An evaluation of the effectiveness of the Cape Flattery Control Zone closure at reducing non-treaty troll fishery impacts on Puget Sound Chinook

Pete McHugh and Angelika Hagen-Breaux, Washington Department of Fish and Wildlife
October 6, 2014

Background and Key Questions

In response to the declining status of Puget Sound Chinook salmon, the State of Washington closed nearly half of Marine Area 4 (MA4) to the non-treaty troll fleet prior to the 1999 fishing season. The closure area, hereafter referred to as the Cape Flattery Control Zone (CFCZ; Figure 1), was implemented without an empirical assessment of the conservation benefits of the proposed fishery restrictions, but instead based on general knowledge of Puget Sound Chinook's ocean distribution. The CFCZ restriction has now been applied to non-treaty (NT) trollers for more than 15 years (1999-2014); the Treaty Indian (TI) troll fleet has had unrestricted access to the CFCZ during this same period. Given that MA4 TI and NT Chinook troll fishery catches are sampled for coded-wire tags at a relatively high rate, this combination of circumstances presents a unique opportunity to evaluate the effectiveness of a sizeable area closure relative to its original intent. Accordingly, here we report on an analysis that aims to address two key questions: (1) did the closure of the CFCZ to the non-treaty troll fleet in 1999 result in a measurable reduction in fishery impacts for Puget Sound Chinook? (2) If the answer to (1) is yes, what magnitude of reduction should be incorporated into the Chinook Fishery Regulation Assessment Model (FRAM) to more accurately capture this fishing pattern in ongoing and future modeling activities?

Evaluation Framework

The effect of the CFCZ was evaluated based on patterns of coded-wire tag (CWT) recoveries in the MA4 troll fishery for three large and consistently tagged Puget Sound fall fingerling production groups using a simple before–after comparison approach, which proceeded in four steps. Firstly (Test 1), we compared the exploitation rates (ER; normalized to catch) of CWT stocks between before vs. after periods for the NT troll fleet alone. We then repeated the same analysis for the TI troll fishery alone (Test 2), to verify our treatment of it as an 'experimental control' (i.e., it was never excluded from the CFCZ). Thirdly (Test 3), we evaluated pre–post CWT recovery patterns for the NT troll fishery relative to those for the TI fleet. It is important to note that although the Treaty (57 cm FL) and Non-treaty (67 cm FL) troll fisheries have operated and continue to operate under different minimum size limits, they have remained consistent during the period under consideration here. Lastly, given results from tests 1-3, we estimated an impact savings for incorporation into fishery modeling based on the FRAM vs. CWT differential in projected impacts for the CFCZ-affected model fishery during the post-closure era.

Data Overview

<u>Data Sources</u>: This analysis was conducted using CWT data assembled by the Pacific Salmon Commission Chinook Technical Committee (CTC) for use in their annual (2014) exploitation rate analysis (i.e., the CTC Cohort Analysis System [CAS] database). Specifically, we used the tag data contained in the CAS database to compute total estimated recoveries per 10K landed Chinook (described below under 'Analysis Approach') as well as 'fishing year ERs' generated through the CTC's annual cohort analysis (Appendix C in CTC *In Prep.*). The fishery catches used in our analyses were assembled from Appendix A of PFMC (2014).

<u>Stocks</u>: In this analysis, we considered three of the CTC's hatchery CWT indicator stocks that are closely aligned with the natural-origin Hood Canal, Mid- and South Puget Sound fall fingerling type Chinook salmon expected to benefit from the CFCZ closure (i.e., the 'Green River derivatives'): (1) George Adams

Hatchery (GAD) in the Skokomish Basin of Hood Canal, (2) Nisqually Hatchery (NIS) in the Nisqually Basin of 'Deep South' Puget Sound, and (3) Mid-Puget Sound[1] (MPS; a CWT aggregate comprising Soos Creek [majority of CWT codes/releases], Issaquah, and Grovers hatcheries). These stocks correspond to FRAM's Hood Canal, Deep South Puget Sound, and Mid-Puget Sound fall fingerling model stocks, respectively. Other Puget Sound Chinook CWT indicator stocks were considered but were not included due to their limited presence in MA4 troll fishery catches (Skagit spring, summer/fall; Skykomish; Stillaguamish; Nooksack spring) or lack of affiliation to a natural stock (Samish fall).

<u>Fishing Years</u>: Data for fishing years 1984 to 2012 (up to 15 before years, 14 after years) were considered for inclusion in our analysis, with the lower limit set by the first year in which treaty and non-treaty CWT recoveries were consistently distinguished in the coastwide Regional Mark Information System database (by gear code) and the upper limit set by the last year included in the 2014 CTC cohort reconstruction for the stocks in question. The 1984-2012 data series was additionally filtered to remove years in which (1) the fishery was either completely closed or quotas were tightly restricted (before period: 1989, 1994-1996; after period: 2007-2008) and/or (2) CWT sampling was insufficient for conducting a reliable tag-based analysis (before period: 1984-1985, 1997; after period: 2011; Table 1). Filter criteria for CWT data adequacy were defined as a fishery sample rate of at least 20% and at least 20 observed tags (across all stocks) recovered from the fishery (PSC CWT Workgroup 2008). This yielded a total of up to 19 fishing years for use in comparisons (n = 8 before-closure, n = 11 after-closure) involving NT troll data, with additional exclusions determined programmatically by the CTC's fishing year ER calculation criteria (minimum of 3 tagged broods, ages 2-5, present in a calendar year). Due to the larger size of the TI troll fishery, Test 2 (TI-only pre- vs. post-CFCZ) included up to 27 years based on the same filter criteria.

