).

Table 2-1. Pre- and post-season (validation) estimates of exploitation rates for Puyallup Chinook.

	Total ER			SUS ER			Terminal		
	Pre-season	Validation	difference	Pre-season	Validation	difference	Pre-season	Validation	difference
2003	50.0%	61.4%	11.5%	39.3%	46.3%	6.9%	28.4%	37.9%	9.5%
2004	50.2%	70.9%	20.7%	25.6%	51.0%	25.4%	15.4%	39.1%	23.6%
2005	49.4%	70.9%	21.4%	31.2%	39.7%	8.5%	21.4%	26.9%	5.5%
2006	50.0%	52.1%	2.1%	28.1%	32.5%	4.4%	17.7%	21.1%	3.5%
2007	48.6%	53.5%	5.0%	29.2%	31.1%	1.9%	20.7%	21.5%	0.7%
2008	49.0%	51.1%	2.0%	26.4%	32.9%	6.4%	18.6%	27.0%	8.4%
2009	49.8%	56.5%	6.7%	28.9%	27.7%	-1.2%	18.1%	18.2%	0.0%
2010	50.0%	56.5%	6.6%	32.0%	42.1%	10.1%	23.0%	33.7%	10.7%
2011	48.3%	48.8%	0.6%	25.2%	28.5%	3.3%	16.8%	21.9%	5.0%
2012	48.5%	61.1%	12.6%	32.2%	37.2%	5.1%	22.6%	27.1%	4.5%

The ER exceedence in 2012 was in large part due to higher than expected impacts in fisheries in British Columbia, but impacts in the net fishery in the Puyallup River were also higher than projected (Table 2-2). In recent years the tribal in-river net fishery has been severely constrained, operating for one day or a fraction of a day during the Chinook management period. Chinook are also caught in the first week of the subsequent coho fishery. Recognizing the consistent errors in pre-season projections of catch and harvest rates, the co-managers have modified methods for modeling impacts. Forecast errors and uncertainty in the abundance of Chinook in the river during fishery openings have contributed to observed errors in estimation of planned impacts. Fishing effort has also been increasing, despite the very short openings.

Table 2-2. Differences between pre- and post-season estimates of fishery specific exploitation rates for Puyallup Chinook.

	2003	2004	2005	2006	2007	2008	2009	2010	2012
Alaska	-0.002	-0.001	0.001	0.001	0.003	0.001	0.002	0.001	-0.001
Canada	0.049	-0.046	0.127	-0.024	0.029	-0.044	0.076	-0.036	0.076
S. Of Falcon Ocean	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
NOF Ocean Troll: NT	-0.002	-0.002	-0.002	-0.004	0.000	-0.004	-0.005	-0.003	0.003
Tr	-0.006	0.003	0.005	-0.001	-0.004	-0.007	-0.021	-0.008	0.003
NOF B10 Sport	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.001	0.004
Pgt Snd Trty Troll	0.002	0.053	0.019	0.001	-0.004	-0.003	0.017	0.006	-0.010
Pgt Snd 6 Sport	0.000	0.000	0.000	0.000	0.000	0.000	0.005	0.001	0.002
Pgt Snd 5,6 Sport	-0.002	-0.003	-0.001	0.001	0.000	0.000	0.003	0.001	0.000
Pgt Snd 7 Sport	-0.001	-0.006	0.001	0.003	0.002	0.000	0.000	-0.001	0.000
Pgt Snd 8-13 Sport	-0.010	-0.026	0.009	0.008	0.019	-0.007	-0.003	0.001	0.004
Out-of-Region net: NT	-0.001	-0.001	0.000	0.000	-0.001	-0.001	-0.002	-0.001	-0.001
Tr	0.000	0.000	0.001	0.002	-0.001	0.003	-0.005	0.000	0.000
Local Terminal Net: NT	0.001	0.000	-0.001	0.000	-0.001	-0.001	-0.002	-0.001	0.000
Tr	-0.002	-0.005	-0.004	0.000	-0.006	0.002	-0.002	0.000	-0.002
Freshwater Sport	0.107	0.020	0.025	-0.003	-0.015	0.003	-0.009	-0.015	0.006
Freshwater Net	-0.015	0.221	0.036	0.038	0.029	0.080	0.013	0.123	0.041

The terminal area tribal net fisheries in 2013 and 2014 were modified to address concerns with previous years' impacts. The tribal Chinook fishery opened earlier (week 33) than in previous seasons under the assumption that abundance earlier in the run would be lower and would result in a lower rate of catch. While overall catch was not reduced, post season harvest rates were lower than pre-season expectations (Table 2-3). The only other year this occurred (2011) also resulted in Puyallup stock meeting the 50% ER ceiling (Tables 2-1 and 2-3), which we are optimistic will be the case for 2013 and 2014, but recognize that other factors will influence the overall ER. The terminal treaty fishery schedule for 2015 will follow the same schedule as was developed in 2014.

The pre-season forecast model has been further adjusted in 2015 to address the chronic under-estimation of harvest rates in the tribal net fishery. Using the current (2015) forecast model (Bill Patton, NWIFC, pers comm) to hindcast, the harvest rates suggests that, since 2009, the treaty net harvest rate would have been underestimated for only two of the six years (2011 & 2012). In the other four years, this model predicts harvest rates that are either very close to the actual observed post-season treaty net harvest rates, or, in the case of 2013, that overestimates the harvest rate.

Table 2-3 Summary of tribal Chinook harvest in the Puyallup River, comparing pre- and post-season harvest rates.

		2007	2008	2009	2010	2011	2012	2013	2014
# days open	Chin wk 33	0	0	0	0	0	0	0.5	0.25
	Chin wk 34	0	0	0	0.25	0	0	0	0
	Chin wk 35	0	0	0.5	0.5	0	0.5	0	0
	Coho wk 36	0.5	0.5	1	1	1	1	1	1
Total tribal Chinook catch		2,457	2,461	1,856	2,757	1,316	1,343	1,474	1,967
Pre Season HR (projected				20.5%	27.3%	18.6%	26.5%	25.3%	24.6%
Post Season HR		19.7%	23.4%	21.5%	36.6%	17.7%	31.4%	22.6%	24.4%
Error (Post - Pre-season)				1.0%	9.3%	-0.9%	4.9%	-2.7%	-0.2%
Pre Season HR (hindcast)		13.4%	10.4%	26.8%	35.7%	12.5%	25.0%	37.5%	23.0%
Error (Post - hindcast pre)		6.3%	13.1%	-5.4%	0.9%	5.2%	6.5%	-14.9%	1.4%
Tribal landings		130	194	103	161	169	127	113	163

From FRAM (Table 2-4), observed terminal abundance was lower than forecast in 2010 and 2011, and much lower in 2012. Forecast errors for natural and hatchery stocks, and differences in pre-terminal fishing mortality from projected levels, inevitably affect the performance of terminal fisheries. Over-forecasting the abundance would contribute to higher ER's for fisheries that do not have relatively constant harvest rates.

