Marine Area 7
Mark-Selective Recreational Chinook Fishery,
February 1 - April 15, 2009

Post-season Report
REVISED DRAFT

June 11, 2010

Prepared by:

Mark Baltzell, Steve Caromile, Karen Kloempken and Laurie Peterson

Washington Department of Fish and Wildlife
Fish Program
600 Capitol Way North
Olympia, Washington 98501

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

The Washington Department of Fish and Wildlife (WDFW) implemented a mark-selective Chinook fishery (MSF) in Marine Area 7 for the second winter season from February 1 through April 15, 2009. Consistent with the 2004 Puget Sound Chinook Harvest Management Plan (Puget Sound Indian Tribes and WDFW 2004) and the intent of previous Puget Sound/Strait of Juan de Fuca mark-selective Chinook fisheries, the primary goal for this pilot fishery was to provide meaningful opportunity to the recreational angling public while minimally impacting ESA-listed Puget Sound Chinook salmon. WDFW's Puget Sound Sampling Unit (PSSU) implemented an intensive monitoring program in Area 7 throughout the season in order to collect the data needed to estimate key parameters characterizing the fishery and its impacts on unmarked salmon. Sampling activities included dockside creel sampling, test fishing, and aerial effort surveys, and we collected voluntary trip reports from charter boat operators and the angling public. Among other parameters, efforts emphasized data collection needs for the estimation of: *i*) the mark rate of the targeted Chinook population, *ii*) the total number of Chinook salmon harvested (by size [legal or sublegal] and mark-status [marked or unmarked] group), *iii*) the total number of Chinook salmon released (by size and mark-status group), *iv*) the coded-wire tag- (CWT) and/or DNA-based stock composition of marked and unmarked Chinook mortalities[1], and *v*) the total mortality of marked and unmarked double index tag (DIT) CWT stocks.

Creel samplers staffed four different access sites on 52 of the 74 days that Area 7 was open under mark-selective harvest regulations. Samplers interviewed an estimated 37% of all participating anglers (n = 2,991 angler trips) and sampled 50% of all marked Chinook harvested (n = 713 ad-marked Chinook sampled). Additionally, other PSSU staff conducted twelve aerial effort surveys, and spent 42 days (246.5 hours) on the water pursuing Chinook using test fishing methods, in support of Area 7 monitoring efforts. Based on these activities, we estimated that 8,167 angler trips were completed by a combination of private fleet, charter, and derby anglers during the fishery. With a CPUE of 0.17 Chinook landed per angler trip, we estimate that these anglers harvested a grand total of 1,420 marked Chinook, while they released an estimated 1,073 Chinook (349 marked and 724 unmarked). Harvested Chinook averaged 74 cm (range: 48 to 115 cm) in total length and were larger than the legal minimum size limit ($\geq$22 in or 56 cm TL) in most instances (dockside marked Chinook observations, 706 legal-marked/713 total marked, or 99%). The majority (88%) of all harvested individuals were 4-year olds (brood year 2005), with age-3 fish primarily making up the catch remainder. In addition, 81 CWTs were recovered from harvested fish, the majority of which were from Puget Sound (82.7%, predominantly from north Puget Sound facilities) and Hood Canal (9.9%) release sites.

During their sampling in Area 7, test fishers encountered 40 Chinook salmon, of which 93% were legal size, and 65% of the legal-size fish were ad-marked. The overall mark rate (legal and sublegal Chinook combined) in the test fishery was also 65%. With a "CPUE" of 0.28 (LM Chinook encounters / angler trip), test fishers experienced a legal-marked Chinook

[1] Though the necessary tissue samples have been collected, DNA-based estimates of stock composition are presently unavailable for Puget Sound/Strait of Juan de Fuca mark-selective fisheries. In the present report, CWT-based (unexpanded) estimates of the stock composition of marked Chinook harvest are provided.

encounter rate that was nearly two times that of charter, derby, and at-large private fleet anglers combined. Chinook encountered by test fishers averaged 73 cm (range: 49 to 87 cm) in total length and were predominantly 4 years in age (73% of marked and 79% of unmarked totals). Given the limited number of test fishery encounters, we chose to pool data across sources (test fishery, charter angler, and private fleet VTRs) in order to estimate the mark rate and size/mark-status composition of the pool of Chinook encountered in the Area 7 fishery. As a result, we estimated the overall mark rate at 71% and size/mark-status composition at 64.6% legal-marked, 28.6% legal-unmarked, 6.1% sublegal-marked, and 0.7% sublegal-unmarked.

By combining dockside sampling results (i.e., legal-marked Chinook harvest estimates) with the size/mark-status composition data from the test fishery as well as private fleet and charter boat VTRs, we generated size/mark-status group-specific estimates of encounters and mortalities. We estimated that a total of 2,501 Chinook were encountered (retained and released) during the Area 7 winter 2009 mark-selective Chinook fishery, with 1,615 of these being legal-marked, 716 legal-unmarked, 153 sublegal-marked, and 17 sublegal-unmarked individuals. Among released encounters, an estimated 31 legal-marked, 106 legal-unmarked, 28 sublegal-marked, and 3 sublegal-unmarked Chinook (169 overall) were estimated to have died due to handling and release effects. Thus, in total, 1,597 Chinook (1,479 marked and 118 unmarked) mortalities occurred (89% due to direct harvest) as a result of the Area 7 fishery.

The number of fish estimated to have been impacted by the Area 7 winter 2009 fishery was considerably less than was predicted based on pre-season modeling results with the Fishery Regulation Assessment Model (FRAM). Whereas FRAM predicted that a total of 5,107 Chinook would have been encountered during the fishery, field data indicated that actual encounters were 49% of this value.

Finally, regarding impacts of MSFs on the coded-wire tag (CWT) program, we estimated that 8 unmarked Chinook belonging to double-index tag (DIT) groups may have died due to the handling-and-release impacts of the pilot winter 2009 Area 7 fishery.

INTRODUCTION

In recent years, abundant runs of hatchery Chinook salmon (*Oncorhynchus tshawytscha*) have been mixed with depressed runs of wild Chinook salmon in the marine environments of the Puget Sound and Strait of Juan de Fuca. Providing recreational anglers with opportunities to harvest abundant hatchery stocks while simultaneously protecting weaker, wild stocks has proven to be a significant conservation and management challenge. The combination of large-scale hatchery marking (i.e., fin clipping) programs and mark-selective harvest regulations makes it possible for anglers to pursue and harvest hatchery Chinook salmon while minimally impacting wild salmon populations. In such "mark-selective fisheries" (MSFs), anglers are generally allowed to retain adipose-fin clipped ("marked") hatchery fish and are required to release unharmed any unclipped ("unmarked", predominantly wild) salmon encountered[2].

Since the first marine selective Chinook fishery occurred in Marine Catch Areas 5 and 6 (Strait of Juan de Fuca) in 2003 (WDFW 2008a), mark-selective Chinook salmon fishing regulations have been implemented on a pilot basis in multiple Puget Sound Marine Catch Areas during both summer and winter seasons. As of the close of the 2007-08 fishing season, pilot *summer* selective Chinook seasons have occurred in Areas 5 and 6 for six years (2003-2008; WDFW 2008a; WDFW 2009a) and in Areas 9, 10, 11, and 13 for two years (2007 and 2008; WDFW 2007a and 2007b, WDFW 2009b and 2009c); pilot *winter* selective Chinook fisheries have occurred in Areas 8-1 and 8-2 for three complete seasons (2005-06, 2006-07, and 2007-08; WDFW 2008b, WDFW 2009d). From February 1 - April 15, 2009, the Washington Department of Fish and Wildlife (WDFW) implemented the second year of the mark-selective Chinook fishery in Area 7 during the winter season. Consistent with the 2004 Puget Sound Chinook Harvest Management Plan (Puget Sound Indian Tribes and WDFW 2004) and the intent of previous mark selective Chinook fisheries, the primary goal for this pilot fishery was to provide meaningful opportunity to the recreational angling public while minimally impacting ESA-listed Puget Sound Chinook salmon.

Given the pilot nature of the Area 7 winter selective Chinook fishery, WDFW's Puget Sound Sampling Unit was tasked with implementing an intensive monitoring program during the entirety of the February 1 – April 15, 2009 season. Our primary goal was to collect the data needed to estimate key parameters characterizing this fishery and its impacts on unmarked salmon. As per State–Tribal agreement (WDFW and NWIFC 2008), we tailored our sampling so that we could reliably estimate: *i*) the mark rate of the targeted Chinook population, *ii*) the total number of Chinook salmon harvested (by size [legal or sublegal] and mark-status [marked or unmarked] group), *iii*) the total number of Chinook salmon released (by size and mark-status group), *iv*) the coded-wire tag- (CWT) and/or DNA-based stock

[2]The regulations specific to the winter 2009 Area 7 mark-selective fishery allowed for the retention of up to two legal-sized ($\geq$22 inches [56 cm]) marked Chinook salmon per day and required the immediate release of all unmarked or sublegal Chinook. Additionally, anglers were: *i*) required to use single-point, barbless hooks while fishing for salmon, *ii*) held to a combined (all salmon species) two-fish daily limit during the Area 7 mark-selective fishery, and *iii*) held to a handling rule that prevented them from bringing unmarked and/or sublegal Chinook aboard their vessels.

composition of marked and unmarked Chinook mortalities[3], and *v*) the total mortality of marked and unmarked double index tag (DIT) CWT stocks. In addition, we acquired and analyzed relevant data characterizing other aspects of the pilot fishery, including descriptors of fishing effort, fishing success (catch [landed Chinook] per unit effort), the length and age composition of encountered Chinook, and the overall intensity of our sampling efforts.

