Salmon Technical Team Report on Western Strait Juan de Fuca Coho Overfishing Assessment

Executive Summary

In 2005, 2006, 2007, and 2008 the Western Strait of Juan de Fuca (SJF) stock of coho salmon fell short of its conservation objective of 11,900 natural spawners despite a preseason expectation the conservation objective would be met. Examination of the levels of smolt production, marine survival, and fishery exploitation patterns clearly indicate that the poor marine survival as the proximate cause of this escapement shortfall. Failure to anticipate the poor marine survival conditions led to the discrepancy between the preseason expectation and actual outcome.

In each of the years during this assessment period the smolt production was near, or above the average for the decade over which we have smolt production estimates. However, marine survival was so poor that ocean abundance was insufficient in every year to have met the escapement goal, even in the absence of all fishing. In each year fishery impacts were no greater that projected preseason and total impacts never exceeded 12 percent. The exploitation rate in Council fisheries was less than 5 percent, which is the threshold in the FMP for exempting a stock from Council action in response to an overfishing concern. It is noted that smolt production from the Western SJF has been less than that from the Queets River in recent years, while the escapement goal for the Western SJF is more than twice that of the Queets. This suggests that smolt production is currently insufficient to provide for meaningful fisheries and meet the conservation objective, even under normal marine survival conditions.

Because adult ocean abundance was insufficient to meet the minimum escapement goal of 11,900 in each year, and fishery impacts were well below the impacts permitted under the management regime, the STT concludes that overfishing did not occur and that the stock was not overfished.

Introduction

In 2009, the Salmon Technical Team (STT) was instructed by the Pacific Fishery Management Council (Council) to complete a stock assessment of Western SJF coho in response to the application of overfishing criteria as defined in Section 3.2 of Pacific Coast Salmon Plan (Framework Management Plan (FMP)). The STT is responsible for determining the status of Western SJF coho and developing recommendations for any management changes to rebuild the stock for application beginning in 2010 if the stock is determined to be overfished. The Council's criteria for an overfishing concern are met if, in three consecutive years, the postseason estimates indicate a natural stock has fallen short of its conservation objective (MSY, MSP, or spawner floor as noted for some harvest rate objectives) in Table 3-1. It is possible that this situation could represent normal variation, as has been seen in the past for several salmon stocks which were reviewed under the Council's former overfishing definition. However, the occurrence of three consecutive years of reduced stock size or spawner escapements, depending on the magnitude of the short-fall, could signal the beginning of a significant downward trend

which may result in fishing that jeopardizes the capacity of the stock to produce MSY over the long term.[CAT1]

Under Amendment 14 of the FMP, the management objective for Western SJF coho salmon was to provide a minimum of 11,900 natural spawners each year, an escapement level that was expected to provide maximum sustainable yield (MSY). The natural spawning escapements in 2005 through 2007 were below 11,900 prompting this review of the status of Western SJF coho. The spawning escapement in 2007 was not known in time to initiate a review in 2008, so the review was initiated in 2009. The natural spawning escapement remained below 11,900 in 2008.

Purpose and need: Federal definition of overfishing

Excerpt from Pacific Coast Salmon Plan Section 3.2 Overfishing Criteria

"Any fishery management plan . . . shall . . . specify objective and measurable criteria for identifying when the fishery . . . is overfished . . . and, . . . contain conservation and management measures to prevent overfishing or end overfishing and rebuild the fishery;"
Magnuson-Stevens Act, § 303(a)(10)

"The terms overfishing and overfished mean a rate or level of fishing mortality that jeopardizes the capacity of a fishery to produce the maximum sustainable yield on a continuing basis."
Magnuson-Stevens Act, § 3(29)

3.2.3.1 Criteria

The Council's criteria for an overfishing concern are met if, in three consecutive years, the postseason estimates indicate a natural stock has fallen short of its conservation objective (MSY, MSP, or spawner floor as noted for some harvest rate objectives) in Table 3-1. It is possible that this situation could represent normal variation, as has been seen in the past for several previously referenced salmon stocks which were reviewed under the Council's former overfishing definition. However, the occurrence of three consecutive years of reduced stock size or spawner escapements, depending on the magnitude of the short-fall, could signal the beginning of a critical downward trend (e.g., Oregon coastal coho) which may result in fishing that jeopardizes the capacity of the stock to produce MSY over the long term if appropriate actions are not taken to ensure the automatic rebuilding feature of the conservation objectives is achieved.

3.2.3.2 Assessment

When an overfishing concern is triggered, the Council will direct its STT to work with state and tribal fishery managers to complete an assessment of the stock within one year (generally, between April and the March Council meeting of the following year). The assessment will appraise the actual level and source of fishing impacts on the stock, consider if excessive fishing has been inadvertently allowed by estimation errors or other factors, identify any other pertinent factors leading to the overfishing concern, and assess the overall significance of the present stock depression with regard to achieving MSY on a continuing basis. Depending on its findings, the STT will recommend any needed adjustments to annual management measures to assure the conservation objective is met, or recommend adjustments to the conservation objective which may more closely reflect the MSY or ensure rebuilding to that level. Within the constraints presented by the biology of the stock, variations in environmental conditions, and the needs of the fishing communities, the STT recommendations should identify actions that will recover the stock in as short a time as possible, preferably within ten years or less, and provide criteria for identifying stock recovery and the end of the overfishing concern. The STT recommendations should cover harvest management, potential enhancement activities, hatchery practices, and any needed research. The STT may identify the need for special programs or analyses by experts outside the Council advisors to assure the long-term recovery of the salmon population in question. Due to a lack of data for some stocks, environmental variation, economic and social impacts, and habitat losses or problems beyond the control

or management authority of the Council, it is likely that recovery of depressed stocks in some cases could take much longer than ten years.