Analysis Approach

<u>Response Variables</u>.—We computed two different response variables for each of the three CWT indicator stocks, one which relies on a full CWT cohort reconstruction (*Fishing Year ER*) and another which simply provides an index on the relative effectiveness of the CFCZ (*NT vs. TI CWT Recovery Differential*): (1) *Fishing Year ER*: We estimated this variable using data contained within the CTC's distribution tables as proxy. Fishing Year ER was computed as adult equivalent (AEQ) total mortality (landed and non-landed) for CWTed fish arising due to the NT or TI Area 4 troll fishery, divided by total AEQ mortality (i.e., across all fisheries plus escapement), within a fishing year for all ages/broods present. Although CWT-based exploitation rates are typically expressed in brood year terms, this metric is a suitable CWT analog to FRAM's fishing year ER. Also, we normalized ERs to landed catch given that changes in ER may have arisen due to either the implementation of the CFCZ or changes in catch. Thus, we divided annual ERs for the TI MA4 and NT MA4 fisheries by catch and additionally multiplied this catch-normalized ER index by 1M for presentation purposes (i.e., it is a very small number otherwise). (2) *NT vs. TI CWT Recovery Differential*: We computed the number of CWT recoveries per 10K fish landed for both NT and TI fleets, and then the within-year difference between fleets. These metrics were computed on a stock-specific (i.e., GAD, NIS, MPS) basis. See Appendix A for a complete table of the data used in the analysis.

<u>Statistical Analysis Methods</u>.—We tested for changes in response variables resulting from the implementation of the CFCZ using a before–after comparison approach using a mixed-effects modelling approach. Specifically, we modeled each response variable as a function of a fixed CFCZ effect (i.e.,

[1] To maintain consistency with FRAM, we refer to this group as Mid-Puget Sound (MPS) even though it is referred to as 'South Puget Sound' (SPS) by the CTC.

before/after implementation), the factor of primary interest, and included stock and year variables as random blocking effects. We subsequently assessed the significance of the CFCZ effect in each model using likelihood ratio tests computed relative to reduced models fitted with the same random structure but not the CFCZ effect. We analyzed the data in this way for two primary reasons. Firstly, we were mainly interested in evaluating the general effect of the CFCZ on the Puget Sound fall fingerling aggregate. In this vein, the levels of 'stock' and 'year' included in our analysis constitute a subset of the broader data universe of interest, but also possess within-group similarities (i.e., non-independence) that must be accounted for analytically. Secondarily, the maximum likelihood-based mixed-effects modeling framework is generally regarded as being more robust to 'treatment' imbalance issues, like those inherent to our dataset, relative to traditional before–after ANOVA comparison approaches (i.e., based on sums of squares). Lastly, it should be noted that although there is potential for serial correlation in time series data, we were unable to account for it in our analysis due to the presence of missing years in our data set.

Analysis Findings and Discussion

Test 1. NT troll Chinook catches varied widely during both pre- (*ca*. 7K mean) and post-CFCZ assessment periods (*ca*. 9K mean) and have not trended in any particular direction through time (Figure 2). Despite this, patterns in catch-standardized fishing year ERs for the NT MA4 troll fishery suggest that there was a CFCZ response consistent with the closure's original intent (Figure 3). While not statistically significant (likelihood ratio test results: $\chi^2 = 2.5$, $P = 0.115$), standardized ERs for the NT troll fishery decreased by 44% on average between the pre- and post-CFCZ period (i.e., based on mixed-effects model parameter estimates; Table 2). Further, the magnitude of decrease varied across the three CWT indicator stocks, as well as across years within individual stocks (Figure 3).

Test 2. In contrast to NT catches, TI troll catches in MA4 have increased progressively from 1984 to 2012 and have more than doubled between the pre- and post-CFCZ periods. Further, consistent with our treatment of the TI troll fishery as a 'control' due to their continued access to the CFCZ, catch-standardized fishing year ERs have remained remarkably stable for the fleet between periods (Figure 4; likelihood ratio test results: $\chi^2 = 0.1$, $P = 0.706$; Table 2).

Test 3. Consistent with the results of tests 1 and 2, which suggest that NT but not TI ERs decreased following the implementation of the CFCZ closure, we observed a shift in the CWT recovery differential for NT and TI fisheries following the implementation of the CFCZ closure (Figure 5; likelihood ratio test results: $\chi^2 = 2.6$, $P = 0.109$; Table 2). In particular, fitted parameter estimates indicate that the recoveries/10K differential shifted from being slightly negative and indistinguishable from zero (i.e., fish for fish, TI and NT fisheries impact Puget Sound Chinook similarly) to a six-fold larger negative number. Thus, given the assumption that the TI is an appropriate control, the impact of the MA4 NT troll fishery on Puget Sound Chinook appears to have been considerably reduced by the CFCZ.

The statistical tests described above provide two lines of evidence indicating that the CFCZ fishery restriction has led to some reduction in NT fleet impacts on Puget Sound fall fingerling Chinook in the MA4 troll fishery. If assessed purely in terms of pre-post differences in impacts for the NT fishery in isolation (i.e., ER comparisons), this decrease may be upwards of 40%. If viewed relative to the TI troll fleet control, the impact reduction resulting from the CFCZ restriction may be even greater. However, neither estimate of the CFCZ effect can be interpreted without qualification. In particular, although *P*-values for both statistical tests were within a neighborhood of probability suggesting that the observed patterns did not arise by chance alone, neither test was statistically significant. Similarly, whereas the CFCZ effect size in both the ER and CWT recovery differential models were of a magnitude of management relevance, neither parameter estimate was particularly precise. Considering this magnitude and uncertainty simultaneously, we believe that efforts to integrate a CFCZ savings into future Chinook FRAM modeling efforts err conservatively in application.

