

Hood Canal Salmon Spawner Survey Project

*Point No Point Treaty Council
Port Gamble S'Klallam Tribe
2017 Tribal Mass Marking Project Report*



Photo credit: Emily Bishop; Emily Hiatt with a pile of dead Chum Salmon on Martha John Creek

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Introduction

The Port Gamble S’Klallam Tribe (PGST) has conducted surveys of spawning salmon in north Hood Canal streams since the early 1990s. Washington State and Tribal fishery co-managers use the data collected through these surveys to develop escapement estimates, assess sustainable yield, and evaluate the integrity of wild stocks. The purpose of the current project is to expand and standardize the data that has historically been collected by PGST. The objectives of the spawner survey project are to quantify escapement within standardized survey reaches, determine condition and origin of spawners, and assess the levels of hatchery Coho Salmon straying in wild systems. The following report details the methodology, results and success of the project for the 2017 Fall Coho and Chum Salmon season.

Methods

Project Implementation

This project was integrated into PGST’s existing sampling program and was a coordinated effort with Point No Point Treaty Council (PNPTC). Biologists from PGST, PNPTC, and Westward Ecology managed and conducted the spawner surveys, compiled and summarized the data, and prepared this report.

Spawner Surveys and Carcass Sampling



Photo Credit: Emily Bishop, Emily Hiatt
measuring a Coho Salmon carcass

Index surveys for Coho and Chum Salmon were conducted on eight Hood Canal streams (see Appendices A-E for stream locations). Our goal each season is to survey stream systems once every seven to ten days. This season, our sampling spanned from October 3rd, 2017 to January 12th, 2018. Pre-established survey reaches were used, including reaches which were formerly considered supplemental on Thorndyke Creek, Shine Creek, and Thomas Creek.

Stream surveys followed the methods for Carcass Counts (pp. 59-85) and Visual Foot-Based Surveys (pp. 435-442) outlined in *Salmonid Field Protocols Handbook* (Johnson et al. 2007). Survey reaches were walked in an upstream direction. Paths were established along stream banks, and effort was taken to minimize walking in streambeds.

Surveyors counted live salmon within the survey reach and identified species and sex, when possible. Carcasses in the stream or riparian zone were identified by species and sex.

Coho Salmon were checked for hatchery marking: coded

wire tags (CWTs) and adipose fin clips. CWTs were detected using the wand-in-mouth technique. Surveyors measured fork length in centimeters and collected tissue samples from Coho Salmon carcasses for DNA analysis per the WDFW DNA Sampling Protocol (2007). Tissue samples were taken from the operculum using forceps and surgical scissors. Tissue was preserved in 95% ethanol. GPS coordinates were recorded for each biological sample. Tails were removed from carcasses of all species to prevent recounting in future surveys.

Stream Flow and Water Quality

Stream flow, visibility, and percent seen (professional estimate of fish habitat visible to the surveyor within the survey reach) were estimated. When available, a YSI PROFESSIONAL SERIES PRO PLUS (YSI, Incorporated Yellow Springs, OH) instrument was used to measure water temperature, dissolved oxygen, conductivity, specific conductance, and salinity. Field data records were compiled, and data was entered into the PGST spawner survey database.

Fisheries Sampling

The PGST Fishery was sampled during the commercial Coho Salmon opening from August 13th, 2017 through October 28th, 2017. Area 9A (Port Gamble Bay, Appendix F) was sampled Monday through Friday at Point Julia. Area 12A (Quilcene Bay) was sampled at the Quilcene Marina. The sampling target was 20% of the PGST catch. Samplers recorded total catch and total adipose fin clips per landing. CWTs were detected using the wand-in-mouth technique. For tagged fish, fork length and sex were recorded. Scale samples were taken on Chum Salmon and Chinook Salmon to determine age class. Data were recorded on WDFW standard Commercial Fishery CWT Recovery Forms, which were sent along with tagged heads and scale cards to WDFW. Fishery sampling and fish ticket data were also recorded in the Tribal database.

PGST fishery sampling results were compared with data extracted from PGST's internal fisheries database and from TOCAS (Tribal Online Accounting System, <http://herring.nwifc.org:8888/pls/htmldb/f?p=101:101:1729213824057940>), with search setting including the "Biological Reports" and "TOCAS/LIFT" tab options. Search settings further included all tribes (including non-treaty code 99) and all gear types. Some discrepancies may at times exist between fish catch totals between PGST and TOCAS databases, with TOCAS data being used in our analysis for these instances.

Results

Spawner Surveys and Carcass Sampling

Overview

Spawner surveys began October 3rd, 2017 and concluded on January 12th, 2018. A total of 61 stream surveys were performed, covering 8 stream systems. On average, each stream was surveyed 6 times during the survey season. The average time between surveys was 14 days. Figure 1 shows the range in results observed over the past 7 survey seasons. No Atlantic Salmon were documented in our sampling (see Appendix G for a summary of the major 2017 Atlantic Salmon escapement event).

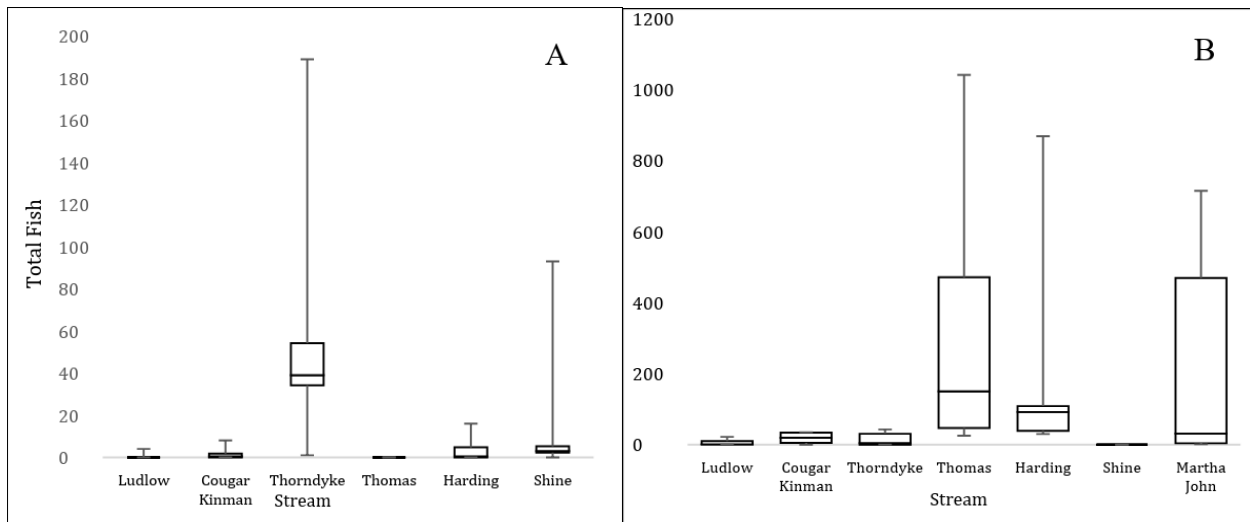


Figure 1. Box and whisker plots of total fish (live and dead) recorded on creeks during the 2012-2017 survey seasons for A) Coho Salmon and B) Chum Salmon. Martha John is excluded from A because those data are positively skewed by a high presence of hatchery Coho.