Available information does not indicate that the Puyallup River sport fishery contributed significantly to the ER exceedances. The post-season estimated ER for the freshwater sport fishery exceeded the predicted ER by only 0.1% in 2008 and by only 0.6% in 2012. The low ER for this fishery is an outcome of hatchery mark-selective fishing rules that require release of unmarked Chinook. The sport fishery was further restricted since the 2012 season, closing major sections of the Puyallup River during the Chinook, pink, and coho migration period when the tribal net fishery was opened.

Terminal area abundance of Puyallup Chinook was substantially lower than forecast in 2010 and 2012 (Table 8), based on comparison of pre-season and validation FRAM estimates. This comparison conflates the effects of differing pre-terminal impacts and pure forecast error, but it is one factor contributing to higher than expected terminal exploitation rates.

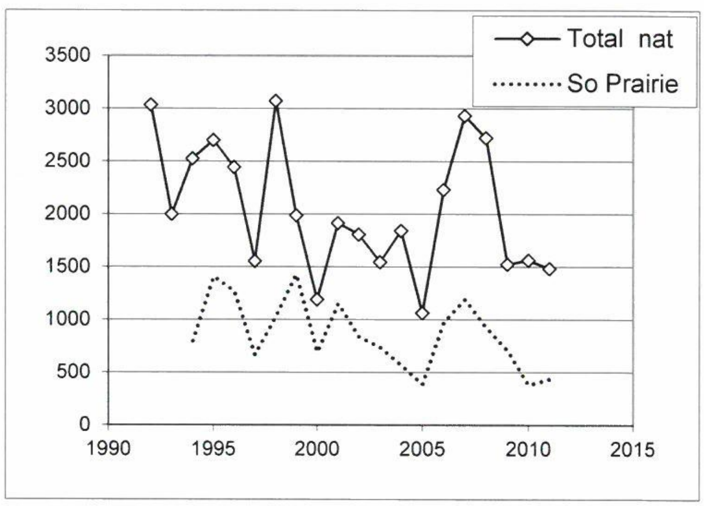
Spawning escapement increased in 2014 relative to two subsequent years of low natural escapement in 2012 and 2013 (Table 2-4). With the exception of these two recent years, total Puyallup River escapement has been stable, exceeding 1,400 in most recent years (in the entire Puyallup basin) and consistently exceeding the LAT of 500 in South Prairie Creek. Estimates of NOR escapement have been well above a critical level of 200, with the exception of 2013.

Table 2-4 Forecast accuracy for terminal abundance of Puyallup Chinook.

Year	Pre-Season	Post-season	error
2003	8,285	7,686	-0.072
2004	6,693	7,635	0.141
2005	7,110	7,552	0.062
2006	7,289	9,596	0.317
2007	7,224	12,374	0.713
2008	6,613	9,863	0.491
2009	9,339	8,630	-0.076
2010	12,898	7,138	-0.447
2011	10,267	7,430	-0.276
2012	10,778	4,483	-0.584

Table 2-5 Natural fall Chinook escapement to the Puyallup River.

	Total	South Prairie
1992	3034	
1993	1999	
1994	2526	798
1995	2701	1408
1996	2444	1268
1997	1554	667
1998	3071	1028
1999	1988	1430
2000	1193	695
2001	1915	1154
2002	1807	840
2003	1547	740
2004	1843	573
2005	1064	389
2006	2232	978
2007	2932	1194
2008	2725	925
2009	1526	710
2010	1563	382
2011	1486	439
2012	772	225
2013	774	52
2014	1,444	408



3. Nisqually

An exploitation rate ceiling was initially established for Nisqually Chinook with the Puget Sound Chinook Harvest Management Plan in 2010. The exploitation rate ceiling reflected a stepped-down implementation process with an ER ceiling of 65% (total ER) for 2010 and 2011, then an ER ceiling of 56% for 2012 and 2013. The ceiling for 2014 and 2015, originally set at 47%, was adjusted by the co-managers to 52%. The available post season estimates of total ER exceeded the ceiling ER levels by 2.2% and 2.3% for the 2011 and 2012 seasons, respectively (Table 3-1). Further more, during 2011 there was an unplanned and unmodeled (pre-season) terminal net fishery at the mouth of the Nisqually River that resulted in an additional ER of 6% post-season. Without this situation, the 2011 fisheries would have been below the ER ceiling of 65%.

Table 3-1. Available pre- and post-season (validation) estimates of exploitation rates for Nisqually Chinook. Shaded cells denote years when management objectives were governed by escapement goals and not by exploitation rate objectives.

	Total ER				SUS ER				Terminal ER		
	Pre-season	Validation	difference		Pre-season	Validation	difference		Pre-season	Validation	difference
2003	76.7%	82.8%	6.1%		69.1%	66.1%	-3.0%		40.6%	46.0%	5.3%
2004	76.0%	79.5%	3.5%		62.0%	58.4%	-3.6%		40.4%	30.5%	-9.9%
2005	76.3%	71.9%	-4.4%		64.8%	46.3%	-18.4%		41.1%	25.7%	-15.4%
2006	64.7%	80.4%	15.6%		50.8%	64.2%	13.4%		29.9%	40.1%	10.1%
2007	62.8%	75.3%	12.5%		48.6%	57.5%	8.8%		33.5%	43.4%	9.9%
2008	72.8%	78.6%	5.8%		53.2%	63.8%	10.6%		39.1%	51.3%	12.2%
2009	75.8%	82.8%	7.0%		58.8%	63.0%	4.2%		39.3%	45.7%	6.5%
2010	64.4%	66.4%	2.0%		47.7%	55.6%	8.0%		30.6%	41.2%	10.7%
2011	64.8%	67.2%	2.4%		46.9%	50.0%	3.2%		27.7%	34.6%	6.9%
2012	55.3%	58.3%	3.0%		41.2%	43.7%	2.5%		20.5%	24.1%	3.6%

The fishery specific ER for several fisheries marginally exceeded their pre-season projections in 2010, 2011, and 2012, but the largest exceedances occurred in the river net fishery. Total ER's in preterminal fisheries (including northern fisheries) were less than projected in 2010, 2011 and 2012. The exceedance for the river net fishery declined substantially in 2012 relative to the errors observed for previous years (Table3-2). The post-season estimated ER for the freshwater sport fishery exceeded the predicted ER by only 0.8% in 2011 and only 1.4% in 2012.