Proposed CFCZ Adjustment for Chinook FRAM Modelling

Given our findings, we compiled data to compute an adjustment factor to account for CFCZ-related reductions in fishery impacts on Puget Sound fall fingerling Chinook in future FRAM modelling activities. We approached the model adjustment derivation using a fairly simplistic approach given a need for a stopgap adjustment while the modern Chinook FRAM base period, which will implicitly include the CFCZ, is completed. In brief, we computed the ratio of model-projected to CWT-estimated marked landed Chinook mortalities (adult equivalent) for the relevant FRAM model fishery[2] using the CWT groups analyzed here and the results from post-CFCZ FRAM validation runs (Table 3). Note also that we restricted calculations to the subset of years within the most recent validation run series (2003-2012, August 2014 draft) that met the same CWT adequacy criteria outlined for NT MA4 analyses above.

This analysis revealed a pattern of deviation between FRAM and CWT projections of marked landed mortalities during the post-CFCZ era that was remarkably consistent with the NT pre- vs. post-CFCZ ER comparison (Test 1) summarized above. Namely, there was considerable variability in the CWT/FRAM ratio across years and stocks, but on average a clear tendency towards reduced impacts relative to a CFCZ-open baseline (in this case FRAM, which projects only pre-CFCZ information). More importantly, if the adjustment factor is estimated on an aggregate basis (i.e., across ages, stocks, and years), the magnitude of deviation between FRAM and CWT projections (CWT/FRAM ratio = 0.56, which corresponds to 44% differential) is identical to the level of reduction estimated in our Test 1 analysis (44%, Table 2). In addition to providing a basis for a model adjustment, this provides a compelling line of corroboratory evidence indicating that the CFCZ closure has lessened the impact of the MA4 troll fishery on Puget Sound Chinook.

An important question remains unanswered—precisely how should this information be integrated into current/future Chinook FRAM modelling efforts, both in terms of magnitude and model operations? Firstly, in light of the uncertainty mentioned above and the original conservation intent of the CFCZ, we recommend using an adjustment that poses little risk of over-correcting for model error. For the same reasons, we also believe that the adjustment should not be estimated on an overly resolved basis but instead in aggregate terms (i.e., compute and apply the same adjustment to the Hood Canal, Deep South Puget Sound, and Mid-Puget Sound FRAM model stocks). With these principles in mind, we propose adopting a 0.75 adjustment (i.e., a 25% reduction) for incorporation into future modeling as a 'Stock-Fishery Exploitation Rate Scalar'. This adjustment is at the conservative end of the distribution of plausible values (Table 2) and is also consistent with the draft value used during the 2014 preseason fishery planning process.

[2] The NT MA4 troll fishery is part of a combined NT MA3 and MA4 model fishery in FRAM. Thus, all CWT and FRAM calculations are based on this fishery aggregation.

References

Pacific Fishery Management Council. 2014. Review of 2013 Ocean Salmon Fisheries: Stock Assessment and Fishery Evaluation Document for the Pacific Coast Salmon Fishery Management Plan. (Document prepared for the Council and its advisory entities.) Pacific Fishery Management Council, 7700 NE Ambassador Place, Suite 101, Portland, Oregon 97220-1384.

CTC (Chinook Technical Committee). *In Prep*. 2014 Annual report of the exploitation rate analysis and model calibration. Pacific Salmon Commission, Report TCCHINOOK (XX)-XX. Vancouver, British Columbia.

Pacific Salmon Commission Coded Wire Tag Workgroup. 2008. An action plan in response to Coded Wire Tag (CWT) Expert Panel Recommendations. Pacific Salmon Comm. Tech. Rep. No. 25: 170 p.

Table 1. Summary of CWT sample data and criteria for including or excluding specific years from the analysis.

Year	NT Obs'd tags	NT Sample Rate	NT MA4 Catch	TI Obs'd tags	TI Sample Rate	TI MA4 Catch	Include In NT?	Basis for NT omission
1984	16	31%	2,329	12	22%	2,081	no	too few tags
1985	0	0%	4,416	16	16%	6,759	no	too few tags (none)
1986	54	35%	4,656	47	26%	5,208	yes	
1987	159	43%	4,838	177	51%	9,480	yes	
1988	335	29%	21,941	102	19%	13,266	yes	
1989	6	25%	282	130	12%	15278	no	low catch, too few tags
1990	233	28%	16,286	240	35%	13,647	yes	
1991	200	32%	15,238	183	32%	16,169	yes	
1992	145	23%	17,076	182	25%	17,305	yes	
1993	106	21%	16,010	338	53%	19,872	yes	
1994	0	NA	0	52	58%	2045	no	low catch
1995	1	NA	3	42	17%	7506	no	low catch
1996	0	NA	0	114	43%	9654	no	low catch
1997	17	20%	3,785	147	52%	11,567	no	too few tags
1998	83	61%	4,160	174	39%	14,050	yes	
1999	195	41%	12,698	641	41%	26,468	yes	
2000	156	59%	7,548	183	52%	6,657	yes	
2001	344	73%	6,253	869	42%	21,236	yes	
2002	413	30%	18,708	519	22%	38,093	yes	
2003	665	35%	30,514	587	25%	34,742	yes	
2004	530	37%	19,084	1512	46%	42,277	yes	
2005	173	24%	11,991	1116	62%	33,815	yes	
2006	134	57%	4,211	507	28%	25,546	yes	
2007	27	69%	554	676	37%	19,585	no	low catch
2008	8	29%	499	556	47%	13,192	no	low catch, too few tags
2009	50	79%	1,201	299	52%	5,146	yes	
2010	235	61%	4,131	692	36%	22,813	yes	
2011	12	6%	2,934	788	39%	28,071	no	low sample rate, too few tags
2012	282	48%	6,102	1657	33%	48,746	yes	

Table 2. Estimates of fitted model parameters (fixed effects) and pre-post shifts from mixed-effects model analysis of CWT response variables.