Coho Salmon

This year Coho Salmon were observed on Martha John, Harding, Shine, Middle and Thorndyke creeks (Table 1). No CWTs for Coho Salmon were recovered in any streams this season, and a total of 14 tissue samples were collected from carcasses. The first Coho Salmon observed was on Martha John Creek, on October 3rd, which is consistent with previous results (PGST spawner database). All intact Coho Salmon carcasses observed on Martha John between October 3rd and 23rd were marked. This is consistent with previous observations that Martha John has a higher incidence of hatchery origin Coho than the other streams surveyed (PGST spawner database).

Table 1. Summary of Coho Salmon data collected during spawner surveys this season by PGST and PNPTC, 2017.

| COHO SALMON | | | | | | | |
|--------------|---------------|------|------------|------|------------|---------------------|------------------|
| Stream Code | Stream Name | LIVE | LIVE JACKS | DEAD | DEAD JACKS | ADIPOSE FIN CLIPPED | DNA TISSUE TAKEN |
| 15.0353 | MARTHA JOHN | 0 | 0 | 9 | 0 | 5 | 0 |
| 15.0368 | COUGAR-KINMAN | 0 | 0 | 0 | 0 | 0 | 0 |
| 17.0192 | LUDLOW | 0 | 0 | 0 | 0 | 0 | 0 |
| 17.0181 | SHINE | 0 | 0 | 3 | 0 | 0 | 0 |
| 15.0417 | THOMAS | 0 | 0 | 0 | 0 | 0 | 0 |
| 15.0408 | HARDING | 5 | 0 | 1 | 0 | 1 | 1 |
| 17.0170 | THORNDYKE | 18 | 0 | 17 | 0 | 0 | 13 |
| 15.0352 | MIDDLE | 0 | 0 | 1 | 0 | 1 | 0 |
| TOTAL | | 23 | 0 | 31 | 0 | 7 | 14 |

The overall abundance of Coho this sampling season was low, with a dramatic decrease from the high number of observations in 2016 (Figure 2). Shine and Thorndyke Creeks are consistently the dominant streams for wild, unmarked, Coho. Martha John is located close to net pens in Port Gamble Bay and is subject to influxes of stray hatchery fish early in the survey season (Figure 3).

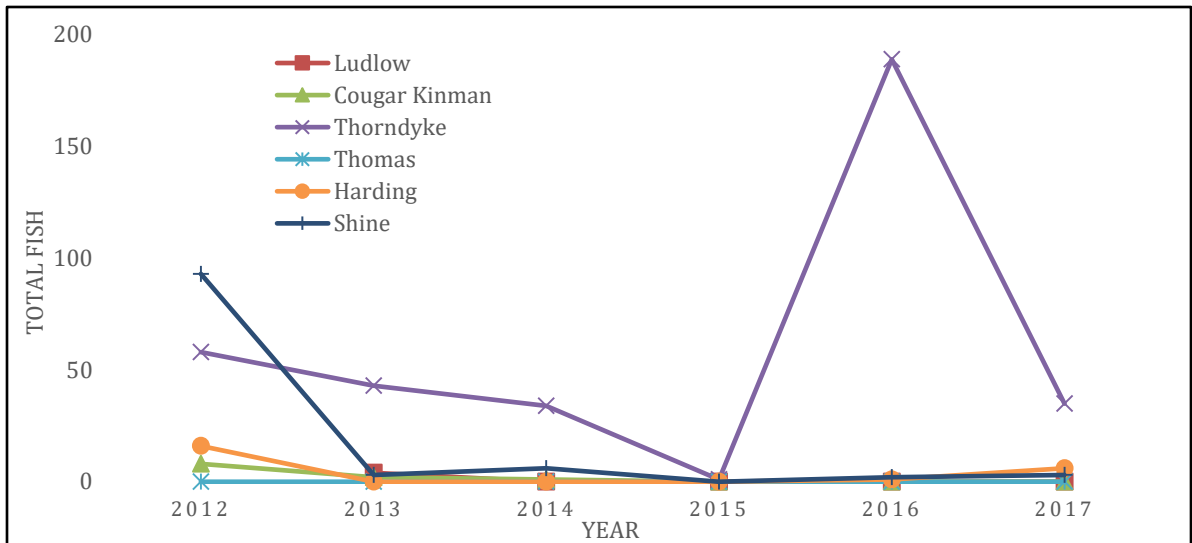


Figure 2. Total live and dead Coho Salmon counted during the past six survey seasons. Martha John is excluded because abundance on that stream appears to be positively skewed by presence of hatchery strays.

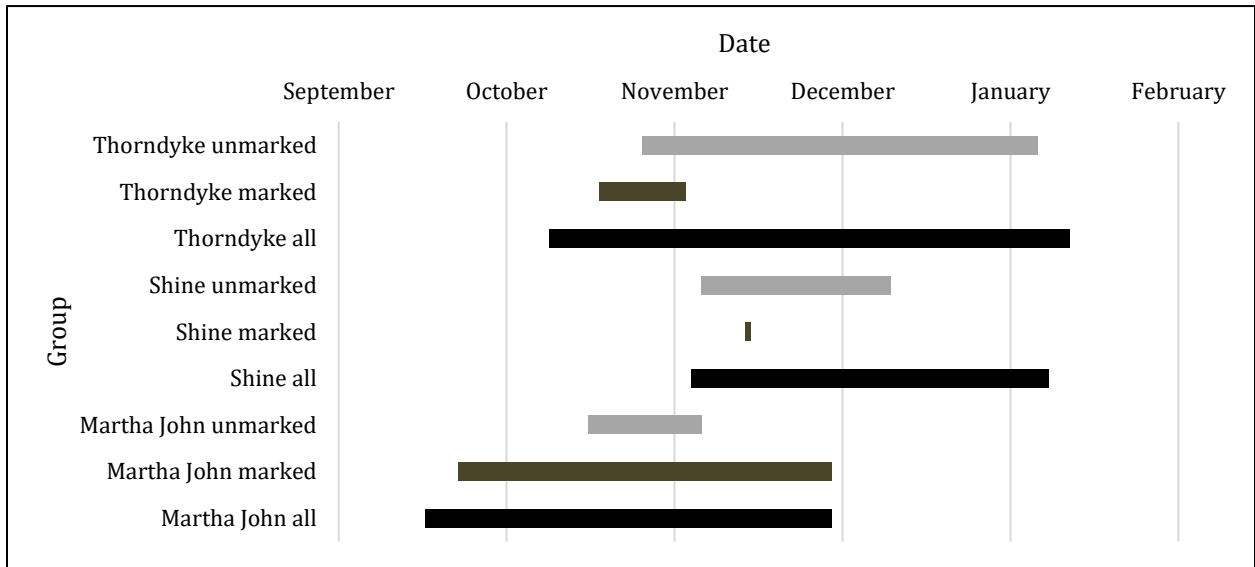


Figure 3. Combined dates of first and last Coho Salmon seen from 2012-2017 along Thorndyke, Shine, and Martha John creeks. For each creek, data is divided among all fish and fish definitively found to be either marked or unmarked. The category “all” includes fish where marking could not be detected due to deterioration or other factors. Only a single marked fish was observed on Shine Creek during these last five years.

Chinook Salmon

No Chinook Salmon were observed this season. This is consistent with previous years’ data.