In the following pages, we report the results generated through our Area 7 monitoring activities from February 1 through April 15, 2009. We first provide a brief review of our in-season sampling and post-season assessment methods and then present detailed results for each component of our selective-fishery monitoring program. Results are presented according to the following sequence: *i*) the intensity (i.e., spatial and temporal coverage) of sampling efforts is described; *ii*) estimates of fishery characteristics obtained from creel survey data are reviewed; *iii*) the results from our recreational test fishery are presented; and *iv*) total fishery impacts—estimated based on the combination of creel and test fishery data—are reviewed and compared with pre-season expectations (i.e., based on Fishery Regulation Assessment Model [FRAM] predictions). Finally, we provide a detailed description of our impact estimation scheme as well as additional and relevant data in a series of appendices (i.e., sample-rate tables and sampling summaries; age composition tables [for landed catch and test fishery encounters]; and raw CWT recoveries).

METHODS

Marine Catch Area Description

Area 7 encompasses the marine waters in and around the San Juan Islands. Its boundaries extend from mainland Washington in the east (inclusive Bellingham Bay) to the US–Canada border in the west, and from approximately Smith Island in the south to the US–Canada border in the north (**Figure 1**). Covering more than 800 square miles (2,050 km^2) of marine waters, Area 7 is one the largest WDFW Marine Catch Areas in Washington's Strait of Juan de Fuca/Puget Sound region (i.e., Areas 5-12). In terms of its characteristics as a winter fishery, Area 7 experiences both local and destination-based (i.e., tourist) angling effort; the majority of this effort is focused on immature Chinook salmon (i.e., "blackmouth").

Monitoring Program Overview

Our sampling program for the Area 7 fishery incorporated comprehensive and complementary data collection strategies, including dockside angler interviews (with catch sampling), aerial effort surveys, test-fishery-based sampling, and voluntary reports of completed trips provided by charter anglers, private anglers, and derby participants (Roche Harbor Salmon Classic, February 6-7, 2009) (**Figure 2**). Given that we relied on aerial surveys rather than boat surveys for the aerial-access sampling design in Area 7 (i.e., the design implemented successfully for the first year of the pilot Area 7 winter selective Chinook fishery during February 2008; see WDFW 2009e), we provide complete detail on this aspect of our design.

[3] Though the necessary tissue samples have been collected, DNA-based estimates of stock composition are presently unavailable for Puget Sound/Strait of Juan de Fuca mark-selective fisheries. In the present report, CWT-based (unexpanded) estimates of the stock composition of marked Chinook harvest are provided.

For other aspects of our monitoring program, we provide only a brief review and refer the reader to WDFW (2007b or 2008b) for additional detail.

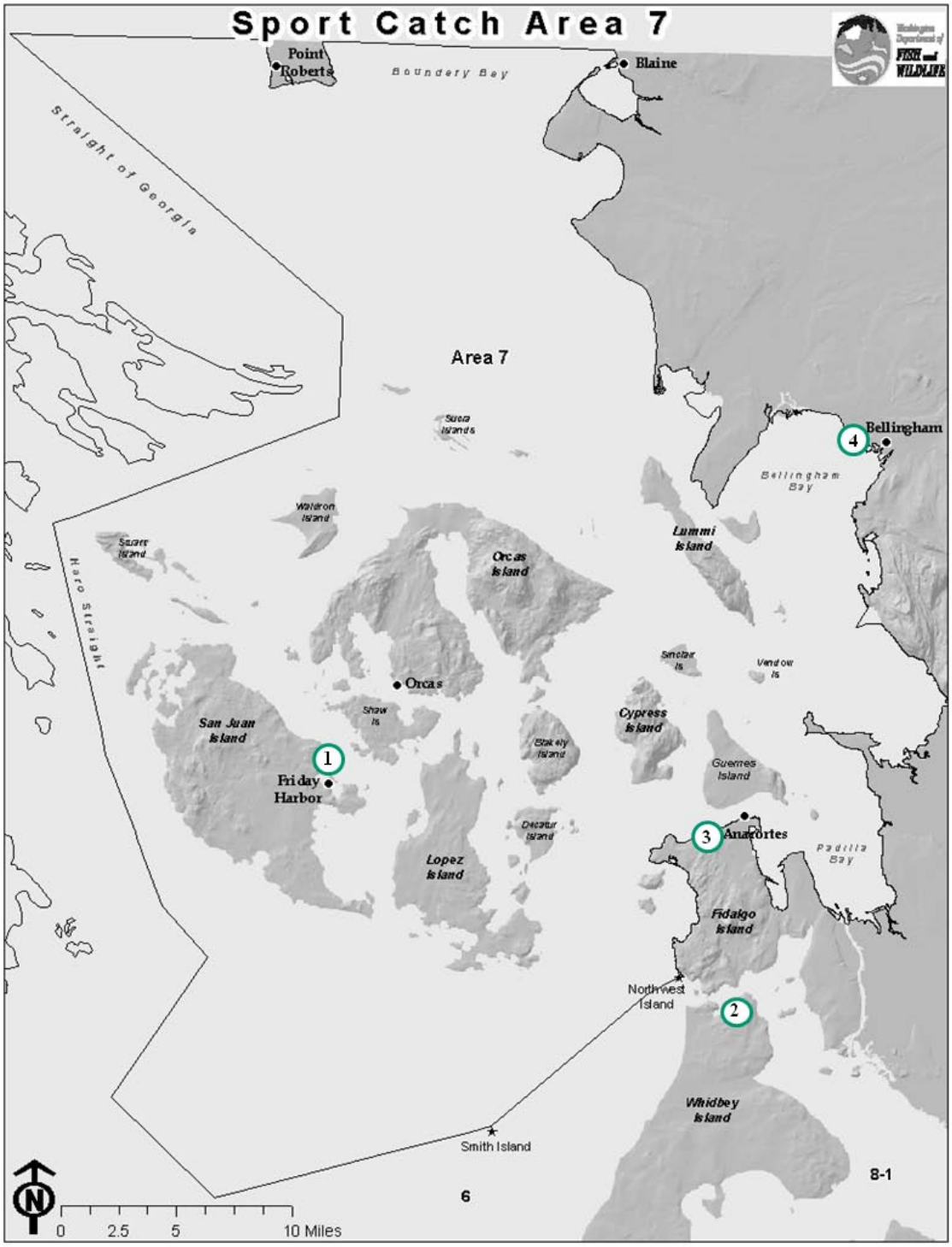

Figure 1. Map of Marine Catch Area 7 in Puget Sound. Open white circles correspond to the approximate location of the four public ramps or marinas where angler interviews and catch sampling occurred (1 = Friday Harbor Marina, 2 = Cornet Bay State Park Ramp, 3 = Washington Park Ramp, 4 = Bellingham Ramp).

Catch and Effort: Sampling and Estimation

We collected data on total catch (observed harvest and reported releases[4]) and total angling effort using an aerial–access design whereby: 1) catch and effort data were obtained by interviewing *all* anglers departing the fishery at four access sites that were staffed on randomly selected sample days (within Monday-Thursday and Friday-Sunday strata); 2) the fraction of total fishing effort contained in our sample frame was estimated from paired peak activity counts (i.e., boats) for sample frame sites and peak aerial boat counts (i.e., for all of Area 7) on days when both dockside sampling and aerial surveys were possible; and 3) total catch and effort estimates were obtained for all sample days by expanding sample-frame observations by the estimated sample fraction.

Dockside Sampling

We collected data on total catch and total angling effort using a two-stage stratified sample design. At the first stage, we selected five sample days from two temporal strata (weekday [Monday-Thursday], with $n = 2$ days sampled; weekend [Friday-Sunday], with each day always being sampled) during each week of the Area 7 winter fishery. On selected sample days, we staffed access sites (i.e., public ramps, boathouses, etc.) for creel sampling. Our dockside sample frame included four moderate-to-high effort, public boat launch facilities used to access Area 7 (these were fixed sites throughout the season as part of the aerial-access design), including: Bellingham, Cornet, and Washington Park ramps and Friday Harbor marina. In contrast to the approach we have used in other marine areas (i.e., $n = 2$ sites are randomly [non-uniform probabilities based on-the-water interviews] chosen from a sample frame; WDFW 2007b), we staffed *all* four sites on scheduled sample days. We opted to visit all sample sites on scheduled sample days so that we could maximize our sample size and minimize the degree of expansion required to obtain fishery-wide estimates of catch, effort, and angler-reported releases. Finally, given that some effort was excluded from our sample frame (i.e., private and/or low-effort access sites), we estimated sample frame coverage from aerial overflight data and accounted for this quantity in estimates of fishery-wide totals (see below and **Appendix A**).

At access sites selected for sampling on scheduled sample days, samplers interviewed *all* parties (from both fishing and non-fishing vessels) exiting the Area 7 fishery. During interviews, samplers acquired data on trip duration (time of start, time of finish), trip intent (i.e., targeted species), fishing method(s) employed (downrigger or diver trolling, jigging, mooching, or other), and fish encountered (kept and/or released, by species). When an interviewed party possessed Chinook or coho salmon, samplers inspected them for CWTs using wand detectors, and collected snouts from CWT-positive individuals for later lab processing. Additionally, samplers took length measurements (fork and total) and scale samples from landed Chinook.

[4] In a recent evaluation of bias in mark-selective fishery parameter estimates, Conrad and McHugh (2008) concluded that recall errors likely cause bias in interview-based estimates of total salmon *releases*. Thus, although estimates of total salmon releases based solely on angler-reported data were generated for this report (**Appendix G**), we focus exclusively on bias-corrected "Method 2" estimates of Chinook encounters (and releases) in our review of the Area 7 fishery.