Table 3-2. Differences between pre- and available post-season estimates of fishery specific exploitation rates for Nisqually Chinook.

	2010	2011	2012
Alaska	0.007	0.005	0.003
Canada	-0.066	-0.012	0.003
S. Of Falcon Ocean	0.000	0.000	0.000
NOF Ocean Troll: NT	0.004	0.004	0.006
Tr	-0.005	0.001	0.004
NOF& Buoy10 Spt	-0.001	0.002	-0.001
Pgt Snd Trty Troll	0.000	-0.019	-0.026
Puget Sound 6 Spt	0.001	0.004	0.005
Pgt Snd 5,6 Sport	0.005	0.003	0.001
Pgt Snd 7 Sport	-0.001	0.002	0.001
Pgt Snd 8-13 Sport	-0.030	-0.029	-0.011
Out-of-Region net: NT	-0.001	-0.001	-0.001
Tr	0.002	-0.005	0.010
Local Terminal Net: NT	-0.003	-0.001	0.000
Tr	-0.018	-0.010	-0.005
Freshwater Sport	-0.008	0.008	0.014
Freshwater Net	0.135	0.072	0.028

Comparing estimates of terminal abundance in the pre-season and validation FRAM runs indicates lower than forecast abundance in 2011 and 2012, but the deviations from projected impacts of pre-terminal fisheries, and pure forecast error are conflated in this comparison (Table 3-3). Because the Nisqually Chinook population is not its own independent stock in FRAM, rather a part of the Deep South Sound Fall Fingerling (DSSff) stock (Table 3-3), harvest impacts in terminal and pre-teriminal fisheries on Nisqually Chinook can be influenced by forecast performance of other DSSff stocks. Forecast accuracy has been a major factor contributing to exceedence of the exploitation rate ceiling in recent years.

Table 3-3 Forecast accuracy for terminal abundance of Nisqually Chinook and percent of total (unmarked + marked) Deep South Sound Fall Fingerlings that are natural origin Nisqually stock and percent of Unmarked Deep South Sound Fall Fingerling (DSSff) that are natural origin Nisqually stock, pre-season and post-season.

	Nisqually Terminal Abundance			Percent of Total (U+M) DSSff			Percent of Unmarked DSSff		
Year	Pre-Season	Post-season	Prop. Error	Pre Season	Post Season	Prop. Error	Pre-Season	Post-Season	Prop. Error
2003	16,360	26,859	0.642	6.95%	4.07%	-0.414	32.71%	19.74%	-0.397
2004	21,749	25,871	0.190	8.56%	12.22%	0.428	56.56%	60.48%	0.069
2005	18,853	29,975	0.590	7.61%	6.61%	-0.131	63.16%	55.70%	-0.118
2006	24,892	36,587	0.470	6.52%	7.86%	0.206	52.64%	61.06%	0.160
2007	31,029	41,900	0.350	5.83%	4.63%	-0.206	44.47%	43.36%	-0.025
2008	33,032	22,808	-0.310	6.72%	11.08%[a]	0.649	56.22%	77.69%[a]	0.382
2009	26,978	21,784	-0.193	8.29%	4.44%	-0.464	58.61%	45.79%	-0.219
2010	26,781	43,674	0.631	8.94%	6.57%	-0.265	64.92%	48.00%	-0.261
2011	35,073	31,438	-0.104	2.33%	1.60%	-0.313	33.62%	22.99%	-0.316
2012	37,878	33,263	-0.122	2.42%	4.54%	0.876	29.95%	64.65%	1.159

[a] Post season data from the 2014 validation runs.

To meet the new ER management objectives in 2010 the number of nets allowed per fisherman in the terminal area treaty net fishery was reduced from 3-5 to three and the number of fishing days per week was reduced from three to two. In addition, the net fishery was closed for two weeks in September to increase escapement.

In 2011, fishing regulations were consistent with 2010 regulations, and stronger enforcement improved compliance. A three week fishery closure was implemented in 2011 for Chinook conservation purposes. Modeling of the terminal fisheries was revised, based on performance in 2010, to improve the accuracy of estimates of catch and mortality.

To achieve the lower ER ceiling for 2012 the net fishery was open two days per week, fishing was closed at night, and the gear allowance was further reduced to 2 nets per person. The fishery was shortened five weeks, (i.e. closed for three weeks during the Chinook management period)

Overall, terminal gillnet fishing effort has been reduced 70% since 2007, and has remained stable at that low level for 2012 – 2014 (Figure 3-1). As a result, terminal exploitation rate has also decreased (Figure 3-2). In contrast, pre-terminal fisheries, including Alaska and Canada, have increased (Figure 3-2) making it even more challenging to meet the conservation goal.

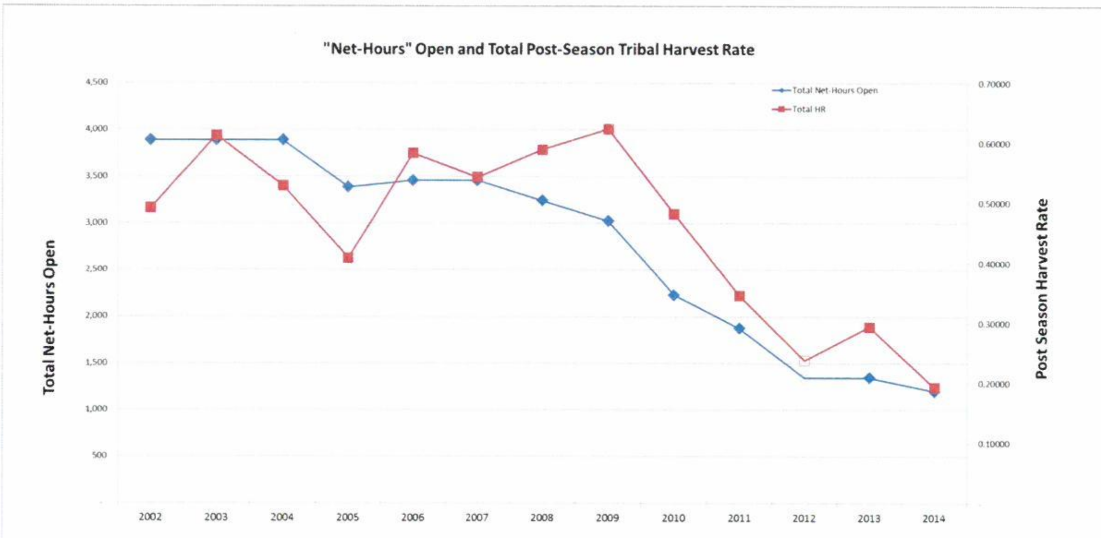


Figure 3-1. Gillnet fishing effort by hour and harvest rates (HR) for the tribal Chinook fishery in the Nisqually River.