Fall Chum Salmon

A total of 1,028 carcasses and live Chum Salmon were observed this season, the majority along Martha John, Thomas and Harding creeks (Table 2). Chum Salmon were also observed on Middle and Thorndyke creeks. First and last sightings of Chum Salmon this season were November 9th, 2017 and December 21th, 2017.

Table 2. Summary of Chum Salmon data collected during spawner surveys by PGST and PNPTC, 2017-18.

| CHUM SALMON | | | |
|--------------|---------------|------------|------------|
| Stream Code | Stream Name | LIVE | DEAD |
| 15.0353 | MARTHA JOHN | 401 | 314 |
| 15.0368 | COUGAR-KINMAN | 0 | 0 |
| 17.0192 | LUDLOW | 0 | 0 |
| 17.0181 | SHINE | 0 | 0 |
| 15.0417 | THOMAS | 56 | 90 |
| 15.0408 | HARDING | 35 | 50 |
| 17.0170 | THORNDYKE | 3 | 8 |
| 15.0352 | MIDDLE | 20 | 19 |
| TOTAL | | 547 | 481 |

Not all of the survey reaches are designed to target Chum Salmon, which spawn in the lower stretches of streams, and therefore results may underrepresent actual abundance. Over the past 5 years, Thomas and Harding creeks have had the highest number of observed Chum, peaking in 2016 (Figure 4).

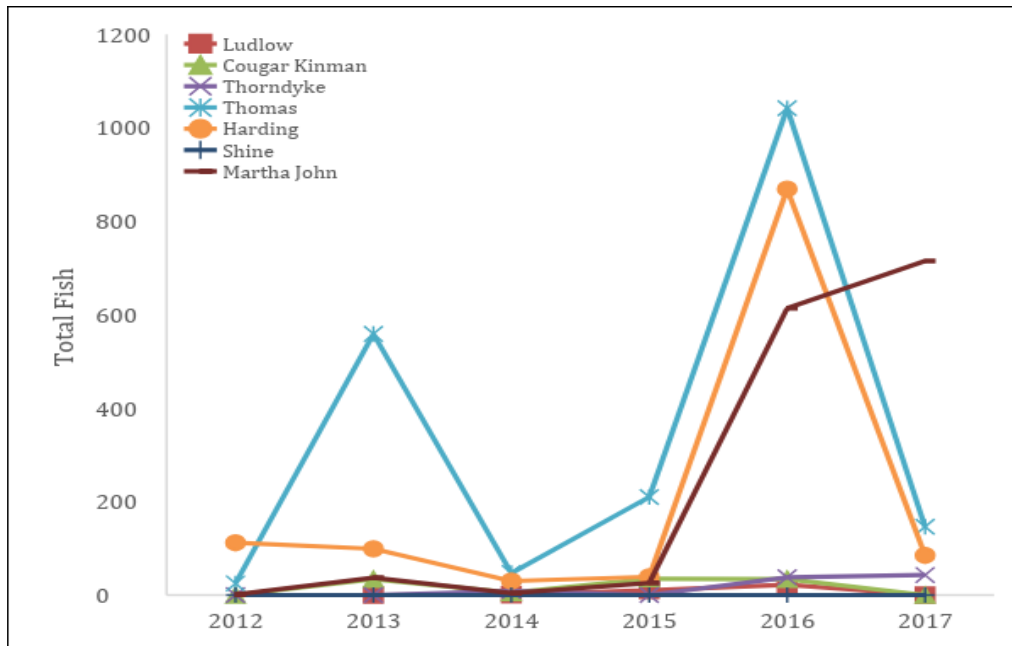


Figure 4. Total live and dead fish counted during the past six survey seasons for Chum Salmon

Pink Salmon

A total of two Pink Salmon were observed on Thorndyke and Ludlow creeks this season (Table 3). The sightings of Pink Salmon this season occurred on October 5th and November 2nd, 2017.

Table 3. Summary of Pink Salmon data collected during spawner surveys by PGST and PNPTC, 2017-18.

| PINK SALMON | | | |
|--------------|---------------|------|------|
| Stream Code | Stream Name | LIVE | DEAD |
| 15.0353 | MARTHA JOHN | 0 | 0 |
| 15.0368 | COUGAR-KINMAN | 0 | 0 |
| 17.0192 | LUDLOW | 0 | 1 |
| 17.0181 | SHINE | 0 | 0 |
| 15.0417 | THOMAS | 0 | 0 |
| 15.0408 | HARDING | 0 | 0 |
| 17.0170 | THORNDYKE | 0 | 1 |
| 15.0352 | MIDDLE | 0 | 0 |
| TOTAL | | 0 | 2 |

Unknown Salmon

Unknown Salmon is a classification used to refer to salmon observed on the index surveys which we were unable to definitively identify by species. This is usually a result of a live fish moving too quickly to positively ID, or a carcass being too advanced in decomposition. A total of 11 Unknown Salmon were observed this season (Table 4).

Table 4. Summary of Unknown Salmon data collected during spawner surveys by PGST and PNPTC, 2017-18.

| UNKNOWN SALMON | | | |
|----------------|---------------|------|------|
| Stream Code | Stream Name | LIVE | DEAD |
| 15.0353 | MARTHA JOHN | 1 | 0 |
| 15.0368 | COUGAR-KINMAN | 0 | 0 |
| 17.0192 | LUDLOW | 0 | 1 |
| 17.0181 | SHINE | 0 | 0 |
| 15.0417 | THOMAS | 0 | 0 |
| 15.0408 | HARDING | 0 | 1 |
| 17.0170 | THORNDYKE | 6 | 1 |
| 15.0352 | MIDDLE | 1 | 0 |
| TOTAL | | 8 | 3 |

Fisheries Sampling

Coho Salmon

The tribal commercial Coho Salmon fishery was sampled during the openings in Port Gamble Bay (Area 9A), Quilcene-Dabob Bay (Area 12A), and Big Quilcene River (Area 82F). In Area 9A, the Coho Salmon tribal fishery was open from August 13th through October 28th, 2017. In Area 12A, the tribal fishery was open from August 21st through October 14th, 2017. And in Area 82F, the fishery was open from September 1st through October 15th, 2017. A Chum Salmon fishery located in a subsection of Area 9 was open to PGST fishermen for the first time this year, from October 22nd through November 4th, 2017.

Area 9A

In Port Gamble Bay (Area 9A), the combined state and tribal fisheries yielded 7,107 Coho Salmon with an average weight per fish of 5.68 pounds (Table 5). PGST fishermen caught a total

of 4,688 Coho Salmon, 66% of the total harvest. PGST fishermen caught an average 19.33 fish per landing¹, and received an average \$2.24 per pound for their Coho Salmon. A total of 837 Coho Salmon were sampled by PGST, 18% of the total PGST catch. 89% of the sampled fish were marked, and a total of 91 CWTs were recovered.