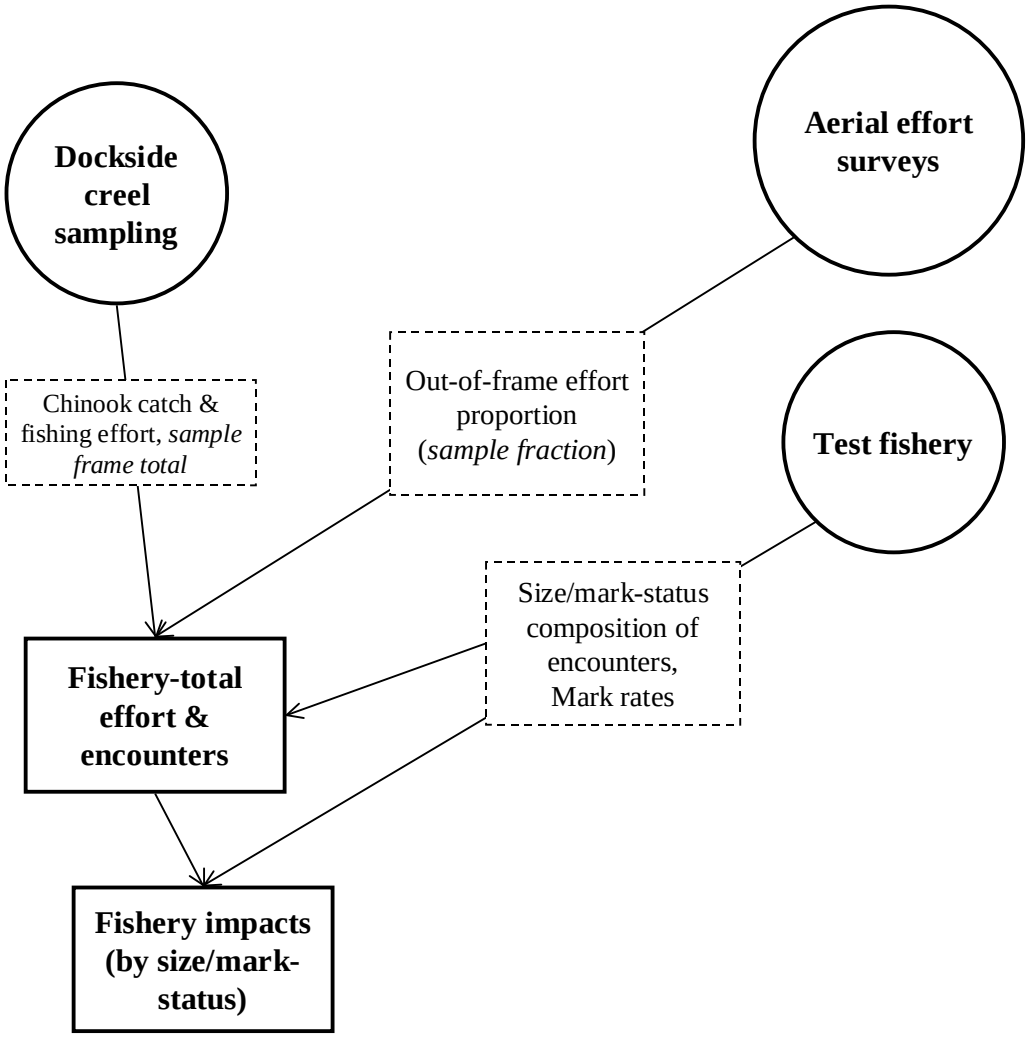

Figure 2. Conceptual diagram of the monitoring plan implemented in Area 7 during its February 1 - April 15, 2009 mark-selective Chinook season. Circles represent discrete sampling activities, dashed boxes represent parameters that are estimated using data from a given activity, and solid boxes depict key quantities estimated from the comprehensive plan. 'Encounters' includes both harvested and released Chinook salmon.

Aerial Surveys

Due to its vast size and complex geography, we used an aerial overflight approach to estimate total Area 7 effort and thus the proportion of effort captured in our four-site sample frame (i.e., the sample fraction [f = 1 – the out-of-frame effort prop'n]). Surveys were conducted on a subset (n = 12) of scheduled (i.e., dockside) sample days and were timed to coincide with the assumed period of peak activity for winter fisheries (1000-1400). Trained WDFW staff conducted the surveys from fixed-wing aircraft piloted by WDFW-enforcement or chartered personnel. For each aerial survey, samplers (aerial observers) circumnavigated the entirety of Area 7 and counted all recreational vessels observed while marking them on a map form.

Aerial observers made no attempt to distinguish recreational boats as being either fishing or non-fishing in nature; however, obvious non-fishing vessels such as sail boats, commercial crabbing vessels, etc., were noted as such on forms and omitted from final counts. Flights took 1.25 h (time over Area 7) on average and were flown at an elevation of 1,000 ft (305 m).

For each flight, we estimated the sample fraction, *f*, by pairing the aerial total boat count with the sample-frame total for boats active during the flight period (i.e., determined from interview details). We then obtained stratum-specific estimates of the mean sample fraction (and its variance) and used these values to obtain stratum- and fishery-total estimates of angling effort and landed catch (**Table 1**). The estimators (totals and variances) associated with this complemented aerial–access approach are provided in **Appendix A**. In addition, to minimize the influence of recall bias on our assessment, we estimated Chinook releases as the difference between estimated catch (i.e., based on *observed* landings) and total Chinook encounters (i.e., releases = encounters – retained catch) generated using the bias-corrected Conrad and McHugh (2008) approach. Briefly, encounters were estimated by dividing the creel estimate of legal-marked Chinook harvest by a field estimate of the proportion of the fishable Chinook population that is of legal size and marked (i.e., our former "Method 2" approach; e.g., WDFW 2007a). Given that this approach yields negatively biased estimates if anglers release any of the legal-marked Chinook they encounter, Conrad and McHugh estimated a "correction" factor to account for this phenomenon and incorporated it into their estimator. See **Appendix B** for complete computational details. Although we do not review estimates of Chinook releases based solely on angler accounts in our assessment, we supply these estimates, as well estimates of retained catch and/or releases for other salmon species, in **Appendix G**.

Voluntary Trip Reports

Voluntary Trip Reports (VTRs) were also completed and returned by a subset of private fleet anglers, to obtain additional information on Chinook encounter rates by mark status and size class in the Area 7 winter 2009 mark-selective fishery. Anglers were asked to record the date, number of anglers, target species, catch Area, each Chinook or coho hooked, whether the fish was kept or released, species (if they positively identified the fish), total length to the nearest 1/8th inch, and whether the fish was adipose fin-clipped (marked) or not clipped (unmarked).

Charter and Derby Sampling

Given the higher catch per unit effort (CPUE) of charter and derby anglers relative to that of the private recreational fleet and the difficulty in directly sampling their catch (e.g., due to private moorage), we acquired catch (harvest + releases) and effort data for these anglers through separate efforts. First, before the start of the season we contacted all salmon charters with known operations in Area 7 and requested that they provide catch and effort information for all paid trips taken during the fishery. We supplied all charter captains with postage-paid Voluntary Trip Report (VTR) forms and a memo detailing instructions for proper form completion. For fishery-total catch and effort estimation efforts, charter data were treated as being the result of a complete census (i.e., with zero variance). Second, we took extra measures to acquire catch (harvest and releases) and effort data for the Roche Harbor Salmon

Classic Invitational Derby (February 6-7, 2009). With the cooperation of derby staff and participating anglers, we attempted to acquire information on catch and effort using derby-specific VTR forms. Also, WDFW personnel staffed the derby to encourage VTR completion as well as to collect biological data (lengths, scales, and coded-wire tags) from landed Chinook.

Due to a lower than expected VTR return rate from Roche Harbor Derby participants, we could not reliably census the total Chinook encounters (retained *and* released) in the derby based on VTR returns; nevertheless, we obtained length and scale samples from 104 of the 141 landed (weighed) Chinook in the derby, and derby organizers provided information on total angler trips, boats, and numbers of harvested Chinook. To estimate total Chinook releases (and associated variances) in the Roche Harbor Derby, we applied the Conrad and McHugh (2008) approach, the same method used to estimate Chinook releases for the private-boat fleet in Area 7.

Test Fishery Methods

In order to obtain accurate estimates (i.e., free from survey-based recall error) of the size (legal or sublegal) and mark-status (marked or unmarked) composition of the pool of Chinook salmon encountered by anglers participating in the fishery, we conducted a recreational test fishery during the entirety of the Area 7 winter 2009 mark-selective Chinook season (**Table 1**). Our test boat crew consisted of two WDFW technicians, each fishing with a single rod for approximately five days a week (Monday-Friday; weather permitting). Test fishers focused their efforts at locations that optimized their overall encounter rate and mirrored choices made by the at-large private fleet. Also, test fishers fished for Chinook using the same methods as the recreational fleet, as prescribed by supervisory staff based on dockside interview results for the preceding week. For each fish brought to boat, test fishers logged details on its identity (species), size (fork length and total length), and, if applicable, mark status (marked or unmarked). For Chinook salmon encounters only, test fishers additionally collected scale and DNA samples (~1-cm^2 piece of dorsal fin tissue).

Estimating Fishery Impacts

Total Encounters and Mortalities

We characterized the overall impacts of the fishery in terms of grand-total estimates of encounters and mortalities and by using estimates specific to each of the four size/mark-status groups (i.e., legal-marked [LM], sublegal-marked [SM], legal-unmarked [LU], and sublegal-unmarked [SU]; **Table 1**). As indicated above and in contrast to previous post-season MSF reports (i.e. reports completed prior to August 2008), we used only one approach to estimate total Chinook encounters and, consequently, mortalities. This single method was selected as a result of a thorough state–tribal review of bias potential in estimators of encounters in MSFs (see Conrad and McHugh 2008 for details). In brief, total encounters were estimated by dividing creel estimates of legal-marked Chinook harvest by the test fishery-based proportion of the targeted Chinook population that was of legal size and marked, inclusive of a bias correction accounting for the modest level of legal-marked Chinook release that may occur in

this fishery. We then decomposed total encounters into size/mark-status group-specific estimates using test-fishery encounters composition data.

We estimated total Chinook mortality resulting from the fishery by applying assumed mortality rates to the total harvest and release estimates for the four size/mark-status groups (LM, LU, SM, and SU). For retained Chinook, the mortality estimate was equivalent to the total harvest estimate for the applicable size/mark-status group. We applied selective fishing mortality (*sfm*) rates of 15% and 20% to legal (marked and unmarked) and sublegal (marked and unmarked) release totals, respectively, to estimate release mortality. See **Appendix B** for a complete description of our impact estimation procedure, including formulae for total and variance estimators.