Response Variable	Fixed effect parameter estimates				Likelihood Ratio Test	
	Parameter	**Est.**	**SE**	**t-value**	χ^2	***P***
NT Standard. ER	Pre CFCZ value (intercept)	0.867	0.220	3.94	2.5	0.115
	CFCZ effect	-0.383	0.238	-1.61		
	Post CFCZ value	0.485				
	% change	-44%				
TI Standard. ER	Pre CFCZ value (intercept)	0.959	0.155	6.17	0.1	0.706
	CFCZ effect	0.077	0.213	0.36		
	Post CFCZ value	1.036				
	% change	8%				
NT-TI Recs/10K	Pre CFCZ value (intercept)	-1.732	4.538	-0.38	2.6	0.109
	CFCZ effect	-8.635	5.464	-1.58		
	Post CFCZ value	-10.367				
	% change	499%				

Table 3. FRAM projections and CWT estimates (i.e., total estimated marked CWT recoveries / % of marked production that is CWTed) of adult-equivalent marked (i.e., adipose-clipped) landed mortality of age 3-5 Chinook salmon in the combined Marine Areas 3 and 4 model fishery. Note, grayed columns are years excluded from analyses based CWT filter criteria.

FRAM-projected Marked Landed Mortalities												
Stock	**Age**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Mean**
George Adams	3	4	7	20	12	--	--	--	72	--	896	168
	4	15	7	9	11	--	--	--	41	--	136	36
	5	0	0	0	0	--	--	--	0	--	0	0
Nisqually	3	0	0	0	0	--	--	--	0	--	0	0
	4	418	179	308	355	--	--	--	144	--	398	300
	5	0	0	0	0	--	--	--	0	--	0	0
Mid-Puget Sound	3	29	25	57	90	--	--	--	19	--	175	66
	4	101	62	75	129	--	--	--	44	--	80	82
	5	23	11	19	37	--	--	--	5	--	27	20
CWT-expanded Marked Landed Mortalities												
Stock	**Age**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Mean**
George Adams	3	0	5	0	1	--	--	--	11	--	123	23
	4	12	12	8	12	--	--	--	0	--	73	20
	5	0	0	6	0	--	--	--	0	--	0	1
Nisqually	3	0	26	0	117	--	--	--	47	--	102	49
	4	460	322	47	78	--	--	--	118	--	128	192
	5	0	24	35	0	--	--	--	0	--	0	10
Mid-Puget Sound	3	0	0	0	23	--	--	--	17	--	0	7
	4	200	56	20	74	--	--	--	51	--	30	72
	5	7	0	0	0	--	--	--	0	--	0	1
Ratio CWT/FRAM Marked Landed Mortalities												
Stock	**Age**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Mean**
George Adams	3	0.00	0.67	0.00	0.08	--	--	--	0.15	--	0.14	0.17
	4	0.83	1.57	0.94	1.12	--	--	--	0.00	--	0.54	0.83
	5	--	--	--	--	--	--	--	--	--	--	--
Nisqually	3	--	--	--	--	--	--	--	--	--	--	--
	4	1.10	1.79	0.15	0.22	--	--	--	0.82	--	0.32	0.73
	5	--	--	--	--	--	--	--	--	--	--	--
Mid-Puget Sound	3	0.00	0.00	0.00	0.25	--	--	--	0.92	--	0.00	0.10
	4	1.98	0.91	0.26	0.58	--	--	--	1.16	--	0.38	0.88
	5	0.29	0.00	0.00	0.00	--	--	--	0.00	--	0.00	0.05
											Ratio of Means (R):	0.56
											Approx. 95% CI of R:	0.25-0.86

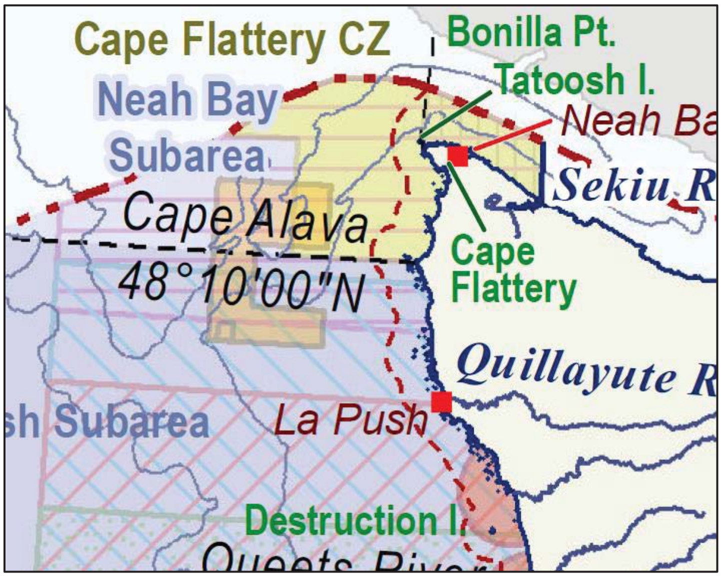

Figure 1. Map of the Cape Flattery Control Zone, denoted by the mushroom-shaped yellow shaded area.