Table 5. Area 9A commercial Coho Salmon fishery sampling results. Management period for Coho Salmon in Area 9A began on August 13th, 2017 (week 33) and ended on October 28th, 2017 (week 43). Total catch numbers were pulled from TOCAS and include both tribal and non-treaty caught fish. Total PGST catch numbers were retrieved from TOCAS. % marked includes adipose fin clipped fish with and without CWTs and unclipped fish with CWTs.

| TRIBAL COMMERCIAL FISHING RESULTS IN AREA 9A - COHO | | | | | | | | | | |
|---|-----------|-------------|--------------|------------------|---------------|----------------------------|-----------------------------|-------------|----------------------|------------|
| DATE | MGMT WEEK | TOTAL CATCH | TOTAL LBS | TOTAL PGST CATCH | CATCH SAMPLED | % TOTAL PGST CATCH SAMPLED | ADIPOSE FIN CLIPPED SAMPLES | CWT SAMPLES | UNMARKED CWT SAMPLES | % MARKED |
| 13-Aug | 33 | 421 | 1727 | 421 | 166 | 39% | 162 | 26 | 3 | 99% |
| 20-Aug | 34 | 1278 | 7479 | 915 | 226 | 25% | 214 | 28 | 4 | 96% |
| 27-Aug | 35 | 1051 | 6245 | 628 | 0 | 0% | 0 | 0 | 0 | 0% |
| 3-Sep | 36 | 1636 | 9714 | 1067 | 128 | 12% | 121 | 9 | 1 | 95% |
| 10-Sep | 37 | 1279 | 7896 | 1031 | 190 | 18% | 157 | 21 | 5 | 85% |
| 17-Sep | 38 | 508 | 2880 | 337 | 0 | 0% | 0 | 0 | 0 | - |
| 24-Sep | 39 | 408 | 2375 | 289 | 127 | 44% | 75 | 7 | 1 | 60% |
| 1-Oct | 40 | 306 | 1646 | 0 | 0 | - | 0 | 0 | 0 | - |
| 8-Oct | 41 | 144 | 848 | 0 | 0 | - | 0 | 0 | 0 | - |
| 15-Oct | 42 | 57 | 330 | 0 | 0 | - | 0 | 0 | 0 | - |
| 22-Oct | 43 | 15 | 85 | 0 | 0 | - | 0 | 0 | 0 | - |
| 29-Oct | 44 | 2 | 15 | 0 | 0 | - | 0 | 0 | 0 | - |
| 5-Nov | 45 | 2 | 11 | 0 | 0 | - | 0 | 0 | 0 | - |
| Totals | | 7107 | 41251 | 4688 | 837 | 18% | 729 | 91 | 14 | 89% |

| COMMERCIAL TRIBAL FISHING RESULTS IN AREA 9A-COHO | |
|---|------------------------|
| Avg. Pounds | 110.98 lbs per landing |
| Avg. Weight | 5.68 lbs per fish |
| Avg. Landing | 19.33 fish per landing |
| Avg. Price | \$2.24 per lb |

Area 12A

In Quilcene-Dabob Bay (Area 12A), the combined state and tribal fisheries in Area 12A yielded 7,454 Coho Salmon. Tribal fishermen landed an average 79 fish per landing with an average weight per fish of 6.20 pounds per fish (Table 6). PGST fisherman harvested 785 Coho Salmon, 10% of the total harvest. PGST fishermen received an average price of \$1.91 per pound for their Coho Salmon. A total of 456 Coho Salmon were sampled by PGST, which is 58% of the total PGST catch. 93% of the sampled fish were marked and a total of 124 CWTs were recovered.

¹ Northwest Indian Fisheries Commission's Tribal Online Accounting System (TOCAS)

Table 6. Area 12A commercial Coho Salmon fishery sampling results. Management period for Coho Salmon in Area 12A began on August 21st, 2017 (week 34) and ended on October 14th, 2017 (week 41). Total catch numbers were pulled from TOCAS and include both tribal and non-treaty caught fish. Total PGST catch numbers were retrieved from PGST's internal database. % marked includes clipped fish with and without CWTs and unclipped fish with CWTs.

| STATE AND TRIBAL COMMERCIAL FISHING RESULTS IN AREA 12A - COHO | | | | | | | | | | |
|--|-----------|-------------|--------------|------------------|---------------|----------------------------|-----------------------------|-------------|----------------------|------------|
| DATE | MGMT WEEK | TOTAL CATCH | TOTAL LBS | TOTAL PGST CATCH | CATCH SAMPLED | % TOTAL PGST CATCH SAMPLED | ADIPOSE FIN CLIPPED SAMPLES | CWT SAMPLES | UNMARKED CWT SAMPLES | % MARK |
| 20-Aug | 34 | 669 | 2887 | 292 | 283 | 97% | 222 | 88 | 32 | 90% |
| 27-Aug | 35 | 1759 | 10426 | 0 | 0 | 0% | 0 | 0 | 0 | 0 |
| 3-Sep | 36 | 4153 | 21726 | 413 | 173 | 42% | 148 | 36 | 20 | 97% |
| 10-Sep | 37 | 775 | 4336 | 0 | 0 | - | 0 | 0 | 0 | 0 |
| 17-Sep | 38 | 23 | 208 | 23 | 0 | 0% | 0 | 0 | 0 | 0 |
| 24-Sep | 39 | 18 | 156 | 0 | 0 | - | 0 | 0 | 0 | 0 |
| 1-Oct | 40 | 57 | 397 | 57 | 54 | 95% | 34 | 4 | 2 | 67% |
| Totals | | 7454 | 40136 | 785 | 456 | 58% | 370 | 124 | 52 | 93% |

| COMMERCIAL TRIBAL FISHING RESULTS IN AREA 12A-COHO | |
|--|------------------------|
| Avg. Pounds | 440.79 lbs per landing |
| Avg. Weight | 6.20 lbs per fish |
| Avg. Landings | 79.35 fish per landing |
| Avg. Price | \$1.91 per lb |

Area 82F

In the Big Quilcene River at Rodgers Street (Area 82F), the combined state and tribal fisheries in 82F yielded 9,429 Coho Salmon. Tribal fishermen caught on average 28 fish per landing (Table 7). PGST fisherman harvested 6,624 of the total 9,429 Coho Salmon (70%). A total of 634 Coho Salmon were sampled by PGST, which is 10% of the total PGST catch. 99% of the sampled fish were marked and a total of 234 CWTs were recovered (Table 7).

Table 7. Area 82F commercial Coho Salmon fishery sampling results. Management period for Coho Salmon in Area 82F began on September 1st, 2017 (week 35) and ended on October 15th, 2017 (week 42). Total catch numbers were pulled from TOCAS and include both tribal and non-treaty caught fish. Total PGST catch numbers were taken from TOCAS. Sampling data were retrieved from the PGST internal database.

| STATE AND TRIBAL COMMERCIAL FISHING RESULTS IN AREA 82F - COHO | | | | | | | | | | |
|--|-----------|-------------|--------------|------------------|---------------|----------------------------|-----------------------------|-------------|----------------------|------------|
| DATE | MGMT WEEK | TOTAL CATCH | TOTAL LBS | TOTAL PGST CATCH | CATCH SAMPLED | % TOTAL PGST CATCH SAMPLED | ADIPOSE FIN CLIPPED SAMPLES | CWT SAMPLES | UNMARKED CWT SAMPLES | % MARKED |
| 3-Sep | 36 | 667 | 3129 | 413 | 0 | 0% | 0 | 0 | 0 | - |
| 10-Sep | 37 | 7731 | 39448 | 6023 | 634 | 8% | 569 | 170 | 64 | 99% |
| 17-Sep | 38 | 644 | 3811 | 168 | 0 | 0% | 0 | 0 | 0 | - |
| 24-Sep | 39 | 129 | 648 | 20 | 0 | 0% | 0 | 0 | 0 | - |
| 1-Oct | 40 | 205 | 1244 | 0 | 0 | 0% | 0 | 0 | 0 | - |
| 8-Oct | 41 | 53 | 309 | 0 | 0 | 0% | 0 | 0 | 0 | - |
| Totals | | 9429 | 48589 | 6624 | 634 | 10% | 569 | 170 | 64 | 99% |

| COMMERICAL TRIBAL FISHING RESULTS IN AREA 82F-COHO | |
|--|------------------------|
| Avg. Pounds | 197.6 lbs. per landing |
| Avg. Landings | 28.4 fish per landing |
| Avg. Weight | 6.96 lbs. per fish |
| Avg. Price | \$1.44 per lb. |

Chinook Salmon

Area 9A

PGST fishermen caught a total of 251 Chinook Salmon during the Coho Salmon opening in Area 9A (Table 8). A total of 32 Chinook Salmon were sampled by PGST, which is 8% of the total PGST catch. 84% of the sampled fish were marked and a total of 10 CWTs were recovered (Table 8).