The final step of our overall impacts assessment involved comparing fishery outcomes to pre-season expectations. To do this, we compared season-total estimates of Chinook encounters and mortalities to pre-season modeled values (FRAM model run no. 2108) for each size and mark-status category.

Table 1. Sampling/estimation details on target parameters associated with the overall Area 7 mark-selective fishery monitoring program (**Figure 1**).

Activity	Focal Parameter(s)	Secondary Parameter(s)	Sample Unit(s)	Finest Estimation Time Step	Comments
Dockside Creel Sampling	Fishing effort (boat & angler trips); kept and released fish[1]	Catch rates (CPUE); length, age, and CWT composition of harvest[2]	Angler trip; kept fish; reported fish release	Week[1]	Within weeks, estimates are also produced by strata (weekday/weekend).
Test Fishing	Size (legal/sublegal) and mark-status composition (marked, unmarked) of encountered Chinook	Chinook length, age, and DNA-based[3] stock composition; species composition of non-Chinook encounters	Fish encounter	Season	Too few encounters occurred to assess mark rates on a finer time scale. In fact, VTRs were ultimately used to bolster test fishery sample sizes.
Overall Fishery Impacts Estimation	Total Chinook encounters and mortalities, by size/mark-status group	Ratios of encounters and mortalities per kept Chinook	N/A	Season	The temporal resolution of impact estimates is constrained by that of the test-fishery encounters data.
Coded-wire tag (CWT) Impacts Estimation	Marked/unmarked double-index tag (DIT) encounters and mortalities	N/A	N/A	Season	The temporal resolution of DIT impacts is constrained by the total number of tags recovered.

[1] Under the "bias-corrected Method-2" approach, Chinook releases can be estimated only as finely as test fishery data allow.
[2] The length and CWT composition of landed catch was assessed on a season-wide basis for impact estimation.
[3] Though samples were collected, DNA-based estimates of stock composition are not yet available for this fishery.

CWT Impacts

To understand the potential effects of the Area 7 mark-selective fishery on CWT-based cohort-reconstruction efforts, we estimated the total number of unmarked-tagged Chinook mortalities that may have occurred during the course of its February 1 – April 15, 2009

season. To do this, we acquired information for all marked CWT double index tag (DIT) groups present in landed catch from the Pacific States Marine Fisheries Commission's Regional Mark Information System (RMIS) and then applied the methods described by the Selective Fisheries Evaluation Committee – Analysis Work Group (SFEC-AWG 2002) to estimate the number of unmarked DIT fish encountered[5]. We subsequently estimated the number of these fish that may have died due to hook-and-release impacts using an *sfm* analogous that used in FRAM modeling. Given our interest in characterizing the impacts of mark-selective regulations on the CWT program and not recreational fishing in general, we used an *sfm* of 10% in all unmarked-DIT mortality calculations. Thus, we used 10% instead of 15% (applied above to legal-sized releases) since unseen drop-off mortality (the 5% differential) is a feature common to selective and non-selective recreational Chinook fisheries.

RESULTS & DISCUSSION

Summary of Sampling Efforts

Ramp samplers were present at the four selected access sites (Bellingham, Cornet, and Washington Park ramps, and Friday Harbor marina) for the entirety (dawn-dusk shifts) of 52 scheduled sample days. This included 21 weekdays, 10 Fridays, and 21 weekend days (**Table 2**). Dockside efforts yielded samples of 1,414 boat trips, 2,991 angler trips, and 719 landed Chinook (713 marked, 4 unmarked, and 2 undetermined) throughout the duration of the fishery. Overall, Washington Park (43% of sampled angler trips) and Bellingham ramps (35%) produced the majority of effort contained in our sample frame, while 10-12% of all sampled angler trips originated from each Cornet Ramp, and Friday Harbor Marina.

In total, we conducted twelve overflights during the Area 7 winter 2009 fishery (2 weekday, 3 Friday, and 7 weekend flights; **Table 2**; **Appendix D**). All flights occurred during periods of high activity, and viewing conditions were excellent in all cases. Over the twelve surveys, aerial observers counted between 15 and 155 (average = 92) recreational vessels in Area 7; between 6 and 116 (average = 48) of these boats returned to sites contained in our dockside sample frame (based on trip times reported during interviews).

[5] For all unmarked-DIT encounters and mortalities calculations, we relied on the unmarked-to-marked abundance ratio (λ) estimated for DIT groups at the time of juvenile release.

Table 2. Sampling calendar for the February 1 - April 15, 2009 Area 7 mark-selective Chinook fishery. Shaded cells are days when dockside creel sampling was conducted at all four sample-frame sites; "A" denotes days when aerial surveys occurred; "TF" represents test-fishing days; "RD" represents supplemental Roche Harbor Derby sample days; "AD" represents supplemental Anacortes Derby sample days. Bold outer boxes denote strata boundaries (Weekday [Monday-Thursday] and Weekend [Friday-Sunday]).

February 2009

Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.
1 **A**	2 **TF**	3 **TF**	4 **TF**	5 **TF**	6 **RD**	7 **RD**
8	9	10	11 **TF**	12 **TF**	13 **TF**	14 **A**
15	16	17 **TF**	18	19 **A, TF**	20 **TF**	21 **A**
22	23 **TF**	24 **TF**	25 **TF**	26 **TF**	27 **A, TF**	28

March 2009

Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.
1	2	3 **TF**	4 **TF**	5 **TF**	6 **TF**	7
8	9 **TF**	10 **TF**	11 **TF**	12 **TF**	13 **A, TF**	14
15	16	17 **A, TF**	18 **TF**	19 **TF**	20 **TF**	21 **A**
22	23 **TF**	24 **TF**	25 **TF**	26 **TF**	27 **TF**	28 **AD**
29 **A, AD**	30	31				

April 2009

Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.
			1 **TF**	2 **TF**	3 **TF**	4 **A**
5	6 **TF**	7 **TF**	8 **TF**	9 **TF**	10 **A, TF**	11 **A**
12	13 **TF**	14 **TF**	15 **TF**	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

Based on the combination of aerial boat counts and dockside observations of boats active during flights, we estimated that on average approximately half (52%) of all Area-7 fishing effort originated from sites contained in our sample frame (**Appendix D**). At 53% and 51%, respectively, the average sample fraction was higher for weekends than it was for weekdays, and both averages were slightly higher than the average sample fraction for Fridays (49%); these differences were not significant, however (**Appendix A**). Thus, flight data were pooled across strata for total estimation.

Fishery Characteristics

Estimates of Fishing Effort and Catch

An estimated 8,167 angler trips were completed by a combination of private fleet, charter, and Roche Harbor Derby anglers during the February 1 - April 15, 2009 Area 7 mark-selective Chinook fishery (**Table 3**). We estimated that the three groups harvested a grand total of 1,420 marked Chinook (and 9 unmarked) and released an additional 1,073 Chinook (349 marked, 724 unmarked).

Private fleet anglers completed a total of 7,471 angler trips (3,565 boat trips) in Area 7 during the 2009 winter selective season (**Table 3**). Over these trips, we estimated that a total of 1,286 Chinook (1,277 marked, 9 unmarked) were retained, yielding a private fleet catch per unit effort (CPUE) of 0.17 retained Chinook per angler trip (**Table 3**). We also estimated that a total of 963 Chinook salmon (314 marked and 649 unmarked) were caught and released by this group of anglers.

Charter fishing activity constituted a minor portion of total fishing activity (0.3% of all angler trips) present in Area 7 (**Table 3**). Two separate charter operators reported taking clients fishing during the fishery, resulting in a total of 26 charter-led angler trips (8 boat trips). These charter anglers encountered a total of 5 Chinook salmon; of these, 2 were retained ad-marked fish, while 3 were released unmarked Chinook. At 0.08 retained Chinook per angler trip, charter-angler CPUE was approximately half of the non-charter private fleet. Charter anglers retained all legal-marked encounters.

In contrast to salmon charters, the Roche Harbor Salmon Classic Invitational Derby (February 6-7, 2009) generated a significant amount of catch (10% total landed Chinook) and effort (8% of total angler trips) relative to fishery totals (Table 3). Based on information from derby organizers, we estimated that a total of 198 boat trips and 670 angler trips occurred during the two-day derby (Feb. 6-7). This effort resulted in an estimated 248 Chinook salmon encounters (141 harvested [all marked] and 108 released [35 marked, 73 unmarked]). At 0.37 landed Chinook per angler trip, the Roche Harbor Derby CPUE was higher than that documented for charter and private-fleet anglers.

Characteristics of Harvested Chinook

Length and Age.—During the course of the Area 7 winter fishery, 719 (713 marked, 4 unmarked, and 2 undetermined) retained Chinook salmon were sampled at dockside (**Table 4)**. All of these fish were measured and examined for the presence of a CWT. Harvested Chinook ranged from 48 to 115 cm and averaged 74.9 cm (SD = 7 cm) in total length (**Figure 3**). Overall, the majority (712/719 or 99%) of Chinook harvested were of legal size (≥22 in or 56 cm TL).

While scales were collected from all 719 sampled Chinook, just 645 of these could be aged, of which 642 were ad-marked. The majority (88%) of all aged Chinook were 4 years old (brood year 2005), and 95% of aged individuals were subyearlings upon outmigration from freshwater (**Appendix E**). The remaining age samples were primarily from brood year 2006 (age 3.1 = 9% of dockside ad-marked samples). In addition, we sampled 16 2004-brood individuals (ages 5.1 and 5.2), as well as a 2002-brood ad-marked Chinook (age 7.1; 110 cm fork length male) that was also coded-wire tagged (**Appendices E and F**).