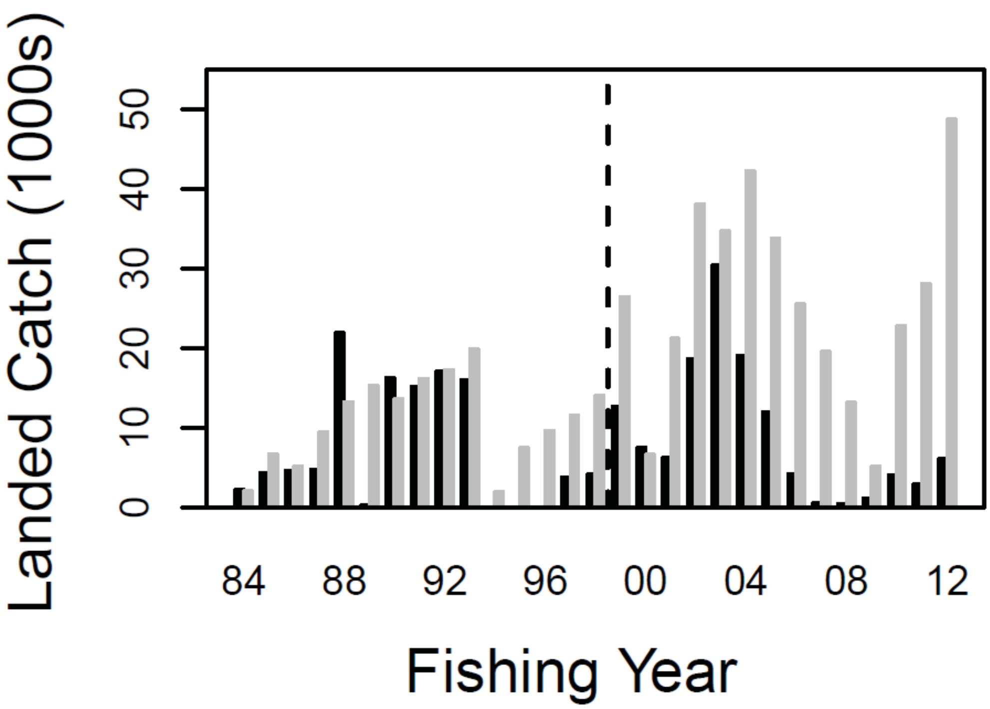

Figure 2. Non-treaty (black bars) and treaty (gray bars) Chinook catch (in thousands of fish) in the Area 4 troll fishery, 1984-2012. Note, the dashed vertical line denotes the break between the pre- and post-CFCZ restriction for the NT troll fleet.

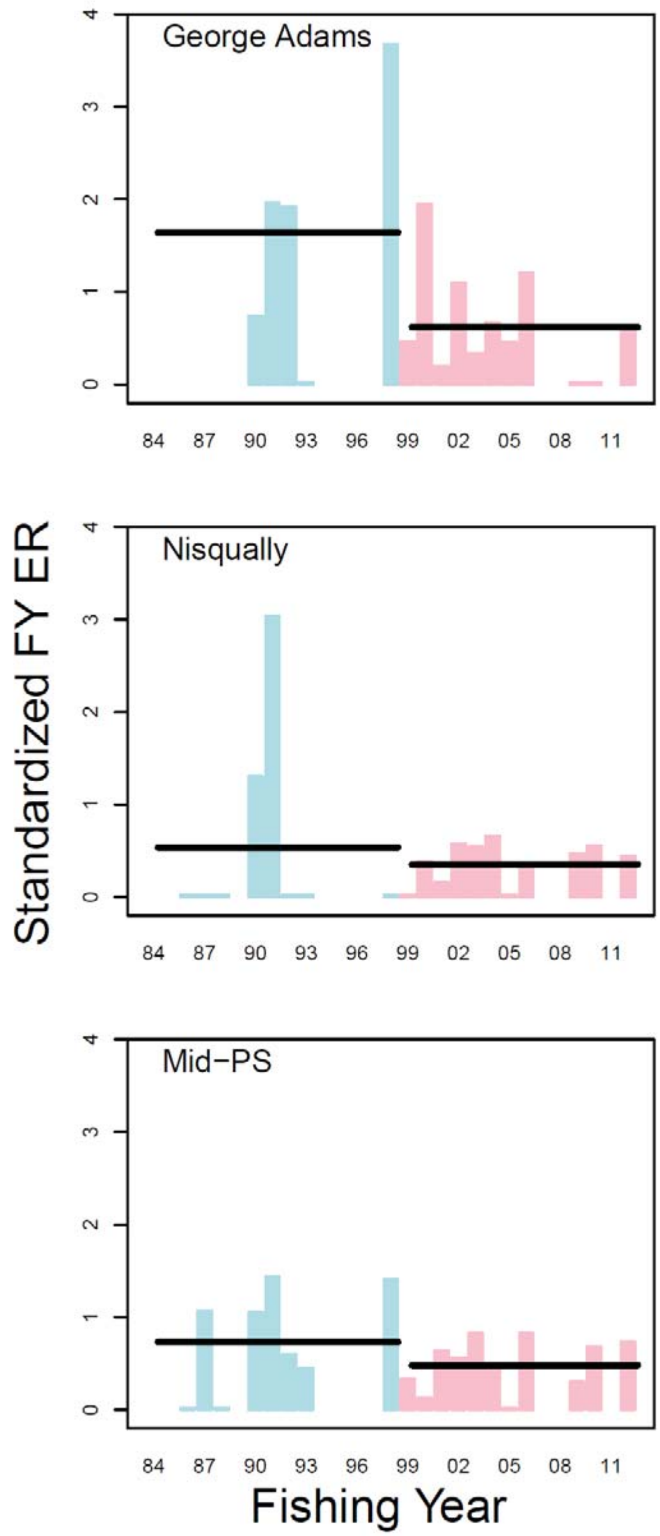

Figure 3. Fishing year exploitation rates (FY ER), standardized to Chinook catch, for the George Adams (Hood Canal), Nisqually, and Mid-Puget Sound (Mid-PS) CWT indicator stocks in the Area 4 Non-Treaty troll fishery, 1984-2012. Note, light blue bars denote the pre-CFCZ period whereas pink bars denote post-CFCZ years. The solid horizontal lines correspond to mean values during pre- and post-CFCZ closure periods.