Table 8. Area 9A Chinook Salmon caught during the commercial Coho Salmon opening. Management period for Coho Salmon in Area 9A began on August 13th, 2017 (week 34) and ended on October 28th, 2017 (week 44). Total catch numbers were pulled from TOCAS and include both tribal and non-treaty caught fish. Total PGST catch numbers were retrieved from PGST's internal database.

| PGST COMMERCIAL FISHING RESULTS IN AREA 9A - CHINOOK | | | | | | | | | |
|--|-----------|------------------|-------------|---------------|----------------------------|-----------------------------|-------------|--------------|------------|
| DATE | MGMT WEEK | TOTAL PGST CATCH | TOTAL LBS | CATCH SAMPLED | % TOTAL PGST CATCH SAMPLED | ADIPOSE FIN CLIPPED SAMPLES | CWT SAMPLES | UNMARKED CWT | % MARKED |
| 13-Aug | 33 | 112 | 998 | 13 | 12% | 11 | 2 | 1 | 92% |
| 20-Aug | 34 | 52 | 482 | 16 | 31% | 11 | 7 | 2 | 81% |
| 27-Aug | 35 | 45 | 414 | 0 | 0% | 0 | 0 | 0 | - |
| 3-Sep | 36 | 24 | 213 | 3 | 13% | 3 | 1 | 0 | 100% |
| 10-Sep | 37 | 14 | 140 | 0 | 0% | 0 | 0 | 0 | - |
| 17-Sep | 38 | 2 | 16 | 0 | 0% | 0 | 0 | 0 | - |
| 24-Sep | 39 | 2 | 22 | 0 | 0% | 0 | 0 | 0 | - |
| Totals | | 251 | 2285 | 32 | 8% | 25 | 10 | 3 | 88% |

| COMMERCIAL TRIBAL FISHING RESULTS IN AREA 9A-CHINOOK | |
|--|-----------------------|
| Avg. Pounds | 28.6 lbs per landing |
| Avg. Weight | 9.10 lbs per fish |
| Avg. Landing | 3.14 fish per landing |
| Avg. Price | \$2.57 per lb |

Hood Canal Summer Chum Salmon:

Chum Salmon were landed during the Coho Salmon fishery in management areas 9A, 12, 12A, and 12B (Table 9). October 1st is considered the transition between summer and fall run Chum Salmon population, which are distinct. Summer-run Chum Salmon are listed as threatened under the endangered species act (ESA) by the federal government. The commercial fishery harvested 228

Chum Salmon in area 9A, 62 Chum Salmon in area 12, and 3,598 Chum Salmon in area 12A prior to October 1st (Table 9).

Table 9. Number of Chum Salmon caught prior to the Chum Salmon fishery in areas 9A, 12, 12A, and 12B, during the Coho Salmon openings from August 13th, 2017 (week 33) to October 15th, 2017 (week 42). Chum Salmon caught before October 1st, 2017 (week 40) are presumed to be summer-run Chum Salmon. Total catch numbers were pulled from TOCAS and include both tribal and non-treaty caught fish.

| | 9A CATCH | 12 CATCH | 12A CATCH | 12B CATCH |
|-----------------------------|----------|----------|-----------|-----------|
| Presumed Summer Chum | 288 | 62 | 3529 | 0 |
| Presumed Fall Chum | 157 | 1095 | 69 | 2365 |
| Total | 445 | 1157 | 3598 | 2365 |

Discussion

Spawner Surveys and Carcass Sampling

Ideally, spawner surveys provide a reasonable approximation of trends in fish abundances. Increased survey effort will not necessarily result in better data due to difficulties of individually marking live organisms. We design our surveys in order to limit the potential of counting the same fish twice. This means observing a given creek approximately once every 10 days. Weather conditions can increase the turbidity of the water and scavengers can remove traces of entire fish from the creeks, both decreasing the numbers of fish that surveyors observe. Rainfall can change the pattern of freshwater entrance which can lead to a patchy distribution of fish in the creeks over time.

Many of the streams we surveyed have, at minimum, a partial fish barrier. During low flow periods some of these barriers impede upstream migration and contribute to lower spawning success. Surveyors have observed bottlenecks of salmon under the heavily sedimented Thomas Creek culvert, and although there were fish above the culvert, it was clearly exhausting spawners able to make it through. Other barriers are not passable, even with increased flows. A culvert on Middle Creek is undersized and perched above the stream bed blocking fish passage to the upper reaches of this fish-bearing stream. This barrier is located very close to the mouth of the creek, and numerous live and dead Chum Salmon were observed in the short stream length below the culvert.

On Harding Creek, beaver dam complexes may be a partial fish passage barrier to the upper reaches of the creek, as fish were not observed above these complexes. It is also notable that a partial fish barrier culvert at the end of our survey reach was removed this year.

Available spawning habitat is abundant on Shine and Thorndyke Creeks. Connectivity in these systems is generally good, with the exception of under sized culverts on Thorndyke Creek at Thorndyke Rd. and on Shine Creek at SR 104 which act as complete-partial fish barriers depending on the flow regime. Despite the relatively good connectivity to spawning habitats in these streams, we continue to see very low returns. We are concerned that a large number of wild Coho Salmon do not return to Shine and Thorndyke Creeks because they are indirectly targeted in the fall Chum Salmon fishery.

Historical data for the north Hood Canal indicates that Coho Salmon spawn from October to early January, with the exception of Gamble Creek and Martha John Creek, where spawning often begins in September (PGST spawner database). Fall Chum Salmon in the same region generally spawn from November to mid-December (PGST spawner database). Reported run size varies greatly between years for both Coho and Chum Salmon in most streams, and each year the timing of fish entering streams correlates with high flow events.