For the purposes of this review, the STT defines "overfishing" as fishery impacts that exceed levels permitted under the FMP, and "overfished" as the failure to meet an FMP conservation objective in three consecutive years as a result of overfishing.

Stock/Ecosystem Description

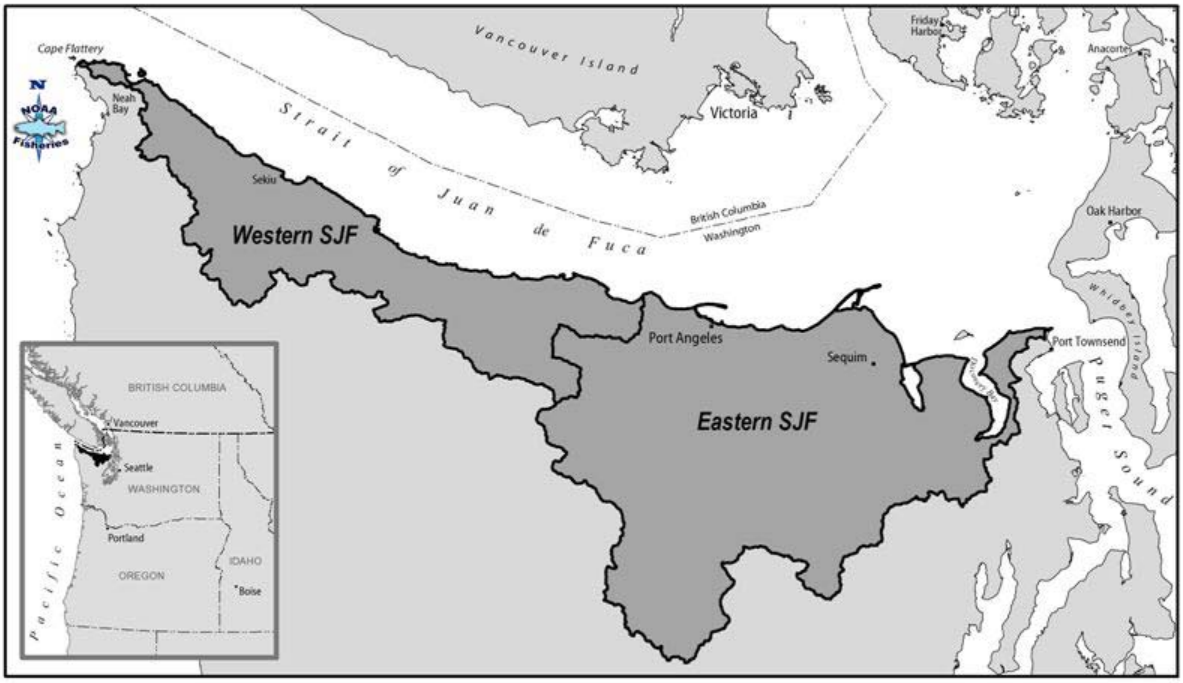
Location and geography

The Western Strait of Juan de Fuca (SJF) includes streams draining the Olympic Peninsula northward into the Strait of Juan de Fuca between the Elwha River on the east and Cape Flattery on the west (Figure 1.). The Western SJF is located in one of the highest runoff yield zones in western Washington (Naiman *et al.* 1992). Hydrologic stress on biological systems are extremely high in the Western SJF, including:

1 Soil types with high water delivery potential,
2 High drainage densities,
3 High road densities,
4 Destabilized channel networks from LWD depletion, accelerated sediment yield and channelization.

In the Western SJF, impacts to freshwater habitat are primarily limited to those associated with 80 years of intensive timber harvest, and in some cases stream bank modifications on lower mainstem rivers. The region's old-growth forests have been rapidly converted to tree farms, as Olympic National Park affords little protection to SJF drainages. Historic management practices have left watershed conditions typically destabilized with high road densities, accelerated rates of mass wasting and altered riparian communities. Past management practices such as stream cleanouts, cedar salvage and channelization have further deteriorated habitat conditions. Because of these conditions, current forest practices rules, though improved, may be inadequate to permit watershed recovery in the Western SJF.

Figure 1. Location of the Western Strait of Juan de Fuca coho stock.



Stock Description

The Western SJF includes natural coho populations spawning in the Sekiu, Hoko, Clallam, Pysht, East and West Twin, and Lyre Rivers as well as several smaller streams. It is managed as part of the SJF management unit, which includes the Western SJF and the eastern SJF (Elwha and Dungeness Rivers and several smaller streams). The SJF management unit was split into eastern and western components in 2000 by Amendment 14 in response to NMFS decision to delineate the boundary between Puget Sound and Washington Coast coho ESUs just to the west of the Elwha River, in the middle of the SJF management unit. As a result of the Council's decision to adopt the Pacific Salmon Treaty (PST) conservation objectives (as recommended by the co-managers) for Puget Sound coho stocks in November 2009, this segregation of Eastern and Western SJF stocks in the FMP will end and they will again have a single conservation objective.