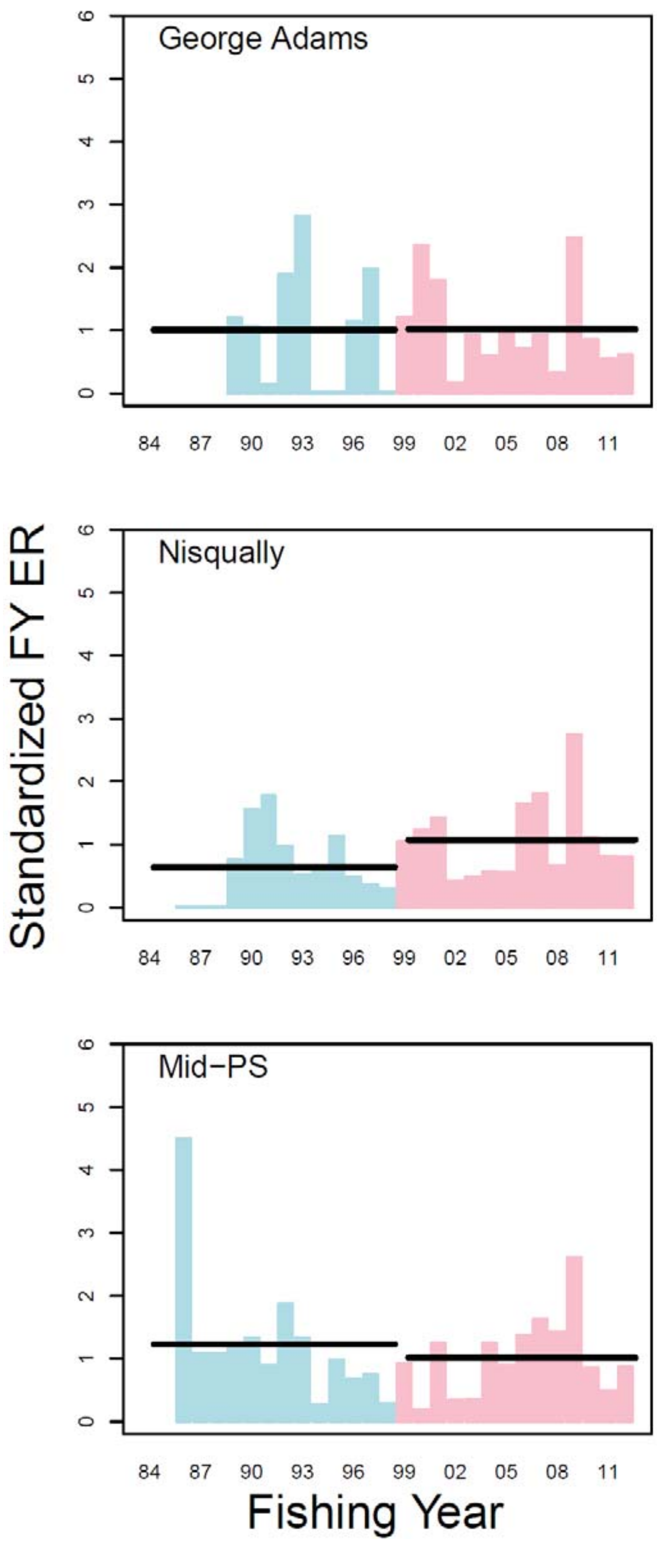

Figure 4. Fishing year exploitation rates (FY ER), standardized to Chinook catch, for the George Adams (Hood Canal), Nisqually, and Mid-Puget Sound (Mid-PS) CWT indicator stocks in the Area 4 Treaty Indian troll fishery, 1984-2012. Although the CFCZ restriction does not apply to the TI troll fleet, pre- and post-CFCZ periods are denoted by bar coloring (see Figure 3); the solid horizontal lines correspond to mean values during pre- and post-CFCZ closure periods.