Management zone 12 includes the marine waters adjacent to Shine and Thorndyke Creeks. In zone 12, the fall Chum Salmon opening occurs directly after the Coho Salmon opening ends, which fall on a given year around the 9th of October. By this time, the majority of hatchery-origin Coho Salmon have returned to the Big Quilcene National Fish Hatchery (Figure 5, Smith et al. 2014). Our data suggests the majority of North Hood Canal unmarked Coho Salmon return after October 15th (Figure 3). Genetic evidence also supports the existence of a unique

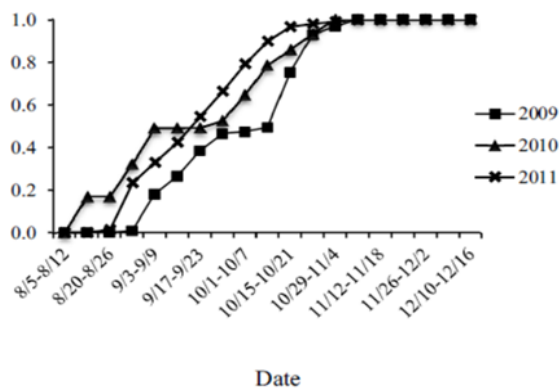


Figure 5. From Smith et al. 2014. One generation of Quilcene NFH produced Coho Salmon, showing three different broodlines. The y-axis represents the percentage of coho returned to the hatchery.

population of wild Coho Salmon in North Hood Canal (Smith et al. 2007). Smith and colleagues analyzed data for 11 microsatellites covering 7 streams and 4 hatcheries in and around Hood Canal. Their results showed that while the Quilcene NFH Coho Salmon grouped with Hood Canal, they were unequivocally unique from the natural origin fish inhabiting Stavis, Tarboo, Thorndyke, Seabeck and Little Anderson creeks, as well as Little Quilcene River. Through pairwise F_{ST} and heterogeneity tests, and by assignment tests, population structure was clearly demonstrated among the 7 Hood Canal wild Coho Salmon stream systems (Smith et al. 2007). A similar analysis investigating the uniqueness of Shine creek Coho Salmon would be of great value.

By artificially selecting early-returning Coho Salmon for spawning, the hatchery in Quilcene created broodlines which differed from surrounding natural populations. On the one hand, this result has allowed for a Coho Salmon fishery opening which predominately targets hatchery produced Coho Salmon. Unfortunately, the later returning wild Coho Salmon are subject to great fishing pressure from the fall Chum Salmon fishery, which may often go unnoticed by managers. Wild Coho Salmon returning to Shine and Thorndyke Creek must navigate fall Chum Salmon commercial fisheries in management zone 12, which from 2013-2017 landed more Coho Salmon than the Coho Salmon opener did (Table 10; Figure 6). Fall Chum Salmon purse seiners have accounted for the majority of Coho Salmon bycatch in management zone 12 (Figure 7B). The impact of the purse seiners in zone 12 is clearly visible when compared to the Coho Salmon bycatch in the neighboring zone 12B, which is impacted by set nets (Figure 7A). This fishing pressure in all likelihood is affecting the escapement numbers on Shine and Thorndyke Creeks and should be addressed by managers.

Table 10. Five year (2013-2017) Coho landings in salmon management area 12. From TOCAS (Tribal Online Accounting System) data.

| Total Coho Landings (lbs) | | | | |
|---------------------------|------|------------------------|-----------------------|--------------------------------|
| Year | Area | Before Fishery Closure | After Fishery Closure | % Caught after fishery closure |
| 2013 | 12 | 28,039 | 78,727 | 73.74% |
| 2014 | 12 | 4,842 | 35,421 | 87.97% |
| 2015 | 12 | 0 | 18,000 | 100% |
| 2016 | 12 | 2,587 | 19,647 | 88.36% |
| 2017 | 12 | 5,675 | 25,075 | 77.37% |
| 2017 | 9 | 0 | 2,938 | 100% |

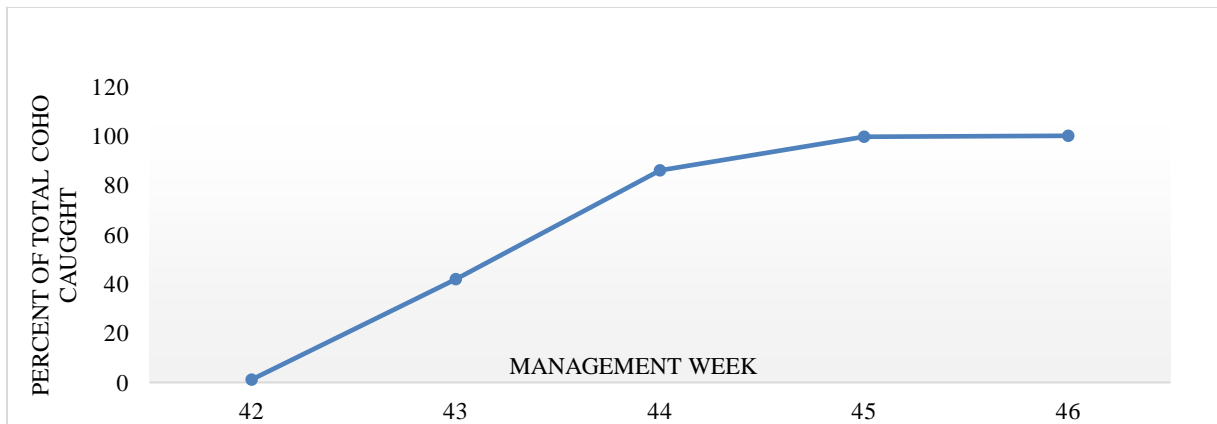
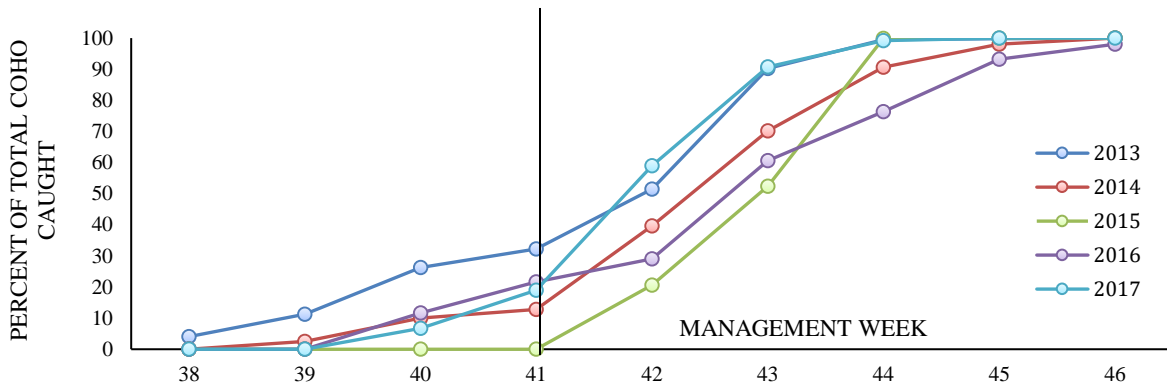


Figure 6. Cumulative catch total for Coho in management zone 12 from 2013-2017. The beginning of management week 41 is marked with the vertical line, and represents the end of the Coho opener for 2013-2016. Fish caught to the right of this line were taken as bycatch during the Chum Salmon opener during 2013-2016. *Fish caught to the right of week 42 were caught as bycatch in 2017.