CWT Samples.—We recovered a total of 81 coded-wire tags from the 713 retained marked Chinook salmon that were examined as part of our dockside sampling efforts (**Table 5**; **Appendix F**). The majority of CWT'd fish were from Puget Sound (82.7%) and Hood Canal (9.9%) release sites, with the remaining 7.4% coming from the Columbia River (2.5%) and Canadian (5%) production facilities in the Georgia Basin (East Coast Vancouver Island and Fraser Basin). For Puget Sound recoveries, north Puget Sound CWT groups were most abundant with nearly half of these tags coming from two release sites and rearing facilities (Marblemount Hatchery and Samish Hatchery). In addition, 37 of the CWTs recovered were associated with a double-index tag (DIT) group (See **Overall Fishery Impacts**: *Estimated CWT-DIT Impacts* for estimated unmarked-DIT mortality results).

Table 3. Estimates of total fishing effort and total salmon catch (harvest and releases) during the February 1 - April 15, 2009 Area 7 selective fishery. Values may not add exactly due to rounding error. AD = marked (i.e., adipose-clipped), UM = unmarked.

Season	Stat Week	Start Date	End Date	Est. Effort		Est. Retained Chinook		Est. Released Chinook[1/]		Est. Total Chinook Encounters
				Boats	Anglers	AD	UM	AD	UM	
Feb 1 - April 15, 2009	5	01-Feb	01-Feb	195	446	173	0	43	89	305
	6	02-Feb	08-Feb	471	1,021	205	0	50	105	360
	7	09-Feb	15-Feb	395	837	179	2	44	90	315
	8	17-Feb	23-Feb	485	1,068	192	2	47	97	338
	9	22-Feb	28-Feb	276	564	118	3	29	58	207
	10	02-Mar	08-Mar	220	438	97	2	24	48	170
	11	09-Mar	15-Mar	255	512	60	0	15	31	105
	12	16-Mar	22-Mar	265	529	25	0	6	13	44
	13	23-Mar	29-Mar	296	640	40	0	10	21	70
	14	30-Mar	05-Apr	444	921	122	0	30	63	215
	15	06-Apr	12-Apr	230	427	45	0	11	23	80
	16	13-Apr	15-Apr	34	68	21	0	5	11	38
Private Fleet Subtotal:				**3,565**	**7,471**	**1,277**	**9**	**314**	**649**	**2,248**
Roche Derby (Feb 6-7, 2009) Subtotal:				**198**	**670**	**141**	**0**	**35**	**73**	**248**
Charter Subtotal:				**8**	**26**	**2**	**0**	**0**	**3**	**5**
ALL ANGLERS TOTAL				**3,771**	**8,167**	**1,420**	**9**	**349**	**724**	**2,501**
Variance:				9,555	36,295	1,657	3	6,411	11,296	28,590
Standard Error:				98	191	41	2	80	106	169
CV (%):				2.6%	2.3%	2.9%	19.1%	23.0%	14.7%	6.8%
95% CI:				3,571-3,954	7,767-8,514	1,338-1,497	5-12	192-506	513-930	2,165-2,828

[1/] Released Chinook (for the private-boat fleet and Roche Harbor Derby participants) were estimated as the difference between retained Chinook estimates and total Chinook encounters generated using a bias-corrected "Method 2" estimator. See **Appendix A** and Conrad and McHugh (2008) for additional details.

Table 4. Summary of harvested Chinook total length samples collected during dockside angler interviews and derby sampling, Area 7 mark-selective Chinook fishery, February 1 - April 15, 2009.

	Number Sampled		
Mark Type	**Legal-size**	**Sublegal-size**	**Total**
Marked	706	7	713
Unmarked	4	0	4
Undetermined	2	0	2
Total	**712**	**7**	**719**

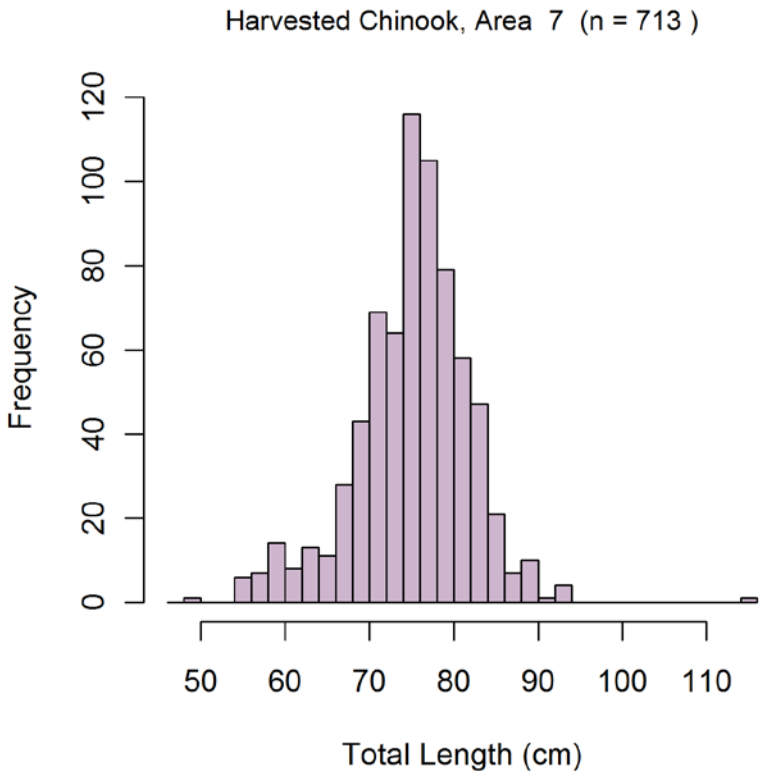

Figure 3. Length-frequency distribution for marked Chinook harvested during the Area 7 February 1 - April 15, 2009 mark-selective Chinook fishery.

Table 5. Summary of coded-wire tags recovered from Chinook salmon harvested during the Area 7 February 1-April 15, 2009 mark-selective Chinook fishery. The field "# DITs" corresponds to the number of tags that belonged to double-index tag groups.

Release Region	Release Site	Rearing Location	CWTs Recovered	No. DITs
British Columbia-Fraser R.	Harrison River	Chehalis River Hatchery	2 (2.5%)	0
British Columbia-Vanc. Isl.	Big Qualicum River	Big Qualicum River Hatchery	1 (1.2%)	0
	Upper Cowichan River	Cowichan River Hatchery	1 (1.2%)	0
Lower Columbia River	Spring Creek	Spring Creek NFH	2 (2.5%)	2
Hood Canal	Finch Creek	Hoodsport Hatchery	5 (6.2%)	0
	Purdy Creek	George Adams Hatchery	2 (2.5%)	2
	Skokomish River	Ricks Pond	1 (1.2%)	0
Puget Sound-Central	Big Soos Creek	Unreported	2 (2.5%)	2
	Grovers Creek	Grovers Creek Hatchery	5 (6.2%)	5
	Issaquah Creek	Issaquah Hatchery	2 (2.5%)	0
	White River	White River Hatchery	1 (1.2%)	0
Puget Sound-North	Cascade River	Marblemount Hatchery	17 (21%)	4
	Friday Creek	Samish Hatchery	10 (12.3%)	10
	N.F. Nooksack River	Kendall Creek Hatchery	7 (8.6%)	7
	Skagit River	Unreported	2 (2.5%)	0
	Tulalip Creek	Bernie Gobin Hatchery	6 (7.4%)	0
	Wallace River	Wallace River Hatchery	5 (6.2%)	4
	Whitehorse Springs	Whitehorse Pond	6 (7.4%)	0
Puget Sound-South	Clear Creek	Nisqually Hatchery	1 (1.2%)	1
	Deschutes River	Tumwater Falls Hatchery	1 (1.2%)	0
	Voight Creek	Voight Creek Hatchery	2 (2.5%)	0
		Grand Total	**81**	**37**

[1]Unofficial release regions. Puget Sound regions were designated based on the WDFW marine catch area containing the river/stream network where juvenile releases originated (i.e., Areas 11 and 13 = South; Areas 9 and 10 = Central; and Areas 7, 8-1, and 8-2 = North).

Test Fishing Results

Fishing Time and Gear Type

Test fishers attempted to fish five days per week (44 days total) throughout the fishery. However, as a result of inclement weather, the test fishers could not fish on two of the scheduled days during the Area 7 winter 2009 season (**Table 2 and Table 6**). In total, test fishers spent 42 days and 246.5 boat-hours (493 angler hours) on the water pursuing Chinook salmon during the 2009 Area 7 winter fishery (**Table 6**). Given that nearly all (99.4%) of the interviewed anglers that successfully encountered Chinook salmon reported doing so while trolling with downriggers, test fishers also pursued Chinook using this method the majority of the time (99.7% of total test fishing hours), while the remainder of their test fishing time was split between the diver and jigging methods (**Table 7**).

Chinook Encounters and Mark Rates

In total, test fishers encountered 40 Chinook salmon as a result of their 42 days and 246.5 boat-hours of fishing. The majority of encountered Chinook were of legal size (93%), and two-thirds of these fish were adipose fin clipped (legal-sized Chinook mark rate: 65%; **Table 6**). The overall mark rate ([LM+SM]/total encounters) was also 65%. With a "CPUE" (i.e., LM Chinook *encounters* / angler trip) of 0.28, test fishers experienced a legal-marked Chinook encounter rate that was nearly two times that of charter, derby, and at-large private fleet anglers combined (0.17).

Table 6. Composition of test fishery Chinook encounters and associated mark-rate and size/mark-status proportion estimates for the Area 7 February 1 – April 15, 2009 mark-selective Chinook fishery. Variances associated with size/mark-status proportions and mark rates are provided in parentheses.