Within the SJF management unit, hatchery production is limited to the Elwha and Dungeness Rivers. These two rivers are managed for hatchery production and receive the bulk of hatchery produced juveniles. Streams in the Western SJF receive limited outplants of hatchery produced juveniles, and the bulk of production is natural origin fish.

<u>Assessment of Stock Status</u>

Escapement

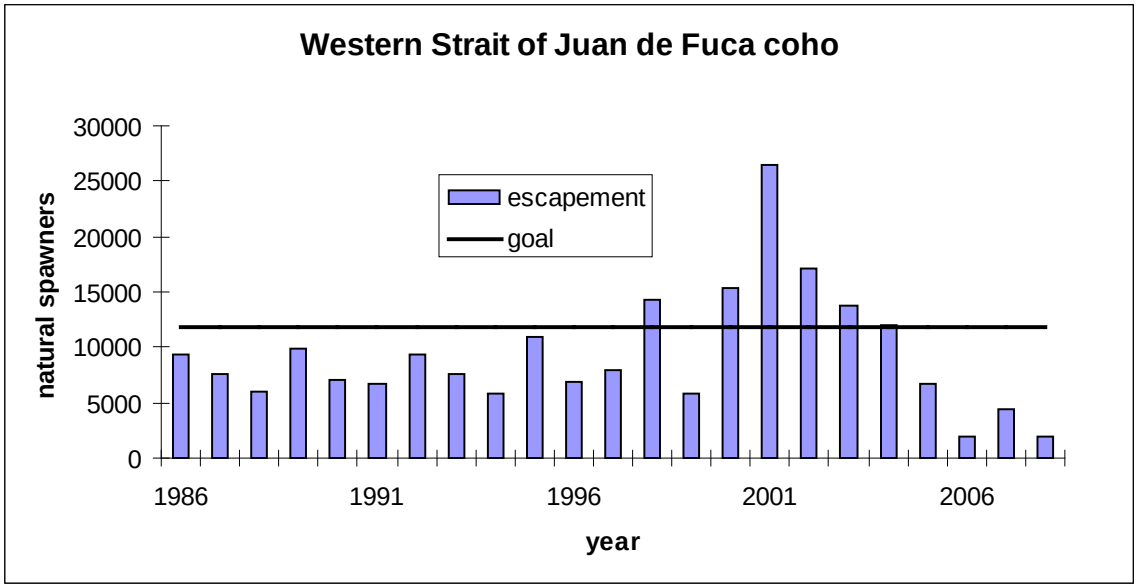
Spawning escapement to the Western SJF has varied considerably since 1986. During this period it has only exceeded the goal of 11,900 a total of six times: 1998 and the period from

2000 through 2004 (Table 1). Escapement did not exceed the current goal during the 12 year period from 1986 through 1997. Spawning escapement in 2002 through 2004 was above the minimum goal and among the highest years on record (Figure 2). Escapement in 2005 was 57 percent of the goal or 72 percent of the average escapement over the entire 23 year period of record. Thus, it appears that parent spawning escapement in the Western SJF was adequate and was not a likely cause of the failure to meet the escapement goal in 2005 through 2008.

Table 1. Adult spawning escapement of coho salmon into streams in the Western Strain of Juan de Fuca

Western Strait of Juan de Fuca	
year	Natural Escapement
1986	9,346
1987	7,600
1988	6,070
1989	9,802
1990	7,078
1991	6,662
1992	9,339
1993	7,594
1994	5,911
1995	10,914
1996	6,956
1997	7,982
1998	14,237
1999	5,831
2000	15,367
2001	26,509
2002	17,115
2003	13,793
2004	12,003
2005	6,777
2006	1,990
2007	4,406
2008	1,902

Figure 2. Adult spawning escapement of coho salmon into streams in the Western Strait of Juan de Fuca relative to the escapement goal of 11,900 adult spawners.



Smolt Production

Smolt production in the Western SJF is monitored in five streams: Salt Creek, East and West Twin Rivers, Deep Creek, and Johnson Creek. Through 2003, smolt emigration was also monitored in the Little Hoko River (Table 2). In the 12 years from 1998 to 2009, the monitored streams accounted for 12.7 to 29.5 percent of the estimated capacity of the Western SJF. The parent escapement in 2002 through 2005 produced the adult returns in 2005 through 2008. In these years, 19 percent of the smolt production capacity was monitored.