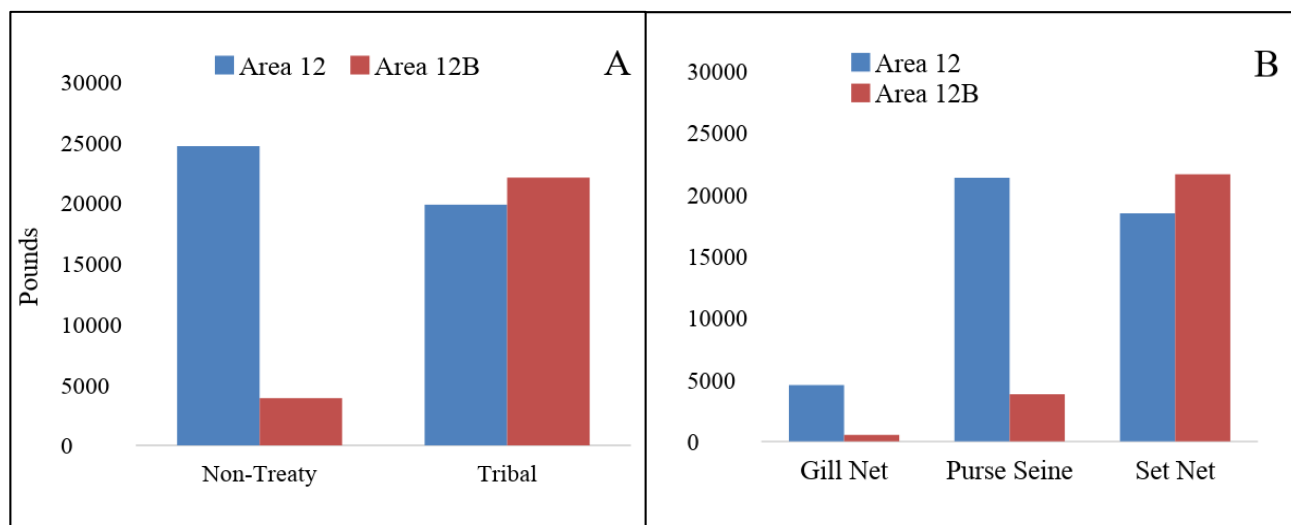


Figure 7. Average annual number of pounds of Coho landed from 2011 to 2017 during the Chum Salmon fisheries in areas 12 – Upper Hood Canal and 12B – Central Hood Canal. For each management zone, the catch is described by the fishery type (A) and the gear type (B).

Fisheries Sampling

Fish ticket data provides an estimate of fishing effort and catch per unit effort; however other factors such as market demand and price per pound also influence this data.

Area 9A

The 2017 tribal commercial catch of Coho Salmon in area 9A was lower than 2016, which was much more abundant than the previous 15 recorded years (Table 11). This year, an average of 53 Coho Salmon were caught per tribal fish ticket in area 9A. Average fishing effort based on the number of landings was lower than last year, and below the mean of the last 15 years of data (Table 11).

Marked fish made up 89% of the total sampled Coho Salmon catch in Port Gamble Bay (Table 5). This is consistent with results from previous years. The temporal breakdown of hatchery to wild fish caught during the 9A opening was also consistent with prior years' data. The percentage of unmarked fish increased toward the end of the opening. Continued sampling past management week 39 would have helped to illustrate this trend more clearly. We sampled 18% of PGST's Coho Salmon landed during the Coho fishery in Area 9A, which is lower than the target 20%.

Table 11. Comparison of fish ticket data for Coho Salmon caught in area 9A. *Data derived from TOCAS.

| YEAR | AVG. FISH PER LANDING | AVG. LBS PER LANDING | AVG. LB PER FISH | # OF LANDINGS | # OF FISH | # OF LBS |
|----------------|-----------------------|----------------------|------------------|---------------|-----------|----------|
| MEAN 2003-2007 | 29 | 211 | 7.3 | 195 | 6,119 | 41,145 |
| 2008 | 15 | 117 | 7.8 | 224 | 3,360 | 26,208 |
| 2009 | 40 | 273 | 6.8 | 192 | 7,680 | 52,416 |
| 2010 | 23 | 171.6 | 7.5 | 191 | 4,394 | 32,776 |

| | | | | | | |
|-------|-------|--------|------|-----|--------|---------|
| 2011 | 33.5 | 210 | 6.3 | 337 | 11,297 | 70,770 |
| 2012 | 29 | 181 | 6.3 | 370 | 10,677 | 66,892 |
| 2013 | 21.7 | 119.8 | 5.5 | 304 | 6,586 | 36,409 |
| 2014 | 22.4 | 135.7 | 6 | 170 | 3,814 | 23,068 |
| 2015 | 17 | 82.7 | 5.2 | 18 | 284 | 1,489 |
| 2016* | 53 | 375.6 | 7.13 | 365 | 21,626 | 156,100 |
| 2017* | 19.33 | 110.98 | 5.68 | 225 | 4,788 | 27,877 |

Area 12A

Marked fish made up 93% of the total sampled Coho Salmon in Area 12A (Table 6). 58% of the total PGST catch were sampled, which exceeds our target zone of 20% (Table 6). The percentage of unmarked Coho Salmon increased towards the end of the opening.

Area 82F

Sampling in area 82F only occurred during one week of the six-week opening. In total, only 10% of the total PGST catch were sampled, falling short of the 20% target (Table 7). Of the fish sampled, 99% were marked (Table 7). Landings in this area are more difficult to identify than in areas 9A and 12A, which could have led to the low sampling effort results. Increased sampling in this area could provide data on the temporal trend of marked and unmarked Coho during the opening.

Hood Canal Summer-Run Salmon

Summer-run Chum Salmon are federally protected but face fishing pressure in management area 12A from the Coho Salmon fishery. The Coho fishery is dynamically regulated, and high numbers of summer-run Chum Salmon bycatch can lead to the suspension of the Coho Salmon fishery. 3,598 Summer Chum Salmon were landed this year in area 12A (Table 9). The average value of the Coho Salmon fishery for the past five years in management zone 12A was approximately \$54,000 (Figure 11). In 2014, the Coho Salmon fishery in 12A was valued at just \$7,872, due to the suspension caused by the large number of summer-run Chum Salmon caught. The effort put into summer-run Chum Salmon restoration and the relatively small value of the Coho Salmon fishery in 12A calls into question the practice of managing a Coho Salmon fishery in this management zone. An alternative, such as releasing more juvenile Quilcene Hatchery Coho Salmon from new locations, may help to preserve the treaty right of access to Coho Salmon by providing tribal fishermen with more fish in areas without the conflicting presence of federally listed summer-run Chum Salmon.