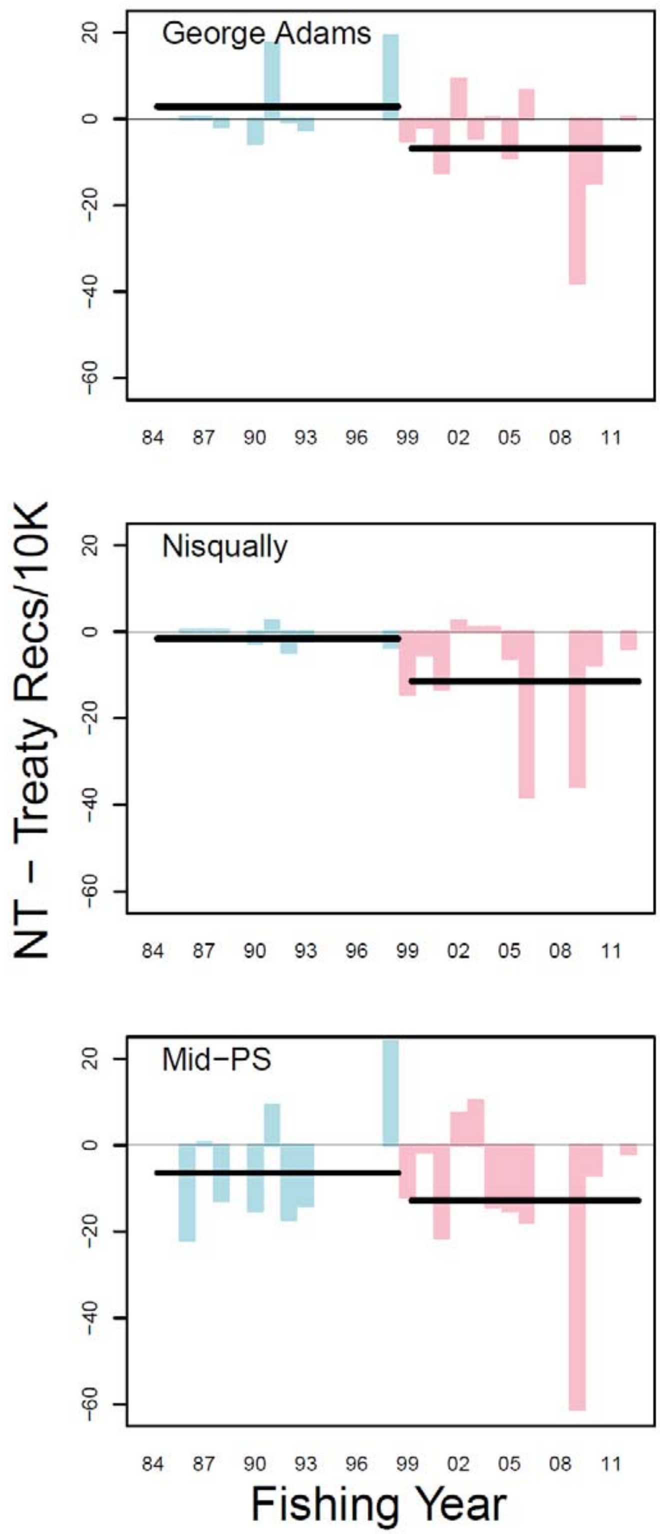

Figure 5. The differential (NT-TI MA4 troll fisheries) in recoveries of CWTs for every 10,000 landed Chinook, for the George Adams (Hood Canal), Nisqually, and Mid-Puget Sound (Mid-PS) CWT indicator stocks in Marine Area 4, 1984-2012. Note, light blue bars denote the pre-CFCZ period whereas pink bars denote post-CFCZ years. The solid horizontal lines correspond to mean values during pre- and post-CFCZ closure periods.

Appendix A. Data table used in CFCZ statistical tests. FY = Fishing Year; CFCZ = before (B) or after (A) Cape Flattery Control Zone closure; ER = fishing year ER; StdER = fishing year ER / landed catch in the fishery x 1M; Recs/10K = total estimated recoveries for the CWT indicator stock per 10,000 fish landed; NT-TI Rec Diff. = the differential between NT and TI in Rec/10K. Note, ‘--‘ denotes years excluded from analysis for a particular variable due to either CWT screening criteria (ER, Std ER, Recs/10K) or exclusion from the CTC fishing year ER calculation based on secondary criteria (min 3 BYs present in fishing year; affects ER, StdER).

			Non-treaty (NT)			**Treaty Indian (TI)**			
FY	**CFCZ?**	**Stock**[3]	**ER**	**Std ER**	**Recs/10K**	**ER**	**Std ER**	**Recs/10K**	**NT-TI Rec Diff.**
1984	B	MPS	--	--	--	--	--	--	--
1985	B	MPS	--	--	--	--	--	--	--
1986	B	MPS	0.00%	0.0000	0.0	2.33%	4.4734	22.4	-22.4
1987	B	MPS	0.51%	1.0439	4.6	1.01%	1.0673	4.4	0.2
1988	B	MPS	0.00%	0.0000	0.0	1.42%	1.0707	13.4	-13.4
1989	B	MPS	--	--	--	1.78%	1.1653	--	--
1990	B	MPS	1.68%	1.0320	56.4	1.80%	1.3175	72.2	-15.7
1991	B	MPS	2.15%	1.4132	24.3	1.42%	0.8770	15.6	8.7
1992	B	MPS	0.99%	0.5773	8.4	3.21%	1.8526	26.1	-17.7
1993	B	MPS	0.68%	0.4249	6.1	2.60%	1.3087	20.6	-14.5
1994	B	MPS	--	--	--	0.05%	0.2562	--	--
1995	B	MPS	--	--	--	0.72%	0.9630	--	--
1996	B	MPS	--	--	--	0.63%	0.6550	--	--
1997	B	MPS	--	--	--	0.84%	0.7270	--	--
1998	B	MPS	0.58%	1.3851	28.1	0.37%	0.2610	4.7	23.4
1999	A	MPS	0.39%	0.3094	5.6	2.40%	0.9074	18.2	-12.6
2000	A	MPS	0.08%	0.1039	2.2	0.12%	0.1767	4.4	-2.2
2001	A	MPS	0.38%	0.6148	24.5	2.62%	1.2333	46.5	-22.0
2002	A	MPS	1.01%	0.5414	17.4	1.20%	0.3162	10.6	6.8
2003	A	MPS	2.45%	0.8025	16.4	1.18%	0.3398	6.6	9.8
2004	A	MPS	0.91%	0.4774	7.7	5.20%	1.2296	22.4	-14.8
2005	A	MPS	0.00%	0.0000	1.5	2.95%	0.8737	17.4	-15.8
2006	A	MPS	0.34%	0.8025	25.4	3.46%	1.3548	43.8	-18.3
2007	A	MPS	--	--	--	3.14%	1.6055	--	--
2008	A	MPS	--	--	--	1.86%	1.4123	--	--
2009	A	MPS	0.03%	0.2775	8.3	1.33%	2.5901	70.0	-61.6
2010	A	MPS	0.27%	0.6589	14.7	1.91%	0.8352	22.2	-7.5
2011	A	MPS	--	--	--	1.33%	0.4752	--	--
2012	A	MPS	0.44%	0.7162	17.9	4.11%	0.8439	20.6	-2.6
1984	B	NIS	--	--	'--	--	--	--	--
1985	B	NIS	--	--	'--	--	--	--	--
1986	B	NIS	0.00%	0.0000	0.0	0.00%	0.0000	0.0	0.0
1987	B	NIS	0.00%	0.0000	0.0	0.00%	0.0000	0.0	0.0
1988	B	NIS	0.00%	0.0000	0.0	0.00%	0.0000	0.0	0.0
1989	B	NIS	--	--	--	1.13%	0.7367	--	--
1990	B	NIS	2.09%	1.2811	16.3	2.09%	1.5288	19.4	-3.1
1991	B	NIS	4.59%	3.0146	6.9	2.84%	1.7545	4.8	2.1
1992	B	NIS	0.00%	0.0000	0.0	1.65%	0.9543	5.3	-5.3
1993	B	NIS	0.00%	0.0000	0.0	0.98%	0.4947	2.7	-2.7
1994	B	NIS	--	--	--	0.13%	0.6346	--	--
1995	B	NIS	--	--	--	0.84%	1.1140	--	--
1996	B	NIS	--	--	--	0.46%	0.4747	--	--
1997	B	NIS	--	--	--	0.40%	0.3435	--	--
1998	B	NIS	0.00%	0.0000	0.0	0.39%	0.2762	4.1	-4.1