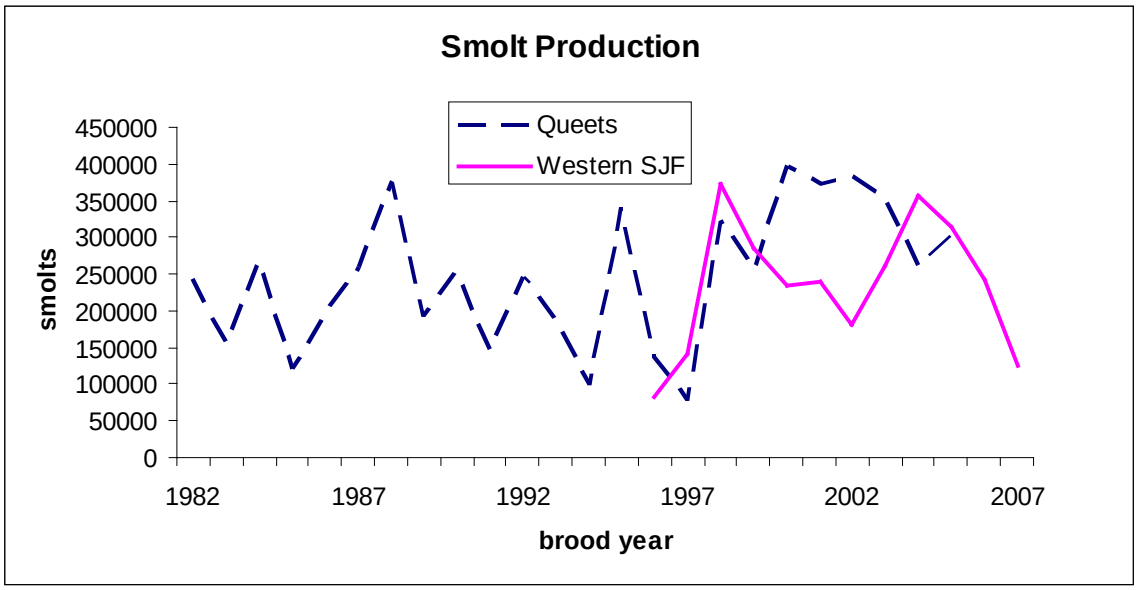
Table 2. Trap-based estimates of smolt production in Western Strait of Juan de Fuca streams. Means reported are for the 1997 through 2006 brood years. Brood year 2007 estimates are very preliminary.

Western SJF										
Brood Yr	Smolt Yr	Salt	E. Twin	W. Twin	Deep	L. Hoko	Johnson	Surveyed	Prop	Totals
1996	1998	7,357			4,022	3,695		15,074	0.1808	83,374
1997	1999	10,711			4,768	4,313		19,792	0.1415	139,873
1998	2000	26,652			10,865	5,755	3,935	47,207	0.1271	371,562
1999	2001	19,923	7,792	5,489	17,360	5,259	5,953	61,776	0.2164	285,432
2000	2002	16,416	7,651	3,629	8,863	5,491	8,790	50,840	0.2164	234,903
2001	2003	15,385	9,772	7,819	11,818	2,050	4,746	51,590	0.2164	238,368
2002	2004	11,423	8,950	2,329	8,254		3,754	34,710	0.1903	182,356
2003	2005	10,567	15,340	11,943	10,062		1,731	49,643	0.1903	260,809
2004	2006	24,038	11,288	8,103	18,796		5,654	67,879	0.1903	356,615
2005	2007	23,672	11,328	5,323	17,400		2,176	59,899	0.1903	314,691
2006	2008	16,309	4,932	4,417	18,376		2,076	46,110	0.1903	242,248
2007	2009	15,277	4,774	4,218	9,733		3,319	37,321	0.2953	126,396
Means		17,510	9,632	6,132	12,656	4,574	4,313	48,945	0.1863	262,686

The pattern of smolt production from the Western SJF and that of the Queets River show a good deal of similarity in the years in which estimates are available for both stocks (Figure 3). Both had low smolt production from the 1996 and 1997 broods (return years 1999 and 2000), followed by higher smolt production from the 1998 through 2005 brood years. For the 1996 through 2005 broods they also have similar levels of smolt production. The average smolt production over the 10 year period for the Western SJF was 247,000 while the average for the Queets was 286,000.

For the 2002 through 2005 brood years, smolt production from the Western SJF was not particularly low compared to the mean over the 1997-2006 broods. For the 2002 brood year, smolt production was 69% of the average, and for brood year 2003 it was 99% of average, while production from the 2004 and 2005 broods was above average. So, while freshwater productivity may have contributed to the shortage of adults, particularly for the 2002 brood, it cannot account for the low abundance of adult returns.

Figure 3. Production of coho smolts from the streams in the Western Strait of Juan de Fuca, compared with production from the Queets River.



Marine survival

Marine survival for the Western SJF coho can only be calculated as far back as we have smolt production estimates. This means that we can only go back as far as the 1996 brood year, or 1999 return year. Marine survival has plummeted precipitously for Western SJF coho since 2000 (Figure 4). The decline is clearly large enough to account for the decline in spawning escapement and the failure to meet the conservation objective in 2005-2008. The Queets coho have also experienced a similar, though slightly less dramatic, decline in marine survival; although, in the case of Queets coho, we have survival estimates back to the1985 return year (1982 brood year). In the longer time series it is evident that though the recent survival rates have been low for the Queets, they are within the range of historic variability, while the marine survival rates experienced by the 1997 and 1998 brood years are the highest on record. This suggests that for both stocks, the high survival of the broods returning in 2000-2004 may have been more anomalous that the low returns since then.