Stat	Fishing Effort		Legal		Sublegal		Total
Week	Days	Hours	AD	UM	AD	UM	
6	4	27.0	3	5	1	0	9
7	3	19.5	3	1	0	0	4
8	3	20.4	6	0	1	0	7
9	4	22.6	2	0	0	0	2
10	4	32.0	0	0	0	1	1
11	5	26.0	3	1	0	0	4
12	4	20.2	2	0	0	0	2
13	4	19.4	3	3	0	0	6
14	3	15.3	1	0	0	0	1
15	5	27.3	0	1	0	0	1
16	3	16.9	1	2	0	0	3
Total	**42**	**246.5**	**24**	**13**	**2**	**1**	**40**
Size/mark-status composition:			0.60 (0.01)	0.33 (0.01)	0.05 (0.00)	0.03 (0.00)	
Legal size mark rate:			0.65 (0.01)				
Overall mark rate:			0.65 (0.01)				

Table 7. Fishing methods employed by private recreational anglers (from dockside interviews, based on number of boat trips sampled, n =510) and test fishers (based on hours fished, n = 246.5) during the Area 7 February 1 – April 15, 2009 mark-selective Chinook fishery.

Statistical Week	DR		WB		Diver		Jig	
	Tst Boat	Private	Tst Boat	Private	Tst Boat	Private	Tst Boat	Private
5	N/A	100.0%	N/A	0.0%	N/A	0.0%	N/A	0.0%
6	100.0%	96.9%	0.0%	1.0%	0.0%	1.0%	0.0%	0.0%
7	96.6%	100.0%	0.0%	0.0%	1.7%	0.0%	1.7%	0.0%
8	100.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
9	100.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
10	100.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
11	100.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
12	100.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
13	100.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
14	100.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
15	100.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
16	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Total	**99.7%**	**99.4%**	**0.0%**	**0.2%**	**0.1%**	**0.2%**	**0.1%**	**0.0%**

Given the limited number of test fishery encounters, we compared the test fishery size/mark-status composition with that estimated from VTR data (i.e., charter and private-boat sources) in order to determine whether data could be pooled across sources. Specifically, we tested whether or not the frequency of observations in legal or sublegal size classes and marked or unmarked groups differed across the three data sources (i.e., test fishery, charter and private VTR sources) using χ^2 tests. Pooling the two VTR data sources, there were no significant differences found between the test fishery and VTR data for the four size/mark status group comparisons ($\chi^2 = 3.3$, df = 3, $P = 0.352$) or the separate marked vs. unmarked comparison (test for mark status homogeneity: $\chi^2 = 3.6$, df = 2, $P = 0.163$; **Table 8**). Thus, we pooled data from the test fishery with those from both private fleet and charter VTRs to estimate the overall mark rate (71%) and the size/mark-status composition of Chinook encounters (64.6% legal-marked, 28.6% legal-unmarked, 6.1% sublegal-marked, and 0.7% sublegal-unmarked). We used these pooled values to estimate total Chinook encounters and associated impacts due to the Area 7 winter selective fishery.

Table 8. Total Chinook encountered (retained and released) by anglers reporting their catch on voluntary trip reports (VTRs), as compared to test fishing encounter data, with estimates of legal, sublegal, and overall mark rates. AD = marked (i.e., adipose-clipped), UM = unmarked. Note that the final dataset used for impact estimation was based on the test fishery and charter/private boat VTRs. Variances associated with size/mark-status proportions and mark rates are provided in parentheses.

		Legal		Sublegal			Mark Rates	
Data source	**Effort & Sample Size**	**AD**	**UM**	**AD**	**UM**	**Total**	**Overall**	**Legal**
Test Fishery	44 days, 88 Angler Trips	24	13	2	1	40	0.65	0.65
Charter VTR	8 1-trip VTRs, 26 Angler Trips	2	3	0	0	5	0.40	0.40
Private VTR	34 1-trip VTRs, 75 Angler Trips	69	26	7	0	102	0.75	0.73
Pooled data	189 Angler Trips	**95**	**42**	**9**	**1**	**147**	**0.71**	**0.69**
	Size/mark-status	0.646 (0.002)	0.286 (0.001)	0.061 (0.000)	0.007 (0.000)			

Chinook Size and Age

For marked and unmarked groups combined, the size (total length) of Chinook encountered by test fishers ranged from 49 to 87 cm and averaged 73 cm (SD = 10). Between groups, unmarked Chinook averaged slightly larger (mean = 75; **Figure 4**) than marked Chinook (mean = 63; **Figure 4**) but were not significantly different in size (two-sample t-test: t = -0.8 df = 38, P = 0.404). At 74 cm, the average size of legal-marked Chinook encountered by test fishers was similar to that for fish sampled in the private fleet's catch at dockside (i.e., 75 cm). Based on 40 readable scales (26 AD, 14 UM) collected from Chinook encountered in the test fishery, three quarters (73% AD, 79% UM) of all marked and unmarked individuals present in the targeted pool of Chinook were 4 years old (**Appendix E**).

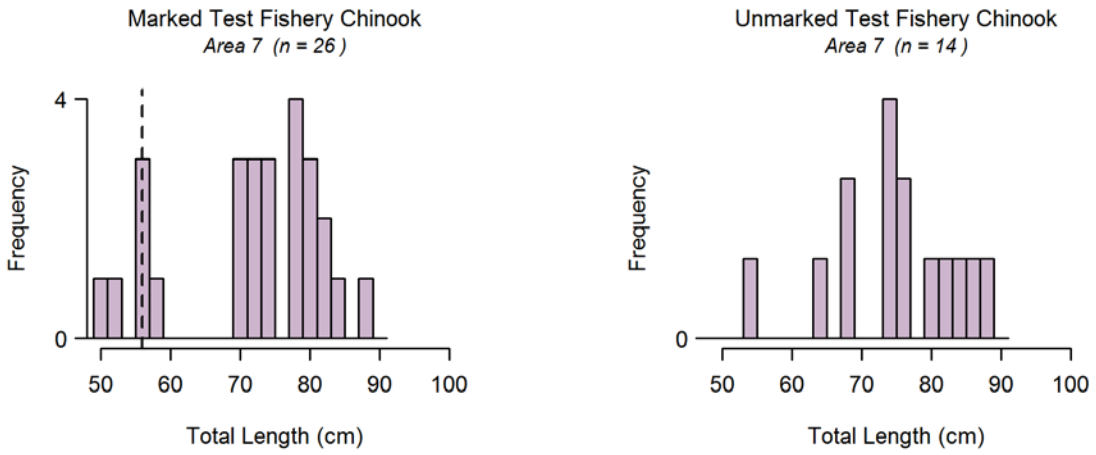

Figure 4. Length-frequency distributions of marked (*left panel*) and unmarked (*right panel*) Chinook encountered by test fishers during the Area 7 February 1 - April 15, 2009 mark-selective Chinook fishery. Note that the vertical dashed line in the left panel corresponds to the legal size limit (22 in or 56 cm).

Other Fish Species Encountered

In addition to the 40 Chinook salmon encounters described above, test fishers caught and released 42 other fish from eight different species groups. Of the 42 other fish encountered, lingcod comprised the highest proportion (40%; **Table 9**) among the species groups.

Table 9. Test fishery catches of species other than Chinook salmon during the Area 7 February 1 – April 15, 2009 mark-selective Chinook fishery.

Common name of species	Scientific Name of species	Number
Copper rockfish	*Sebastes caurinus*	8
Kelp greenling	*Hexagrammos decagrammus*	6
Lingcod	*Ophiodon elongatus*	17
Pacific cod	*Gadus macrocephalus*	6
Pacific halibut	*Hippoglossus stanolopis*	1
Quillback rockfish	*Sebastes maliger*	2
Shiner surfperch	*Cymatogaster aggregata*	1
Speckled sanddab	*Citharichthys stigmaeus*	1
TOTAL		**42**

Overall Fishery Impacts

Total Encounters and Mortalities

Based on the combination of dockside sampling results (i.e., legal-marked Chinook harvest estimates derived from data in **Tables 3** and **4**), test fishery and VTR size/mark-status composition data (**Table 8**), and our intensive charter and derby census efforts (**Table 3**), we estimated that that 1,615 legal-marked, 716 legal-unmarked, 153 sublegal-marked, and 17 sublegal-unmarked Chinook salmon were encountered by anglers fishing in Area 7 during winter 2009 (**Table 10**). These encounters were comprised of an approximately 60:40 mix of retained (1,428 fish) and released (1,073 fish) Chinook salmon. Further, we estimated that approximately one-half (0.5) unmarked Chinook salmon and 0.8 Chinook salmon overall were handled per legal-marked fish harvested. Given the assumed mortality rates of 0.20 for sublegal- and 0.15 for legal-sized Chinook salmon, we additionally estimated that 31 legal-marked, 106 legal-unmarked, 28 sublegal-marked, and 3 sublegal-unmarked Chinook (169 overall) died due to handling-and-release effects; this translates into an estimated 0.04 unmarked and 0.08 marked Chinook release mortality per legal-marked Chinook retained. In total, 1,597 Chinook (1,479 marked and 118 unmarked) mortalities occurred—89% due to direct harvest—as a result of the Area 7 winter 2009 mark-selective fishery. In addition, given the 40 (24 LM, 13 LU, 2 SM, 1 SU) Chinook caught and released in the Area 7 test fishery, an estimated 6 (4 marked, 2 unmarked) Chinook may have died as a result of our sampling activities.

Table 10. Summary of season-wide fishery impact estimates for the Area 7 February 1 –April 15, 2009 mark-selective Chinook fishery. Values may not add up perfectly due to rounding error.

Total Encounters (E):	**2,501**[a/]									
V(E):	**37,772**									
Size/mark group	**Encounters**	**No. Retained**	**No. Rel'd**	**Rel. Mort. Rate**	**Rel. Mort.**	**Total Mortality**	**Var**	**SE**	**95% CI**	**CV (%)**
Legal marked	1,615	1,406	210	0.15	31	1,437	1,738	42	1355 - 1519	3
Legal unmarked	716	9	708	0.15	106	115	267	16	83 - 147	14
Sublegal marked	153	14	139	0.20	28	42	132	11	19 - 64	28
Sublegal unmarked	17	0	17	0.20	3	3	12	3	3 - 10	100
All groups combined	**2,501**	**1,428**	**1,073**		**169**	**1,597**	**2,148**	**46**	**1506 - 1688**	**100**

[a/] The total Chinook encounters estimate of 2,501 includes estimated encounters for private boats, charter vessels, and Roche Harbor Derby participants combined.