[3] Note ‘MPS’ corresponds to the CTC ‘SPS’ indicator stock.

FY	CFCZ?	Stock[3]	Non-treaty (NT)			Treaty Indian (TI)			NT-TI Rec Diff.
			ER	Std ER	Recs/10K	ER	Std ER	Recs/10K	
1999	A	NIS	0.00%	0.0000	0.0	2.73%	1.0326	14.9	-14.9
2000	A	NIS	0.27%	0.3590	2.2	0.81%	1.2196	8.1	-5.9
2001	A	NIS	0.08%	0.1333	2.1	3.00%	1.4115	15.7	-13.7
2002	A	NIS	1.03%	0.5496	7.6	1.54%	0.4049	5.5	2.1
2003	A	NIS	1.58%	0.5187	7.9	1.64%	0.4719	7.4	0.5
2004	A	NIS	1.21%	0.6353	9.8	2.32%	0.5486	9.2	0.5
2005	A	NIS	0.00%	0.0000	0.0	1.83%	0.5420	6.7	-6.7
2006	A	NIS	0.12%	0.2949	7.9	4.16%	1.6285	46.8	-38.9
2007	A	NIS	--	--	--	3.50%	1.7870	--	--
2008	A	NIS	--	--	--	0.86%	0.6501	--	--
2009	A	NIS	0.05%	0.4493	8.3	1.40%	2.7252	44.6	-36.3
2010	A	NIS	0.22%	0.5350	9.4	2.49%	1.0904	17.6	-8.2
2011	A	NIS	--	--	--	2.24%	0.7995	--	--
2012	A	NIS	0.25%	0.4175	6.2	3.82%	0.7845	10.7	-4.5
1984	B	GAD	--	--	--	--	--	--	--
1985	B	GAD	--	--	--	--	--	--	--
1986	B	GAD	--	--	0.0	--	--	0.0	0.0
1987	B	GAD	--	--	0.0	--	--	0.0	0.0
1988	B	GAD	--	--	0.0	--	--	2.3	-2.3
1989	B	GAD	--	--	--	1.79%	1.1741	--	--
1990	B	GAD	1.16%	0.7131	9.4	1.42%	1.0400	15.7	-6.3
1991	B	GAD	2.95%	1.9375	18.1	0.19%	0.1178	1.0	17.1
1992	B	GAD	3.23%	1.8891	3.3	3.23%	1.8641	4.5	-1.2
1993	B	GAD	0.00%	0.0000	0.0	5.56%	2.7957	3.2	-3.2
1994	B	GAD	--	--	--	0.00%	0.0000	--	--
1995	B	GAD	--	--	--	0.00%	0.0000	--	--
1996	B	GAD	--	--	--	1.08%	1.1198	--	--
1997	B	GAD	--	--	--	2.26%	1.9550	--	--
1998	B	GAD	1.52%	3.6483	18.8	0.00%	0.0000	0.0	18.8
1999	A	GAD	0.56%	0.4414	3.7	3.14%	1.1846	9.4	-5.7
2000	A	GAD	1.45%	1.9241	16.4	1.56%	2.3374	19.0	-2.6
2001	A	GAD	0.11%	0.1767	1.7	3.76%	1.7691	14.6	-12.9
2002	A	GAD	2.00%	1.0701	10.3	0.57%	0.1502	1.6	8.7
2003	A	GAD	0.95%	0.3112	2.7	3.13%	0.9021	7.9	-5.2
2004	A	GAD	1.23%	0.6438	7.6	2.46%	0.5816	7.8	-0.2
2005	A	GAD	0.51%	0.4282	5.7	3.42%	1.0128	15.3	-9.5
2006	A	GAD	0.50%	1.1844	13.7	1.75%	0.6833	7.6	6.0
2007	A	GAD	--	--	--	1.78%	0.9113	--	--
2008	A	GAD	--	--	--	0.40%	0.3042	--	--
2009	A	GAD	0.00%	0.0000	0.0	1.26%	2.4510	38.5	-38.5
2010	A	GAD	0.00%	0.0000	0.0	1.90%	0.8341	15.3	-15.3
2011	A	GAD	--	--	--	1.46%	0.5218	--	--
2012	A	GAD	0.37%	0.6132	16.8	2.87%	0.5887	16.7	0.1