Because marine survival has been more variable than freshwater smolt production, reconstructed ocean abundance bears a strong resemblance to marine survival (Figure 5). It is readily apparent that ocean abundance in 2005 through 2008 was insufficient to meet the conservation objective for Western SJF coho in the absence of fishing.

Figure 4. Marine survival for Western Strait of Juan de Fuca coho. Survival is calculated as January age-3 ocean abundance divided by smolt production from the same brood. Marine survival for Queets coho is also shown for comparison.

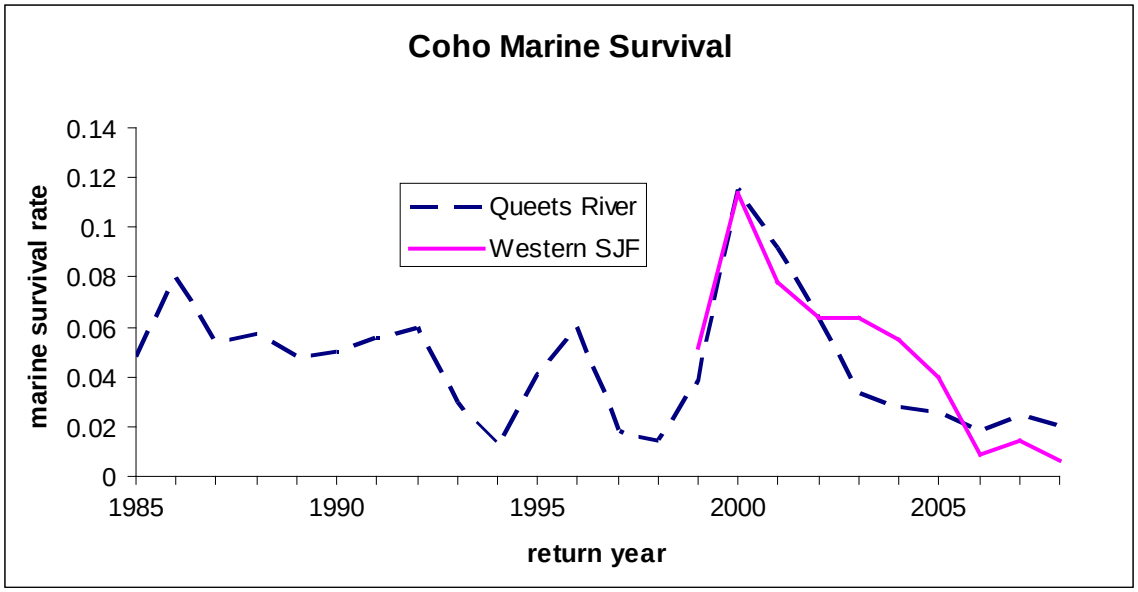
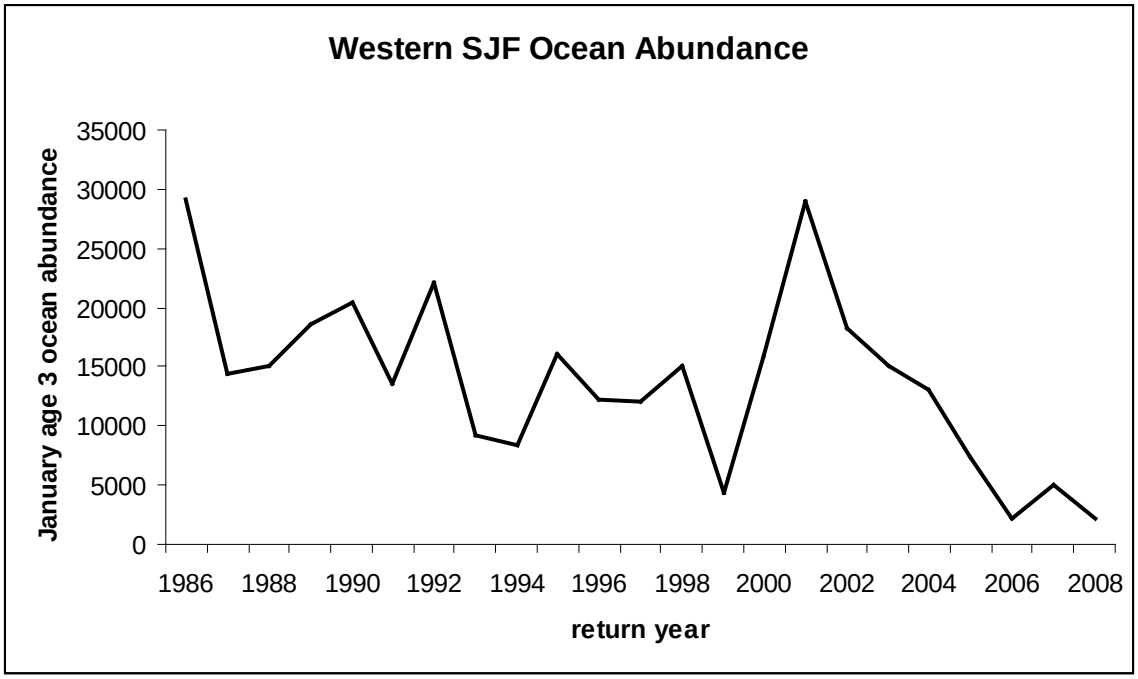


Figure 5. Reconstructed ocean abundance of Western Strait of Juan de Fuca coho. Abundances for the 1986 through 1992 return years were reconstructed using the Mixed Stock Model, and for 1993 return year on were generated from backward FRAM runs.