FRAM versus Creel Comparison

The number of fish estimated to have been impacted by the Area 7 February 1 - April 15, 2009 fishery was considerably less than was predicted based on pre-season modeling results. Whereas FRAM predicted that a total of 5,107 Chinook would have been encountered during the fishery, field data indicated that actual encounters were 49% of this value (**Table 11**, **Figure 5**). Field data also suggested that actual legal-sized and sublegal-sized Chinook

encounter rates were 68% higher and 95% lower, respectively, than those expected as a result of pre-season modeling. For harvest and release mortality combined, FRAM predicted that a total of 416 unmarked, 2,118 marked, and 2,534 Chinook overall would die during the selective season (**Table 12**, **Figure 5**), with a nearly 70:30 harvest and release mortality prediction. In contrast, creel results indicate that only 63% as many fish may have died during the course of the fishery, with 89% of these impacts being due to marked Chinook harvest.

In contrast, even though field observations were less than pre-season expectations in most cases, we noted some data comparisons in which FRAM predictions were lower than or similar to creel estimates. For example, FRAM's prediction for the number of marked Chinook to be landed (789 fish) was only 56% of the estimate from the creel survey (1,420 fish). Also, estimated legal-unmarked Chinook mortality was comparable to what was expected based on pre-season modeling (**Figure 5**). Further, the FRAM-predicted overall mark rate (65%) was within 10% of what we estimated from field data (71%).

Table 11. Comparison of modeled (i.e., using FRAM, model run 2108) and estimated total Chinook encounters for the Area 7 February 1- April 15, 2009 mark-selective Chinook fishery.

Data Source	Group	Total Encounters	Legal	Sublegal	Landed Only
FRAM Encounters	Unmark.	1,803	548	1,255	44
	Mark.	3,304	839	2,465	789
	Total	5,107	1,387	3,720	833
	% Mark.	65	61	66	95
Estimated (Creel) Encounters	Unmark.	733	716	17	9
	Mark.	1,768	1,615	153	1,420
	Total	2,501	2,332	170	1,428
	% Mark.	71	69	90	99

Table 12. Comparison of modeled (i.e., using FRAM, model run 2108) and estimated total Chinook mortalities for the Area 7 February 1 - April 15, 2009 mark-selective Chinook fishery.

	FRAM Chinook Mortalities			Estimated Chinook Mortalities		
Mortality Category	Unmark.	Mark.	Total	Unmark.	Mark.	Total
Total (Landed + Released)	416	2,118	2,534	118	1,479	1,597
Released Legal	121	836	957	106	31	138
Released Sublegal	251	493	744	3	28	31
Landed Only	44	789	833	9	1,420	1,428

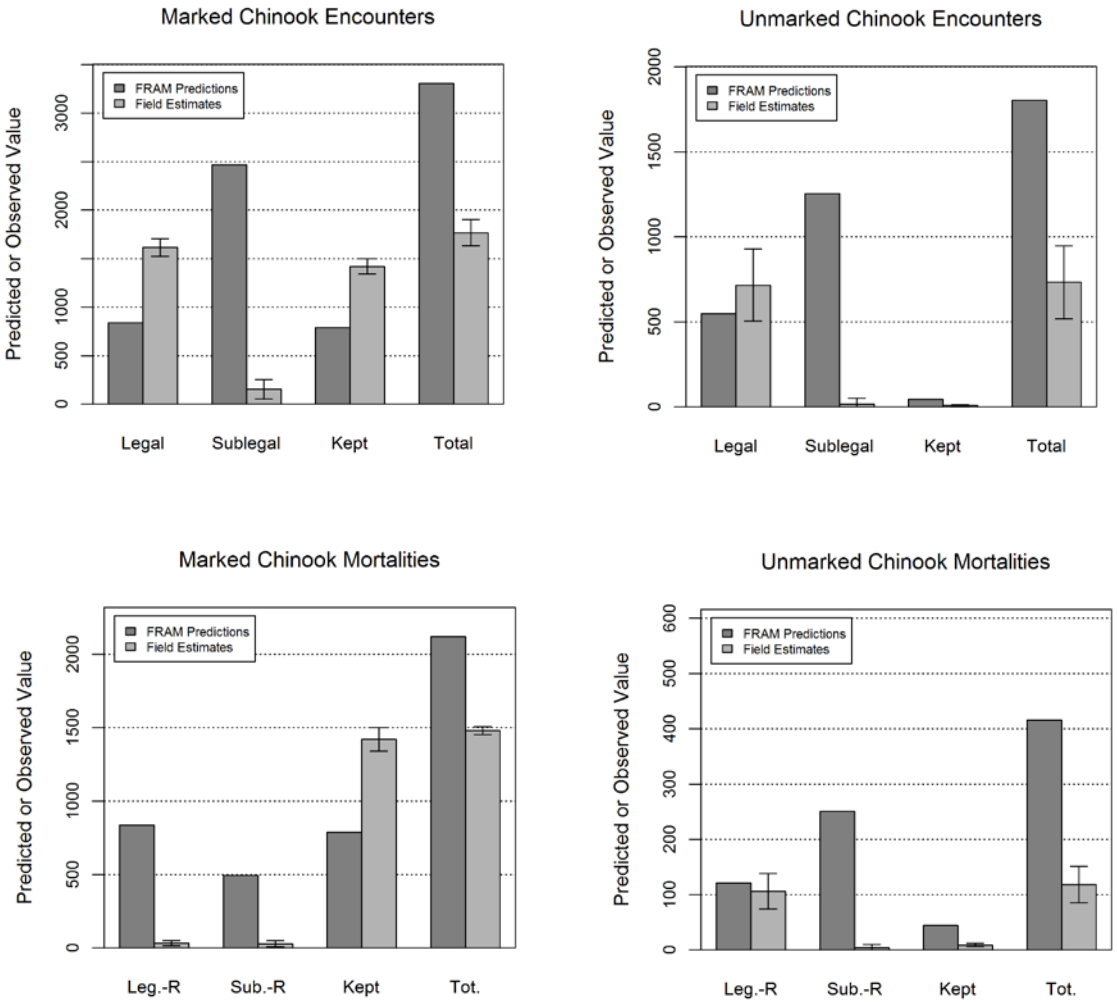

Figure 5. Comparison of modeled (i.e., using FRAM, model run 2108) and estimated total Chinook encounters (*upper panel*) and mortalities (*lower panel*) for the Area 7 February 1- April 15, 2009 mark-selective Chinook fishery. Error bars represent approximate 95% confidence intervals for field estimates.

Estimated CWT-DIT Impacts

Of the 81 coded-wire tags recovered during the Area 7 winter fishery, 37 belonged to double-index tag (DIT) release groups (**Table 13**). Based on the release details associated with these tags and their unmarked sister groups, we obtained an estimate of the unmarked-to-marked release ratio (λ) at juvenile release for each applicable hatchery of origin and brood year, and we used this value to estimate total unmarked DIT encounters for the entirety of the Area 7 fishery. In total, we estimated that 76 unmarked-DIT Chinook were caught and released during the fishery, the majority of which (25%) were from Samish Hatchery (brood years 2005 and 2006), followed by Kendall Creek Hatchery (21%; brood years 2005 and 2006) and Grovers Creek Hatchery (17%; brood year 2005). Given an *sfm* rate of 0.10, we estimate that as many as eight of these unmarked-DIT Chinook may have died as a result of Area 7 winter mark-selective fishery.

Table 13. Summary of double-index tagged (DIT) Chinook kept by anglers, and estimated total mortality of unmarked DIT Chinook due to hook-and-release impacts resulting from the Area 7 February 1 -April 15, 2009 mark-selective Chinook fishery. AD = marked (i.e., adipose-clipped), UM = unmarked.

Hatchery	Brood Year	DITs Obs'd	AD DIT Harvest		UM DIT Enc.	UM DIT Mortality		
			Est.	var(Est.)		Est.	var(Est.)	SE(Est.)
George Adams Hatchery	2005	2	2.35	0.41	2.35	0.23	0.004	0.09
Grovers Creek Hatchery	2005	5	9.89	10.50	12.91	1.29	0.179	0.90
Kendall Creek Hatchery	2005 2006	6 1	14.05 2.18	19.64 2.57	14.10 2.04	1.41 0.20	0.198 0.023	1.07 0.15
Marblemount Hatchery	2004 2005	3 1	6.54 2.18	7.72 2.57	6.44 2.18	0.64 0.22	0.075 0.026	0.47 0.16
Nisqually Hatchery	2006	1	2.18	2.57	2.19	0.22	0.026	0.16
Samish Hatchery	2005 2006	9 1	18.61 2.18	20.79 2.57	16.92 2.17	1.69 0.22	0.172 0.026	1.21 0.16
Soos Creek Hatchery	2005	2	3.35	2.78	3.44	0.34	0.029	0.21
Spring Creek NFH	2005 2006	1 1	1.17 2.18	0.20 2.57	1.18 2.18	0.12 0.22	0.002 0.026	0.05 0.16
Wallace River Hatchery	2002 2005	1 3	1.17 6.54	0.20 7.72	1.19 6.63	0.12 0.66	0.002 0.079	0.05 0.49
TOTAL		**37**	**74.59**	**82.82**	**75.91**	**7.59**	**0.865**	**5.31**

ACKNOWLEDGEMENTS

The monitoring of the February 1 - April 15, 2009 Area 7 mark-selective Chinook fishery was the result of the efforts of many individuals. We would like to acknowledge and thank all of them for their hard work. Foremost, we thank Steve Axtell (North Sound Sampling Supervisor) and his dedicated sampling staff (Marcus Thompson, Mary Mureau, Lynn Stricker, Al Esparza, Alan (Skeeter) Lowe, and Patrick Morrison) as well as test fishing staff (Chad Paul and Bob Chichester) for their efforts. Additionally, we thank WDFW pilots Marty Kimbrel, Jim Hodgson, and Kevin Nelsen and samplers Mark Baltzell, Chris Moran, Laura Klein, Ellie Heikilla, and Gerald Weinandt for their time in surveying Area 7 from the sky. For the coordination and sampling of the Roche Harbor Derby, we would like to thank Debbie Sandwith (Roche Harbor Market), derby entrants, and supporting WDFW-Fish Program staff (Gerald Weinandt). Similarly, we would like to acknowledge the several Area 7 charter operators for their willingness to supply catch and effort data via our Voluntary Trip Report program.