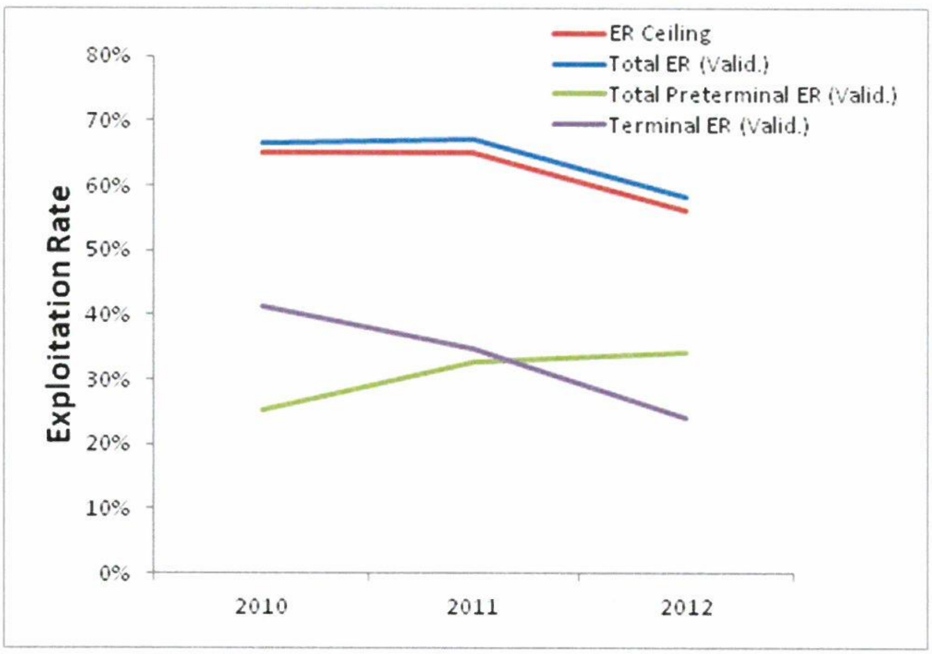


Figure 3-2. Recent three-year trend (2010-2012) in target management exploitation rate (ER Ceiling), and observed exploitation rates from validation runs for Total ER, Total Preterminal ER (including Canada and Alaska), terminal ER (treaty and non-treaty fisheries).

Pre-season terminal net fishery modeling has substantially improved since first implemented in 2010. Errors of pre-season projections of exploitation rates in comparison with available post season validations have declined from 13.5% in 2010 to 2.8% in 2012. The reduction of fisheries to meet the ER ceiling, with changing terminal fishing regimes, has presented challenges to accurately predicting impacts.

Comparison of preseason and post season harvest rates is considered a more useful indicator of in river fishery performance than exploitation rates, since in-river exploitation rates are affected by the accuracy of modeling the impacts of pre-terminal fisheries and abundances. Specifically, if the pre-terminal fisheries and extreme terminal run size (ETRS) forecasts do not perform as modeled pre-season, the resulting mark rates and eventual abundance in the terminal area will deviate from those expected pre-season.

Harvest rate estimates for the treaty gill net fishery indicate error associated with the 2014 season was less than 0.1% while harvest rates in 2013 were higher than expected (Table 3-4). During 2012, gill-net harvest rates only minimally (0.9%) exceeded pre-season expectations, yet terminal net fishery ER was still above pre-season expectations possibly as a result of tangle net fishery performance (tangle net fishery performance and implementation are further outlined below). In 2011, gill-net harvest rate was much lower (-3.4%) than expected. Although an unplanned fishery, as previously mentioned, increased terminal treaty FW ER by 6%, there is still 1.2% ER exceedance remaining for the FW Treaty fishery. This result indicates that even if terminal fisheries can be managed at, or below, their pre-season harvest rate expectations, ERs can be exceeded. As such, using ERs to evaluate terminal fishery performance is not an appropriate metric for reasons already noted. The greatest deficit of HR occurred in 2010 which also coincided with the initial implementation of an exploitation rate management objective for the Nisqually stock. Since then, gill net harvest rate model performance has substantially improved over the recent years (Table 3-4).

Table 3-4. Assessment (Post-Pre) of pre-season and observed post-season treaty gill net harvest rates in the Nisqually River, 2010-2014, and performance (via hindcasting) of the 2015 Harvest Rate model used to predict fisheries impacts for 2015.

	2010	2011	2012	2013	2014
Pre Season HR (projected	0.39015	0.38010	0.22895	0.23900	0.19295
Post Season HR	0.48265	0.34632	0.23797	0.29393	0.19305
Error (Post - Pre-season)	0.0922	-0.03378	0.00902	0.05493	0.0001
Pre Season HR (hindcast w/ 2015 model)	0.52514	0.4168	0.25747	0.22950	0.26058
Error (Post - hindcast)	-0.04279	-0.07048	-0.01950	0.06443	-0.06752