Harvest Impacts

During the review period of 2005-2008 for Western SJF, the preseason expectation was for the stock to meet its FMP conservation objective of minimum escapement. Yet in each year, the stock failed to do so. These escapement expectations are generated each year by beginning with an ocean abundance forecast, and accounting for the expected impacts in ocean and river fisheries. The escapement forecast model for Western SJF can be arranged into a simple linear form as

Escapement = (Ocean Abundance)(1-ER) (1)

where ocean abundance and exploitation rate (ER) are both forecast quantities. For the Western SJF, there are no substantial river fisheries, and equation (1) is an adequate description. In this form, the expected escapement is a simple product of forecast terms, and the forecast quantities are directly comparable. Examination of the forecasts for each of these terms can help to pinpoint where the expectations went awry.

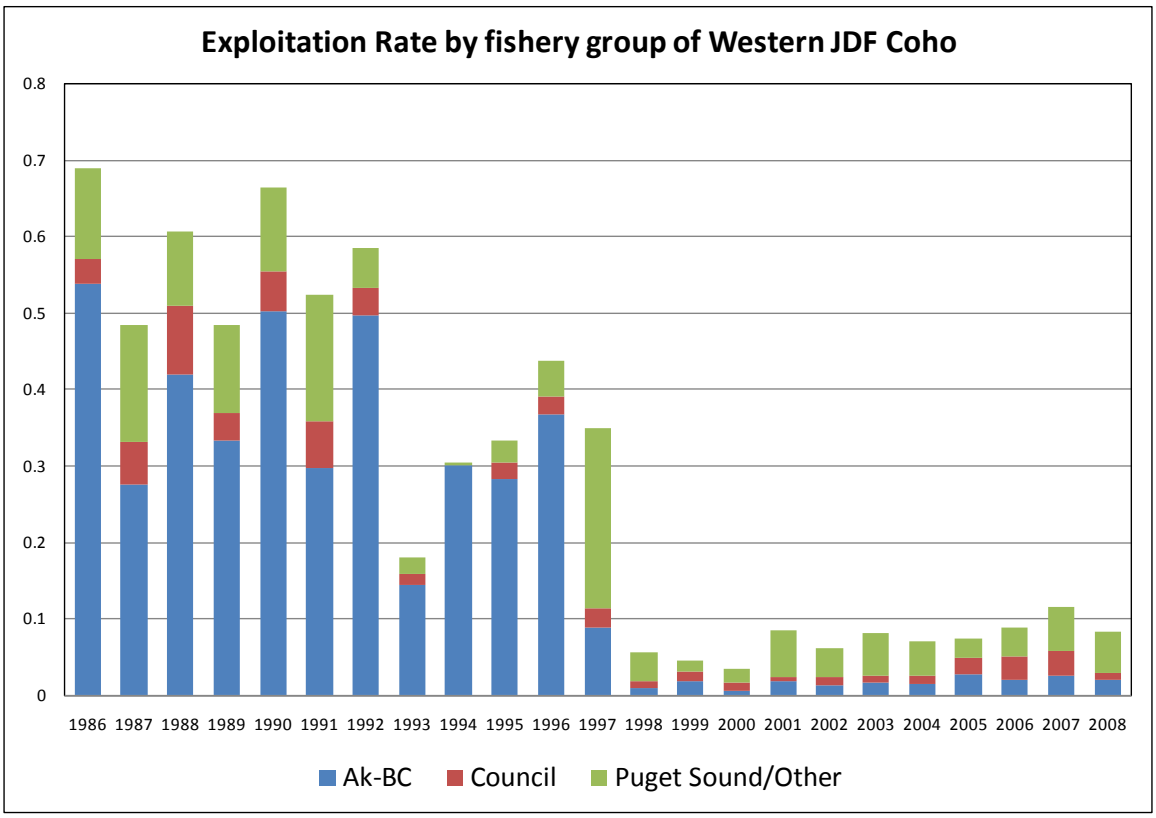
For Western SJF coho, the pattern is very consistent (Table 3). Each year, the ocean abundance was much lower than the forecast value, ranging from 44 percent of the forecast in 2005 to only 10 percent of the forecast in 2006. Abundance forecasts are generated by multiplying the estimated smolt emigration by expected marine survival. Because the smolt production estimates are the same values used in the post-season reconstructions, the prediction error is a direct measure of the error in predicting marine survival. In every year, the fishery impacts were equal to, or less than, the preseason projection, and total fishery impacts never exceeded 12 percent.

Table 3. Western Strait of Juan de Fuca coho salmon preseason expectations and postseason estimates. In each yearly block of numbers, preseason forecast, the postseason estimate, and the ratio of post season estimate to preseason forecast is presented. Ratios less than 1.0 represent overestimates of preseason abundance, and underestimates of fishery impacts. For each year, the forecast escapement was expected to exceed the minimum goal of 11,900, while the postseason estimate was below the goal, and the forecast error with the largest contribution to the escapement shortfall is highlighted in bold.