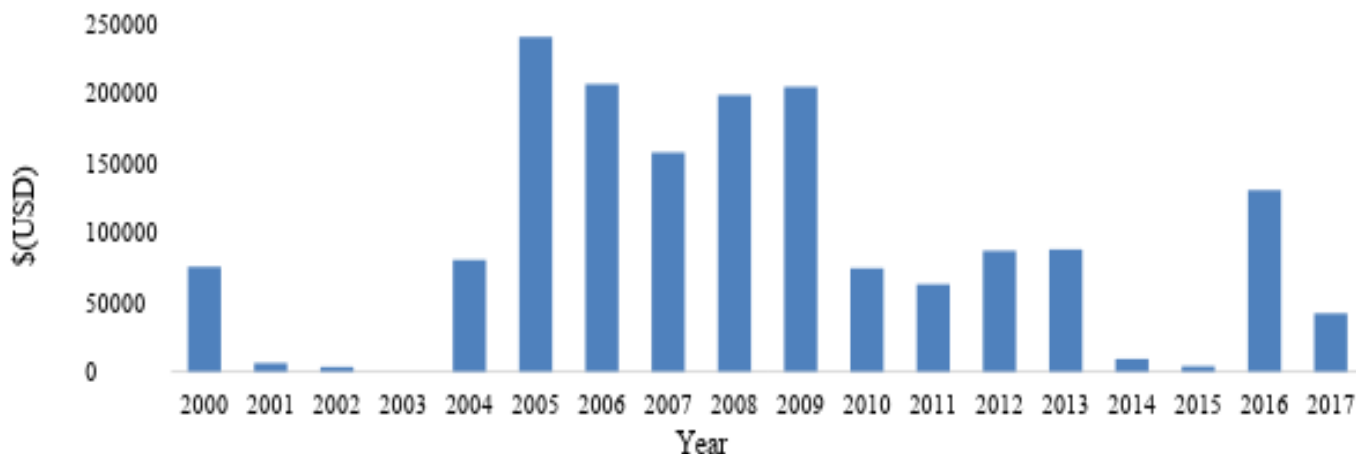


Figure 11. Annual value of Coho Salmon landed in management zone 12A from 2000-2017. Average market price of \$1.50/lb was used to convert pounds to USD for each of the past 18 years

Management Area 9

2017 was the first year that the Port Gamble S’Klallam Tribal Fishery extended to include a portion of management area 9 (Figure 10). The fishery opening was limited to waters North of the Hood Canal Bridge and South of the line running from White Rock in Port Ludlow to landfall on the Kitsap Peninsula (Figure 10).

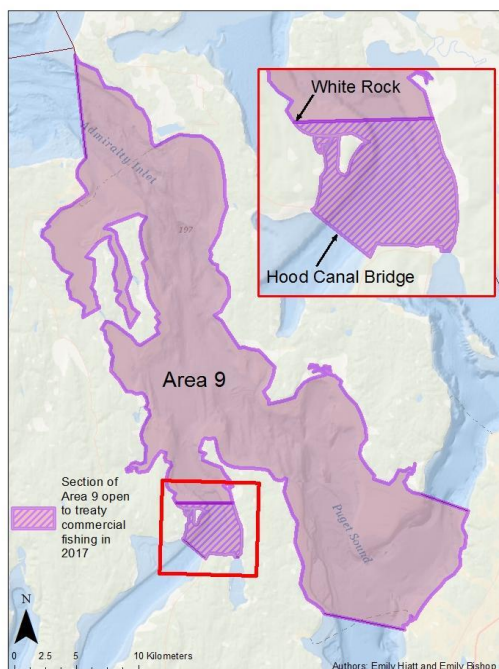


Figure 10. Map of Management Area 9. The area open in 2017 is represented by the striped section.

fisheries, so it is unknown whether these were marked or unmarked individuals.

In 2017, Skokomish, Suquamish, Lower Elwha Klallam and Port Gamble S’Klallam tribal commercial fisheries had landings in this management zone. The tribal fishery was opened for a total of 14 days between October 22nd and November 4th, 2017.

Though there was no tribal or co-manager agreement for the Chum fishery in Area 9, the Suquamish Tribe proposed that a threshold of 30,000 Chum salmon caught before November 5th would result in a conference call among participating tribes to discuss management actions (2017 Final Co-Manager List of Agreed Fisheries). This threshold was not met so no actions were taken at that time (Table 12).

As seen in the TOCAS data, a total of 2,938 Coho Salmon were caught as bycatch during the Chum opener in management weeks 43 and 44 (Table 12). There is limited data on Coho sampling by PGST

Table 12. Area 9 Coho Salmon caught during the commercial Chum Salmon opening. Management period for Chum Salmon in Area 9 began on October 22nd, 2017 (week 43) and ended on November 4th, 2017 (week 44). Total catch numbers were pulled from TOCAS.

| COMMERCIAL TRIBAL FISHING RESULTS IN AREA 9-COHO | | | | | |
|--|---------------------|--------------|---------------|-----------|---------------|
| Mgmt Week | Tribe | Units | Pounds | Landings | Avg Price |
| 43 | Port Gamble Klallam | 2312 | 21670 | 14 | 1 |
| 44 | Port Gamble Klallam | 32 | 288 | 1 | 1 |
| 44 | Suquamish | 594 | 5441 | 7 | 1.65 |
| Totals | | 2,938 | 27,399 | 22 | \$1.22 |

| COMMERCIAL TRIBAL FISHING RESULTS IN AREA 9-COHO | |
|--|----------------------|
| Avg. Pounds | 57.5 lbs per landing |
| Avg. Weight | 6.76 lb per fish |
| Avg. Landing | 8.8 fish per landing |
| Avg. Price | \$2.07 per lb |

Area 9 is a mixed stock fishery for all Salmon returning to Hood Canal. Sampling in this zone could inform fishery managers of the specific Coho populations being targeted during Chum Salmon openings.

Conclusion and Recommendations

Spawner Surveys and Carcass Sampling

The continually low number of Coho Salmon returning is alarming. Judging by behavior and the presence of eggs and redds, the spawning fish appear healthy. We know that relatively recently a population with a unique genetic signature was returning to spawn in Thorndyke Creek (Smith et al. 2007). Based on the numbers we have seen return in the last couple of years, further verification of the persistence of the Thorndyke stock should be confirmed. In addition, we propose sampling the genetics of Coho Salmon returning to Shine Creek in order to compare these fish with those returning to Thorndyke and other local streams. Unique genetic populations should be monitored closely and fishery decisions should be made in order to reduce the risk of losing these unique populations for good.

We continued to follow a slightly altered survey schedule that correlates with stream flow and prioritized survey efforts directly following high flow events. This modification was successful for recovering carcasses and collecting tissue samples. Once flow increases, it is essential to get out on the streams quickly for carcass sampling as they degrade and/or are consumed by scavengers quickly. Carcasses remain a while on Martha John, but on streams such as Thorndyke and Shine where the predation rate is high, carcasses are usually only a few days old when recovered. Therefore, it is important to maintain a weekly sampling effort on these streams.

Fisheries Sampling

The Coho Salmon fishery sampling portion of this project was successful in reaching a target of 20% of total PGST catch in area 12A, but less so in areas 9A and 82F. Our sampling is an important tool for evaluating the proportion of influence of hatchery and wild stock fish to the

Coho Salmon fishery. We have worked extensively with our fishermen, buyers and sampling staff to limit the occurrence of unreported catch and to record information accurately. Continuing the effort to communicate the sampling goals and rationale with all the stakeholders will be important to the continued success in collecting commercial fishery data.

Acknowledgements

We thank the PGST field technicians and PGST for providing additional resources and survey equipment.

Appendices

Appendix A: Port Gamble S’Klallam Tribal Spawner Survey Reaches: Ludlow Creek, Thorndyke Creek, Shine Creek, and Cougar-Kinman Creek

Appendix B: Port Gamble S’Klallam Tribal Spawner Survey Reaches: Martha John Creek

Appendix D: Port Gamble S’Klallam Tribal Spawner Survey Reaches: Thomas Creek

Appendix E: Port Gamble S’Klallam Tribal Spawner Survey Reaches: Harding Creek

Appendix F: Salmon Management Areas

Appendix G: 2017 Atlantic Salmon Escapement Event Summary

Citations

Johnson D. et al. 2007. *Salmonid Field Protocols Handbook*. American Fisheries Society, Bethesda, MD.

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