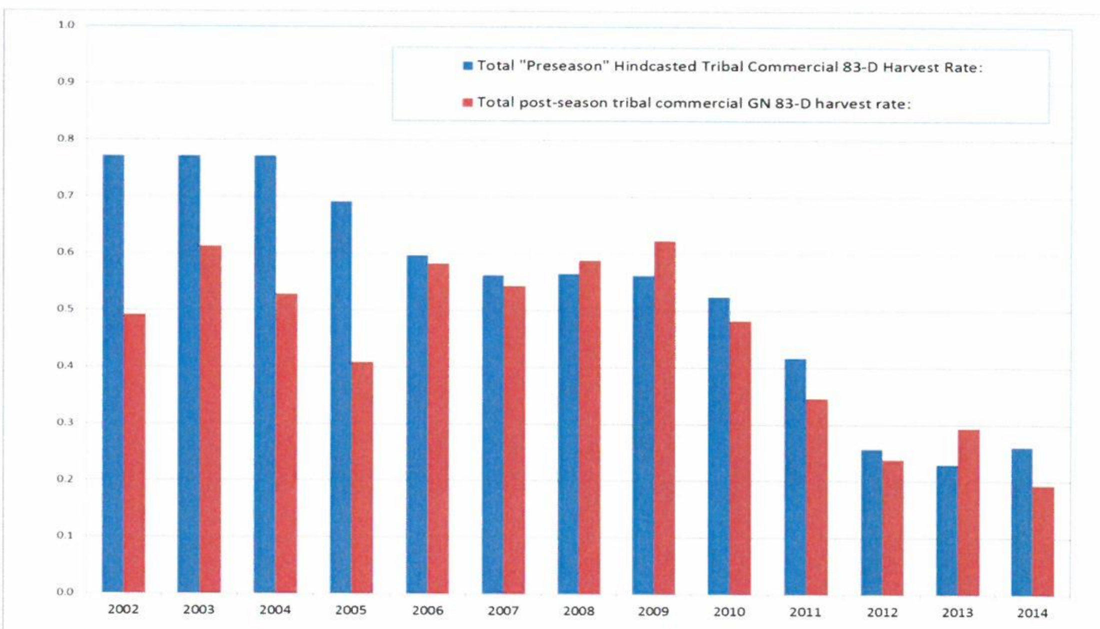
Table 3-5. Assessment (Post-Pre) of preseason and observed post-season treaty tangle net encounter rates in the Nisqually River, 2012 and 2014.

	2012	2014
Pre Season HR (Projected)	0.0767	0.0778
Post Season HR	0.0937	0.1396
Error (Post-Pre)	0.0170	0.0618

Tangle-net fisheries were first implemented in 2012 and then again in 2014 as a mark-selective net fishery in the Nisqually River. Initial modeling of tangle net encounters, with no history of application in the Nisqually River, were highly uncertain and lead to poor model accuracy during the initial fishery development (Table 3-5). Now with two years of tangle-net fishery specific data available, more robust model inputs (effort, efficiency, and encounter rates) have improved model accuracy. It is expected that tangle net model accuracy will continue to further improve over the coming years as has been noted with the gill net model. As a result of recent model input improvement, the tangle net fishery in 2015 will likely be shortened.

The gill net (GN) fishery season in 2015 will likely be identical to the last few years. For the model that will be used to project the impacts of the 2015 fishery, the mean daily harvest rate is derived from data collected from 2012 – 14, when gear restrictions and other regulations were consistent with planned fisheries. When used to hindcast the effects of fisheries in previous years, the 2015 model performs well, in particular for 2014 (Fig 3-5; Table 3-4). The 2015 fishing schedule will not be expanded in-season, but in-season monitoring may cause closure or a reduced fishing schedule.

Figure 3-5. Performance of the 2015 model for the tribal gillnet fishery in the Nisqually River, used to hindcast the effects of fisheries in previous years.



If tangle-net (TN) fisheries are implemented in 2015, GN fisheries will be reduced in order to accommodate this fishery. The TN model is now using gear specific data and the number of days TN gear is fished will drop from previous years as a result. The effects of the tanglenet fishery in 2015 will be projected with a model using encounter rate estimates collected from tanglenet fisheries in recent years (models for previous years estimated encounter rates based on data collected from gillnet fishing, i.e. by estimating reductions in efficiency and effort). The 2014 model projected 196 total hours of tanglenet fishing, with an encounter rate of 0.078. For 2015, the latest model projects 84 hours of tanglenet fishing, with an encounter rate of 0.065. Unmarked retention rates in the tanglenet fishery have varied widely, so if the unmarked retention rate in any week exceeds 10%, the 2015 tangle net fishery will be closed for the remainder of the Chinook management period, until week 42 when Chinook have cleared fishing area.

Several actions have been taken since 2010 to improve fishery management and forecast performance: 1) Increased enforcement presence in recent years is expected to improve compliance with fishing regulations; 2) Age 2 abundance is now being forecast with an Age 2 from Age 3 methodology instead of utilization of a single static value employed in the post-season validation runs summarized above (Tables 3-1 and 3-2); and 3) escapement estimation is now done by a change-in-ratio (CIR) methodology that is expected to reduce estimation error associated with varying spawner survey condition and small sample size.

Although the Nisqually River sport fishery does not appear to be contributing significantly to observed ER exceedances, this fishery has been further restricted by co-manager agreement since the 2012 season to achieve management objectives of the PSCHMP, and to reduce conflicts between tribal net and sport fisheries.

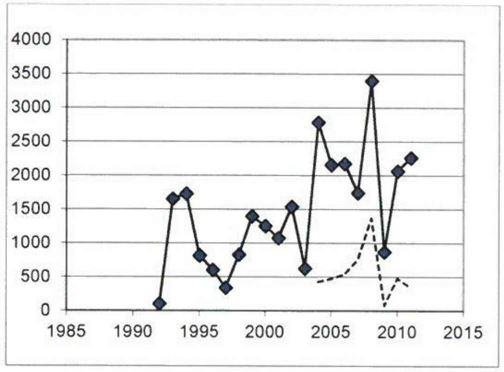
An initial assessment of the Age-2 from Age-3 abundance methodology, based on hindcast of validation runs, suggests an overall 1-3% decline in total ER on Nisqually stock would be expected when compared to recent (2010-2012) post-season fishery observations where management objectives were defined by an ER ceiling.

Escapement estimates of unmarked chinook from spawning ground surveys are highly uncertain due to spawner survey conditions and small sample sizes of carcasses recoverd which can affect the total UM run size to the river, therefore significantly affecting the ER. The new CIR escapement method is expected to reduce estimation error associated with the spawning ground escapement estimation.

Recent exceedance in the exploitation rate ceiling for Nisqually Chinook notwithstanding, escapement to natural spawning areas has been increasing in recent years (Table 3-6). Levels have been much higher than the LAT established in 2014. Estimates of natural escapement have been much higher than the generic critical level.

Table 3-6. Natural Chinook escapement to the Nisqually River.