	Ocean Abundance	**Survival through fisheries**	**Escapement**
2005			
Preseason	16,464	0.88	14,507
Postseason	7,309	0.93	6,778
Post/Pre	**0.44**	1.05	0.47
2006			
Preseason	22,242	0.89	19,699
Postseason	2,179	0.92	1,990
Post/Pre	**0.10**	1.03	0.10
2007			
Preseason	26,549	0.88	20,678
Postseason	4,974	0.89	4,416
Post/Pre	**0.19**	1.01	0.21
2008			
Preseason	19,428	0.89	15,984
Postseason	2,120	0.92	1,902
Post/Pre	**0.11**	1.03	0.12

Coho salmon from the SJF are harvested in ocean fisheries in Washington, British Columbia, and to a lesser extent, in Alaska. They are also taken in Puget Sound fisheries, and commercial and recreational fisheries in the SJF. There are no significant terminal net fisheries in the Western SJF, and recreational harvest in the rivers is negligible. Prior to 1997 the majority of harvest occurred in Canadian fisheries off the west coast of Vancouver Island. Beginning in 1997, Canada severely restricted coho fisheries to minimize impacts on Upper Fraser coho stocks, and Canadian fishery impacts on Western SJF coho decreased sharply (Figure 6).

Figure 6. Magnitude and distribution of fishery impacts on Western Strait of Juan de Fuca coho salmon.



In 2002 the Pacific Salmon Commission adopted a management plan for coho salmon originating in Washington and southern B.C. river systems. The plan is directed at the conservation of key management units, four from Southern B.C. (Interior Fraser, Lower Fraser, Strait of Georgia Mainland, Strait of Georgia Vancouver Island) and nine from Washington (Skagit, Stillaguamish, Snohomish, Hood Canal, Strait of Juan de Fuca, Quillayute, Hoh, Queets, and Grays Harbor). Under the plan, the United States and Canada were required to constrain total fishery exploitation rates to levels associated with the categorical status (low, moderate, and abundant) and target exploitation rates of the key management units as determined by domestic managers. Ceilings on exploitation rates by intercepting fisheries were established through formulas specified in the plan.

Under the terms of the PST agreement, SJF coho have been classified as of moderate abundance despite the depressed status of Western SJF stocks. This is a result of the entire SJF being considered a single stock (as it now also is under the FMP), and recent stock forecasts that have been very optimistic. Because of the aggregated abundance classification of SJF, the PST allows a total fishery exploitation rate on coho from the Western SJF of up to 40 percent. However, since the PST agreement was reached, exploitation rates on Upper Fraser River coho in all Southern U.S. fisheries combined have been capped at 10 percent because the stock has been classified as critically depressed. Canada has severely restricted Canadian coho directed

fisheries in an effort to reduce their impacts on Upper Fraser coho as close to zero as possible. These restrictions are likely to remain in place for the near future.

Because of the restrictions to Canadian and Southern U.S. fisheries, and the limited availability of Western SJF coho salmon to Council fisheries, the total fishery exploitation rates have been less than 10 percent in each of the 4 years in which the stock failed to meet its conservation objective (Table 4). Impacts in Council fisheries in each of these years were less than 4 percent and the postseason assessment was that actual exploitation rates in Council fisheries were less than projected preseason. These impacts were below the 5 percent threshold in the FMP for exempting stocks from Council action in response to an overfishing concern. Because of these low levels of exploitation in fisheries, we believe that overfishing did not occur, and that the stock is therefore not overfished.

Table 4. Comparison of preseason and postseason estimates of the distribution of fishery impacts on Western Strait of Juan de Fuca coho during 2005-2008.

	2005		2006		2007		2008	
FISHERY COMPONENT	**Preseason**	**Postseason**	**Preseason**	**Postseason**	**Preseason**	**Postseason**	**Preseason**	**Postseason**
Ocean Age 3 Abundance (Pre I)	16464	7309	22242	2179	26549	4974	19428	2120
FMP Escapement Goal	11900	11900	11900	11900	11900	11900	11900	11900
Escapement after all fisheries	14507	6778	19699	1990	20678	4416	15984	1902
Alaska-Canada	245	207	368	41	265	124	336	44
Council North of Falcon								
Treaty Troll	401	116	454	58	534	121	312	18
Nontreaty Troll	108	7	52	1	117	8	23	0
Sport	95	17	81	4	99	18	48	1
Council South of Falcon	39	4	68	2	112	6	4	0
Council Subtotal	643	145	654	64	862	154	388	19
Preterminal Other								
Troll	9	2	6	0	9	1	35	0
Net	420	9	441	33	321	49	376	19
Sport	581	183	934	33	1290	212	831	89
Terminal Net and Sport	4	1	13	9	13	17	10	0