	Total
2004	2788
2005	2159
2006	2179
2007	1744
2008	3398
2009	872
2010	2067
2011	2264
2012	3677
2013	2293
2014	956



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4. Skokomish

The 50% total exploitation rate ceiling was first implemented for Skokomish management in 2010. Post-season estimates of ER exceeded the ceiling from 2010 – 2012 (Table 4-1).

Table 4-1. Pre- and post-season (validation) estimates of exploitation rates for Skokomish natural Chinook.

	Total ER				SUS ER				Terminal ER		
	Pre-season	Validation	difference		Pre-season	Validation	difference		Pre-season	Validation	difference
2003	60.0%	57.8%	-2.2%		45.7%	39.9%	-5.9%		31.3%	31.3%	0.1%
2004	52.5%	56.0%	3.5%		33.9%	36.4%	2.6%		22.2%	23.1%	0.9%
2005	62.9%	64.7%	1.8%		43.7%	37.4%	-6.3%		31.6%	26.5%	-5.1%
2006	57.3%	65.4%	8.1%		37.5%	50.7%	13.2%		28.5%	39.3%	10.9%
2007	66.3%	69.1%	2.8%		47.1%	49.8%	2.7%		38.7%	38.1%	-0.6%
2008	59.7%	64.4%	4.8%		36.9%	51.1%	14.1%		27.7%	39.9%	12.2%
2009	58.1%	67.3%	9.2%		43.3%	48.3%	5.0%		31.5%	36.2%	4.7%
2010	49.8%	55.9%	6.1%		33.2%	44.5%	11.3%		21.3%	33.0%	11.7%
2011	50.0%	53.5%	3.5%		32.7%	36.8%	4.1%		20.5%	27.6%	7.0%
2012	47.9%	58.1%	10.1%		34.3%	47.7%	13.4%		21.8%	36.1%	14.3%

From comparison of pre-season and validation model runs, fishery specific ERs for several fisheries contributed to the exceedences in 2010 – 2012. Terminal marine and in-river net fisheriesshowed relatively larger exceedence of the pre-season estimates (Table 4-2). The major and common factors contributing to these exceedences was errors in prediction of terminal abundance and CPUE. In these years the forecasting methodology focused on short term trends that excluded a minimum of a complete brood year cycle of five years to account for variation with that brood cycle. Current forecast methodologies now encompass a complete brood cycle. Total ER's in pre-terminal fisheries (including northern fisheries) were less than projected in 2010, 2011, and 2012.

Table 4-2 The differences between pre- and post-season (validation) estimates of fishery-specific exploitation rates for southern Hood Canal Chinook stocks.

		2010	2011	2012
Alaska		0.000	0.000	0.000
Canada		-0.052	-0.006	-0.032
S. Of Falcon Ocean	NT	0.000	-0.001	0.000
NOF Ocean Troll:	NT	-0.005	0.001	0.006
	Tr	-0.007	-0.001	0.007
Ocean & Buoy10 Spt		0.003	0.002	0.002
Pgt Snd Trty Troll		0.012	-0.005	-0.007
Pgt Snd 5,6 Sport		0.002	0.001	0.003
Pgt Snd 7 Sport		0.002	0.006	0.001
Pgt Snd 8-13 Sport		-0.008	-0.018	-0.014
Out-of-Region net:	NT	-0.003	-0.001	-0.002
	Tr	-0.007	-0.013	-0.006
Local Terminal Net	NT	0.000	0.000	0.000
	Tr	0.028	0.032	0.041
Freshwater Sport \5		0.004	0.005	0.018
Freshwater Net \5		0.084	0.033	0.084

Table 4-3 Forecast accuracy for southern Hood Canal Chinook stocks.

	Skokomish			George Adams			Hoodsport		
	Pre-Season	Post-season	% error	Pre-Season	Post-season	% error	Pre-Season	Post-season	% error
2003	2,447	1,928	-21.2%	11,864	17,175	44.8%	18,702	19,300	3.2%
2004	1,898	3,677	93.8%	10,581	18,824	77.9%	20,576	13,074	-36.5%
2005	2,245	3,579	59.4%	11,924	28,226	136.7%	15,679	26,774	70.8%
2006	2,057	2,537	23.3%	12,447	25,932	108.3%	17,424	18,163	4.2%
2007	3,144	1,182	-62.4%	22,060	29,543	33.9%	23,161	8,566	-63.0%
2008	2,042	2,448	19.9%	19,663	28,752	46.2%	13,702	9,010	-34.2%
2009	2,139	2,228	4.1%	26,657	26,830	0.6%	13,301	14,415	8.4%
2010	2,281	1,954	-14.3%	29,962	30,792	2.8%	12,768	10,385	-18.7%
2011	2,061	2,377	15.3%	29,027	46,320	59.6%	9,494	21,199	123.3%
2012	2,679	3,428	28.0%	31,135	58,782	88.8%	13,187	39,261	197.7%

In response to the 2013 performance assessment (PSIT and WDFW 2013), changes in the terminal area fishing regime were again implemented in 2014 with the intent to reduce the harvest rate in the tribal net fishery and meet the ER ceiling. For 2014, the tribal net fishery was completely re-structured by time and area in order to focus harvest on early returning hatchery Chinook and allow passage of fish to spawning grounds (Table 4-4). This re-structuring included opening the Skokomish River from the mouth to the HWY 106 bridge on July 13 for 3 days per week closing on July 29, until October 1; then reopening. The river was then re-opened from the HWY 106 and HWY 101 bridges for up to 3 days per week beginning the week of August 1 and closing on August 20 until September 14 when the river re-opened to Coho fisheries for 2 days per week until October 11. In previous years (2002-2013), the only area accessible to tribal net fishing included the river between the HWY 106 and HWY 101 bridges which was open for up to 5 days per week August 1 through mid-September and then 7 days per week until November 30. In 2013, the Skokomish River tribal net fishery was reduced by twenty (20) days from 2010-12 fishing levels in response to the exceedence of the pre-season harvest rate. In 2014, further measures were taken by re-structuring the Skokomish River tribal net fishery in time and area which included a three (3) week fishing closure of the entire river during the peak Chinook return timing. The coho fishery was also reduced to two (2) days per week to minimize by-catch of Chinook and increase passage to the spawning grounds. Skokomish Tribe commercial fishery sampling supported the assumption that by moving the tribal Chinook fishery to the July opening resulted in a reduction of tribal catch by 61% and a 94-100% harvest on hatchery origin fish (Table 4-5 and Figure 4-1). A lower than predicted run size in 2014 may have contributed to this assumption and exceedence of the pre-season harvest rate, which again identifies that more years of data are needed to assess the changes in the tribal Chinook terminal net fishery. Harvest of natural origin Chinook in freshwater commercial net fisheries has been a small portion (~2-4%) in recent years (Table 4-6). Given the positive increase in NOR spawner abundance (described below, Figure 4-3) suggests that current treaty fisheries management, although only one part of the overall impact on Skokomish Chinook, is providing assurances to improve NOR recruits to the spawning.