	2005		2006		2007		2008	
FISHERY COMPONENT	**Preseason**	**Postseason**	**Preseason**	**Postseason**	**Preseason**	**Postseason**	**Preseason**	**Postseason**
Alaska-Canada	1.5%	2.8%	1.7%	1.9%	1.1%	2.5%	1.9%	2.1%
Council North of Falcon								
Treaty Troll	2.4%	1.6%	2.1%	2.7%	2.3%	2.4%	1.7%	0.9%
Nontreaty Troll	0.7%	0.1%	0.2%	0.0%	0.5%	0.2%	0.1%	0.0%
Sport	0.6%	0.2%	0.4%	0.2%	0.4%	0.4%	0.3%	0.0%
Council South of Falcon	0.2%	0.1%	0.3%	0.1%	0.5%	0.1%	0.0%	0.0%
Council Subtotal	3.9%	2.0%	3.0%	3.0%	3.7%	3.1%	2.2%	0.9%
Preterminal Other	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Troll	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%
Net	2.6%	0.1%	2.0%	1.5%	1.4%	1.0%	2.1%	0.9%
Sport	3.5%	2.5%	4.2%	1.5%	5.5%	4.3%	4.6%	4.3%
Terminal Net and Sport	0.0%	0.0%	0.1%	0.4%	0.1%	0.3%	0.1%	0.0%
Total Exploitation Rate	**11.6%**	**7.4%**	**10.9%**	**8.3%**	**11.8%**	**11.2%**	**11.0%**	**8.2%**

Discussion

During the period from 1986 through 1997 spawning escapement of coho salmon to Western SJF streams was chronically below the goals established by the co-managers. This was apparently the result of very high exploitation rates in coho directed fisheries in Canada. These fisheries were dramatically reduced beginning in 1998, and from 1998 through 2004, the stock met its conservation objective in all years except 1999. Since then, spawning escapement has fallen short of the conservation objective of 11,900 natural adult spawners.

In each year since 2004, the Council expected to meet the conservation objective for Western SJF coho. The combination of forecast abundance and projected fishery impacts provided more than enough spawners to meet the conservation objective, yet in each year the actual escapement was below goal. The reason for the discrepancy between the preseason expectation and the realized outcome can clearly be traced the use of an expectation of marine survival that was much higher than was realized. The actual ocean abundances during these years ranged from 10 to 44 percent of the predicted values. During the same period, total fishery exploitation rates never exceeded the projected values. However, had the forecasts been perfectly accurate, it is unlikely that the outcome would have been any different.

If forecasts had been accurate the stock may have been projected to be the critically low abundance category. This would have allowed U.S. fisheries an exploitation rate not to exceed 10 percent on the SJF coho management unit. It would also have placed the same constraint on Canadian fisheries, for a total allowable exploitation rate of 20 percent. Except for 2007, total fishery impacts were less than 10 percent in all fisheries combined, and there were no fisheries targeting the Western SJF stock.

It is noteworthy that the smolt production from the Western SJF coho stock has followed a similar pattern to that of the Queets River in the years for which we have estimates for both stocks, yet the average production from Western SJF has been about 15 percent lower than that of the Queets. This contrasts with an escapement goal for Western SJF that is more than twice that of the Queets. It appears that during years of average marine survival the smolt production is sufficient to meet the conservation objective for Western SJF coho, under the minimal exploitation rates the stock has been experiencing, but not to support more extensive fisheries. In years of poor marine survival, the smolt production is insufficient to meet the conservation objective, even in the absence of fishing. Providing for meaningful fisheries will require either increasing the productive capacity of the habitat or reducing the escapement goal to reflect current productive capacity.

Conclusions and Recommendations

The Western SJF coho stock failed to meet its conservation objective in 2005, 2006, 2007, and in 2008. The proximate cause of this failure was depressed adult ocean abundance because of poor marine survival though this may have been exacerbated by the limited capacity of the habitat to produce smolts.

- Regardless of adult abundance, the FMP and the PST allow up to a 10 percent exploitation rate in Southern U.S. fisheries and an overall exploitation rate of 20 percent. Actual exploitation rates were well below these limits.
- Had exploitation rates been reduced to zero, the Western SJF stock would still have failed to meet its conservation objective in every one of these years.
- Therefore, the STT concludes that overfishing on the Western SJF coho stock did not occur, and that the stock is depressed, but not overfished.

Recommendations:

- Forecasting methodology should be closely examined. While preseason forecasts were overly optimistic in each year of the 2005-2008 period, more accurate forecasts would not have required changes in fishery management or allowed the stock to meet its conservation objective in any year.
- The escapement goals for the Strait of Juan de Fuca populations should be re-examined. In the 1997 through 2005 brood years, the Western SJF produced approximately the same number of coho smolts as the Queets River did, yet the aggregate escapement goal for the SJF is more than twice that of the Queets River. This suggests that the escapement goals for the SJF may be unrealistically high relative to the current habitat capacity.
- The Council should maintain marine exploitation rates in Council fisheries below the limits allowed by the FMP and the PST so that fisheries do not interfere with the stock's ability to recover when marine conditions improve.
- The Council should encourage the resource agencies to take actions to improve the habitat in the Strait of Juan de Fuca.

LITERATURE CITED

Naiman, R.J., T.J. Beechie, L.E. Benda, D.R. Berg, P.A. Bisson, L.H. Macdonald, P.L. Olson, and E.A. Steel. 1992. Fundamental elements of ecologically healthy watersheds n the Pacific northwest coastal ecoregion. In: R.J. Naiman, editor. Watershed management: balancing sustainability and environmental change. Springer-Verley, New York.