Table 4-4. Summary of the tribal commercial Chinook fishery schedule in the Skokomish River.

		NUMBER OF DAYS OPEN						
		2010	2011	2012	2013	2014		MGMT PERIOD
7/13-7/19						3	MOUTH	CHINOOK
7/20-7/26						3	TO	CHINOOK
7/27-8/2			3	2		3	HWY 106	CHINOOK
8/3-8/9	HWY 106	4	3	3	3	3		CHINOOK
8/10-8/16	TO	4	4	4	3	4		CHINOOK
8/17-8/23	HWY 101	4	4	4	3	4		CHINOOK
8/24-8/30		4	4	3	3	CLOSED	PEAK ENTRY	CHINOOK
8/31-9/6		4	3	3	2	CLOSED	PEAK ENTRY	CHINOOK
9/7-9/13		4	3	3	3	CLOSED	PEAK ENTRY	CHINOOK
9/14-9/20		4	3	4	3	2		COHO
9/21-9/27		7	6	4	3	2		COHO
9/28-10/4		7	7	7	3	2		COHO
10/5-10/11		7	7	7	3	2		COHO
10/12-10/18		7	7	7	6	7		COHO
Total Days Open		*56*	*54*	*51*	*35*	*35*		
WEEK ~ DUE TO YEARLY CALENDAR DAY SHIFTS								

Table 4-5. Summary of sampling of the 2014 tribal commercial Chinook fishery in the Skokomish River.

WEEK	82G-TOTAL SAMPLE RATE- (20% MINIMUM GOAL) CHINOOK 2014	SAMPLE ADMARK RATE-HOR	UMNB-NOR	DIT	# DAYS OPEN	MGMT PERIOD	# FISH LANDED
7/13-7/19	57%	96%	0%	4%	3	CHINOOK	46
7/20-7/26	28%	93%	6%	1%	3	CHINOOK	765
7/27-8/2	34%	97%	0%	3%	3	CHINOOK	269
8/3-8/9	88%	95%	1%	4%	3	CHINOOK	428
8/10-8/16	55%	93%	2%	5%	4	CHINOOK	881
8/17-8/23	20%	92%	1%	6%	4	CHINOOK	762
CLOSED							
CLOSED							
CLOSED							
9/14-9/20	68%	95%	3%	2%	2	COHO	308
9/21-9/27	55%	100%	0%	0%	2	COHO	20
9/28-10/4	50%	100%	0%	0%	2	COHO	2
10/5-10/11						COHO	0
10/12-10/18						COHO	0
10/19-10/25							0
2013 Total CHINOOK Catch Commercial Fishery				8894	**% DIFFERENCE 2013 VS 2014**		
2014 Total CHINOOK Catch Commercial Fishery				3481	**-61%**		

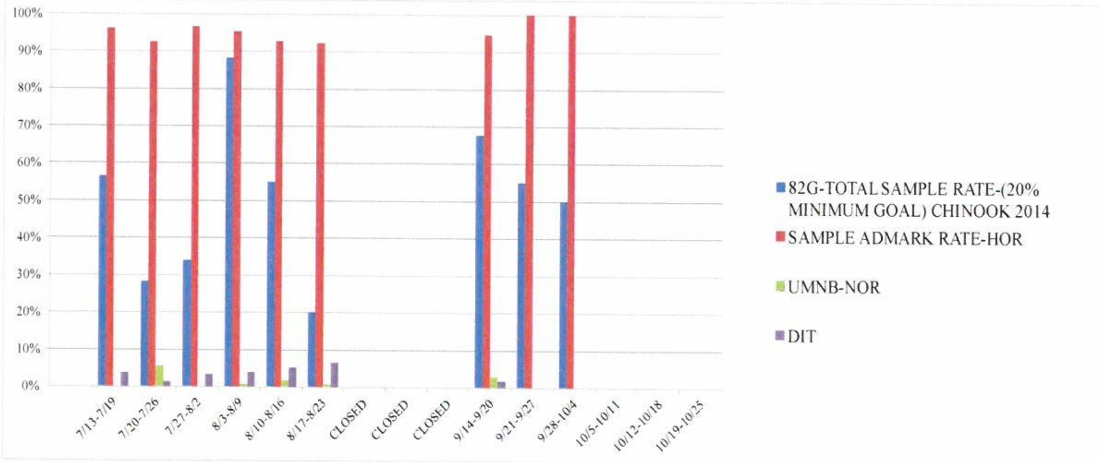

Figure 4-1. 2014 Skokomish Tribe Chinook commercial fishery sampling.

Table 4-6. Fishery sampling results of marked and unmarked fish in Skokomish Tribe Chinook commercial fishery, 2010-2014.

	2010	2011	2012	2013	2014
AD-CLIP MARK RATE (TOTAL SAMPLE)	83%	94%	94%	93%	94%
NATURAL FISH (UMNB-NOR)	13%	3%	2%	4%	2%
DIT (UM CWT)	4%	3%	4%	3%	4%

The ER on Skokomish River Chinook associated with the Skokomish River sport fishery was reduced from about 14% to an average of less than 3% with the implementation of hatchery mark-selective fishing in 2010. To improve accuracy of predicting the total mortality of this fishery, WDFW implemented a creel survey to evaluate the accuracy of catch record card estimates. The Skokomish River sport fishery was further restricted to reduce conflict with tribal fisheries and these restrictions also were expected to reduce the impact on Skokomish River Chinook.

Natural escapement to the Skokomish River was variable but stable over the last ten years (Table 4-7). The relatively low total spawning escapement in 2014 is attributable to unusually low survival of hatchery production, recruits from which have comprised most natural spawners. The Skokomish Tribe began comprehensive spawning ground surveys throughout the lower North Fork Skokomish River in 2008 coinciding with the beginning of normative flow releases from Cushman #2 dam into the system. Since 2008, there has been a positive trend in escapement estimate on the North Fork for all the major salmon species utilizing the watershed (note that none of the slopes show at least 95% confidence of not being zero due to low sample sizes and variability in escapements). The most significant increases have been in the chum and coho salmon numbers. Escapement trends from 2008 through 2014 have shown positive results for all salmon and steelhead in the North Fork including natural origin Chinook.

However, Chinook escapement trends are not quite as straight forward as other species due to the large proportion of hatchery origin Chinook on the spawning grounds. Linear regression analysis shows a very weak (low confidence) average increase of 20 fish per year (95% CI: -47– 87, p=.4776). This slight growth is just under 5% of the escapement average during the same period. 2014 showed the lowest escapement estimate during the time period not only in the North Fork, but in natural spawning Chinook throughout the watershed and hatchery returns to George Adams. This suggests that the unusually low Chinook escapement in 2014 was due to factors outside of the North Fork Skokomish River. A graph of Chinook escapement estimates from 2008-2014 is shown in Figure 4-2. If the 2014 outlier is removed from the linear regression then there is a statistically significant increase in Chinook escapements of 62 fish per year (95% CI: 27-98, p= .008). The question remains whether the external factors that caused the low Chinook returns throughout the Skokomish watershed in 2014 were an anomaly or will be a trend leading into the future.

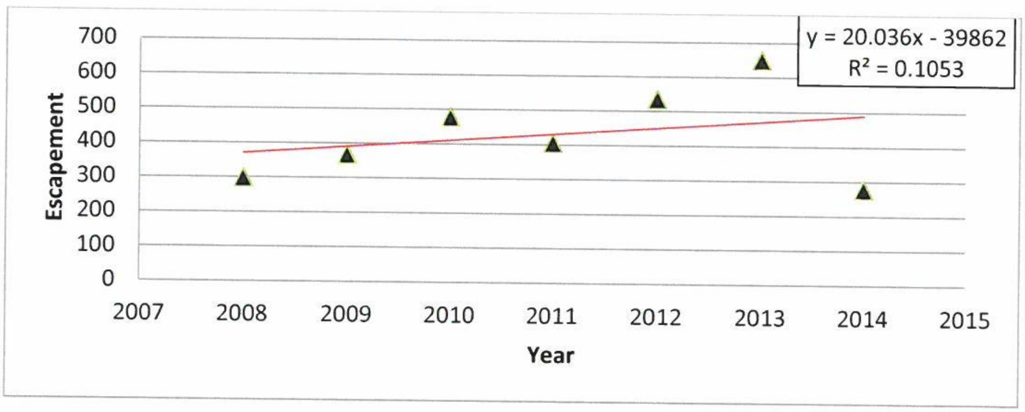

Figure 4-2. Chinook escapement estimates to the North Fork of the Skokomish River.

Looking deeper into the proportion of natural origin Chinook on the spawning grounds (PNOS) and the North Fork escapements estimates based on PNOS, even more positive trends begin to emerge. In 2008 and 2009, the percent of unmarked carcasses sampled on the North Fork spawning grounds was less than the percent of unmarked hatchery fish released from George Adams from corresponding brood years (based on hatchery clip rates and age composition of carcass samples, WDFW 2014). Notwithstanding the poor accuracy of escapement estimates, this information suggests a natural origin recruit (NOR) escapement estimate of zero in the North Fork for 2008 and 2009. The next three years, both PNOS and natural origin escapements increased each year. In 2014, natural origin escapement estimate was unable to be calculated due to the lack of carcass samples. Based on linear regression there is a statistically significant increase in the NOR Chinook escapement estimates of 56 fish per year (95% CI: 22-91, p=.01). A graph of NOR Chinook estimates from 2008-2013 is shown in Figure 4-3.

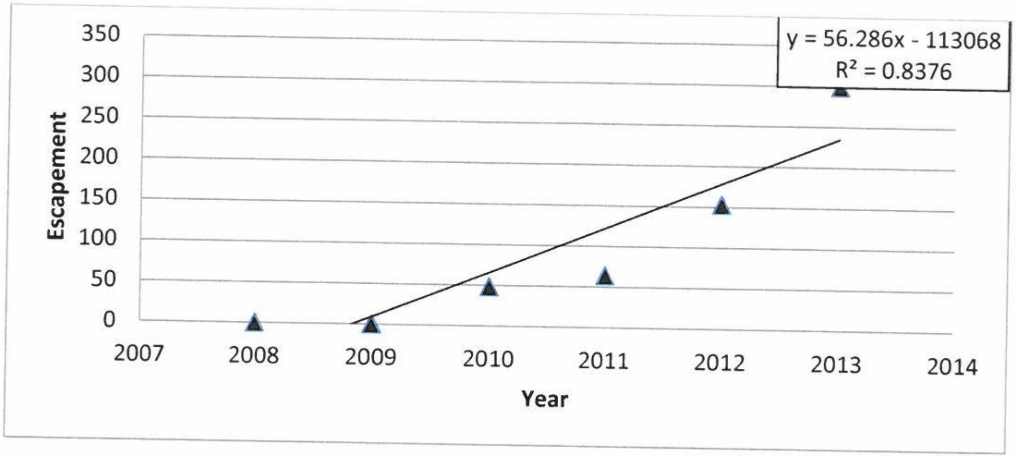

Figure 4-3. Escapement of natural origin Chinook to the North Fork Skokomish River.

Table 4-7. Estimates of escapement of naturally spawning Chinook to the Skokomish River.

	Total natural	NOR
2005	2032	433
2006	1209	492
2007	531	419
2008	1134	257
2009	1066	304
2010	1214	312
2011	1321	157
2012	1533	199
2013	1722	233
2014	849	290 ++

Methods for assessing forecast accuracy:

Skagit Coop staff provided their own analysis of forecast accuracy. For the other units we used the same method for assessing forecast accuracy that was used in the 2013 Management Assessment (PSIT and WDFW 2013). For Puyallup and Nisqually the pre-season 'forecast' of terminal abundance was that calculated in TAMM table 2A_CMk&Unmk (i.e. sum projected terminal area catch and escapement). For Skokomish, George Adams, and Hoodsport the pre-season terminal abundance was from the TAMM HdC sheet, Table 12E?, columns BM, BM, and BO. The post season estimates for all management units were extracted from the abundance input tables in the validation runs.