At WDFW Headquarters in Olympia, we thank both Lance Campbell and John Sneva for their scale-reading expertise. We also thank Susan Markey, Gil Lensegrav, and the CWT Lab staff for their help and expertise in providing decoded CWT data, and biometricians Kris Ryding and Wan-Ying Chang for their comments and suggestions on the design and analysis of the Area 7 aerial–access survey design. Also from WDFW Headquarters, Lee Dyer provided substantial help with personnel logistics and support services for the project. Karen Kloempken managed the WDFW sampling databases and provided finalized post-season data. WDFW Biologists Steve Caromile and Are Strom worked on database development in order to better manage, query, and report on the selective fishery data; in addition, Are Strom completed “R” programming updates to enable efficient analyses of selective fishery data and produce tables and figures for this post-season report. Biologists Mark Baltzell, Karen Kloempken, Steve Caromile, and Laurie Peterson prepared this post-season report.

REFERENCES

Cochran, W.G. 1977. Sampling Techniques (third edition). John Wiley and Sons. New York.

Conrad, R., and P. McHugh. 2008. Assessment of Two Methods for Estimating Total Chinook Salmon Encounters in Puget Sound/Strait of Juan de Fuca Mark-Selective Chinook Fisheries. Northwest Fishery Resource Bulletin Manuscript Series No. 2. http://www.nwifc.org/publications/northwest-fishery-resource-bulletin/; http://wdfw.wa.gov/fish/salmon/suggested_reading.htm.

SFEC-AWG. 2002. Pacific Salmon Commission, Joint Selective Fisheries Evaluation Committee Report, Investigation of methods to estimate mortalities of unmarked salmon in mark-selective fisheries through the use of double index tag groups. TCSFEC (02)-1, February 2002.

Murthy, M.N. 1957. Ordered and unordered estimators in sampling without replacement. Sankhya 18:379-390.

Puget Sound Indian Tribes and WDFW. 2004. Comprehensive Management Plan for Puget Sound Chinook: Harvest Management Component. Olympia, WA. 253 pp.

Washington Department of Fish and Wildlife (WDFW). 2007a. Marine Areas 9 and 10 Selective Chinook Fishery, July 16-31, 2007: Post-season Report. Draft Report: October 3, 2007. Washington Department of Fish and Wildlife. Olympia, Washington. 82 pp. http://wdfw.wa.gov/fish/salmon/suggested_reading.htm.

Washington Department of Fish and Wildlife (WDFW). 2007b. Marine Areas 11 and 13 Selective Chinook Fishery, 2007: Post-season Report. Draft Report: October 30, 2007. Washington Department of Fish and Wildlife. Olympia, Washington. 80 pp. http://wdfw.wa.gov/fish/salmon/suggested_reading.htm.

Washington Department of Fish and Wildlife (WDFW). 2008a. A Multi-year Assessment of the Marine Areas 5 and 6 Selective Chinook Fishery: 2005-2007. Final Report Draft: March 14, 2008. Washington Department of Fish and Wildlife. Olympia, Washington. 177 pp. http://wdfw.wa.gov/fish/salmon/suggested_reading.htm.

Washington Department of Fish and Wildlife (WDFW). 2008b. A Multi-year Assessment of the Marine Areas 8-1 and 8-2 Selective Chinook Fishery: 2005-2007. Final Report Draft: February 25, 2008. Washington Department of Fish and Wildlife. Olympia, Washington. 149 pp. http://wdfw.wa.gov/fish/salmon/suggested_reading.htm.

Washington Department of Fish and Wildlife (WDFW). 2009a. Marine Areas 5 and 6 Mark-Selective Recreational Chinook Fishery, Summer 2008: Post-season Report. Revised Draft Report: February 17, 2009. Washington Department of Fish and Wildlife. Olympia, Washington. 64 pp. http://wdfw.wa.gov/fish/salmon/suggested_reading.htm.

Washington Department of Fish and Wildlife (WDFW). 2009b. Marine Areas 9 and 10 Mark-Selective Recreational Chinook Fishery, July 16-August 15, 2008. Revised Draft Report: February 23, 2009. Washington Department of Fish and Wildlife. Olympia, Washington. 60 pp. http://wdfw.wa.gov/fish/salmon/suggested_reading.htm.

Washington Department of Fish and Wildlife (WDFW). 2009c. Marine Areas 11 and 13 Mark-Selective Recreational Chinook Fishery, Summer 2008. Revised Draft Report: February 24, 2009. Washington Department of Fish and Wildlife. Olympia, Washington. 64 pp. http://wdfw.wa.gov/fish/salmon/suggested_reading.htm.

Washington Department of Fish and Wildlife (WDFW). 2009d. Marine Areas 8-1 and 8-2 Mark-Selective Recreational Chinook Fishery, November 1, 2007-April 30 2008. Revised Draft Report: February 20, 2009. Washington Department of Fish and Wildlife. Olympia, Washington. 62 pp. http://wdfw.wa.gov/fish/salmon/suggested_reading.htm.

Washington Department of Fish and Wildlife (WDFW). 2009e. Marine Area 7 Mark-Selective Recreational Chinook Fishery, February 1-29, 2008. Revised Draft Report: February 20, 2009. Washington Department of Fish and Wildlife. Olympia, Washington. 47 pp. http://wdfw.wa.gov/fish/salmon/suggested_reading.htm.

Washington Department of Fish and Wildlife (WDFW) and Northwest Indian Fisheries Commission (NWIFC). 2008. 2008-09 Co-managers' List of Agreed Fisheries. Olympia, Washington.

APPENDICES

Appendix A. Total estimators for the aerial–access sample design.

A. Estimating daily-, stratum-, and season-total fishery parameters

Total fishing effort (in angler trips and boat trips) and Chinook encounters (harvested and/or released, by mark-status group) were estimated for each sampled day *i* in each stratum *j* (*j* = Monday-Thursday and Friday-Sunday strata, by week) by expanding dockside sample-frame totals to the non-sampled fraction of the fishery. First, dockside-frame totals ($y_{ij}^{(ds)}$) were computed for each parameter (effort, catch, or reported releases) by summing observations from sampled sites (*k* = 1, 2, 3, or 4 [Bellingham Ramp, Cornet Ramp, Friday Harbor Marina, or Washington Park Ramp]):

(1) $$y_{ij}^{(ds)} = \sum_{k=1}^{4} y_{ijk}$$

Given that *all* four dockside sample-frame sites were sampled for the entirety of *every* scheduled sample day, $y_{ij}^{(ds)}$was taken as a census total with zero variance. Combining $y_{ij}^{(ds)}$ with an estimate of the fraction of area-wide effort encompassed by sampled sites ($\bar{f}_j$, described below) estimated from flight data, daily fishery-wide totals were estimated according to:

(2) $$\hat{Y}_{ij} = \frac{y_{ij}^{(ds)}}{\bar{f}_j}$$, with variance

$$\mathrm{var}(\hat{Y}_{ij}) = (y_{ij}^{(ds)})^2 \,\mathrm{var}(\frac{1}{\bar{f}_j})$$

For the weekend stratum (Fri-Sun), during which 100% daily coverage was achieved, stratum totals were taken as the sum of daily values estimated by Equation 2; the variance about stratum totals was taken as the sum of daily variances defined above, where $\mathrm{var}(\frac{1}{\bar{f}_j})$ is estimated according to the parametric approach described below (Equation 5). Totals were estimated for the weekday (Mon-Thurs) stratum according to:

(3) $$\hat{Y}_j = N_j \frac{\sum_{i=1}^{n_j} \hat{Y}_{ij}}{n_j}$$, with variance

$$\mathrm{var}(\hat{Y}_j) = N_j \left(\frac{N_j - n_j}{n_j} \right) \frac{\sum_{i=1}^{n_j} (\hat{Y}_{ij} - \bar{Y}_j)^2}{n_j - 1} + \frac{N_j}{n_j} \sum_{i=1}^{n_j} \mathrm{var}(\hat{Y}_{ij})$$

where N_j and n_j are the total and sampled number of days in stratum *j*, respectively, and $\bar{Y}_j$ is the mean daily total for sampled days in stratum *j*.

B. Estimating the sample fraction from aerial and dockside survey data

1. *Conceptual overview*

We estimated the fraction of area-wide effort encompassed by our dockside sample frame using a parametric statistical approach derived by Wan-Ying Chang, WDFW-Fish Program biometrician (unpublished memo). To do this, we viewed $f_{ij,}$ the true fraction of area-wide effort encompassed by the dockside sample frame, as a fixed unknown parameter; we also considered $\hat{f}_{i}$, the fraction estimated from any given aerial survey, to vary as a function of flight time according to a specified probability distribution model (described below), with mean equal to f_{ij}. We further assumed that $\hat{f}_{i}$ was independent and identically distributed (i.i.d.) across all days within relevant blocks. Based on these assumptions, we constructed a sampling distribution for $\bar{f}_{j}$ using data from days when both dockside and aerial surveys were conducted (by stratum *j*, if appropriate). Additionally, we derived an estimator for the variance of fishery totals (i.e., $\hat{Y}_{i}$, Equation 3) that was consistent with $\bar{f}_{j}$'s sampling distribution.

There are two main advantages of this compared to other estimation approaches. First, depending on the distributional model chosen for $\bar{f}_{j}$, this parametric approach provides an analytical basis for computing the bias associated with $\hat{Y}_{i}$ estimates. This information is needed to understand the quality of estimates, particularly given the potential for bias in ratio estimates in small sample-size cases (e.g., Cochran 1977). Second, using the parametric approach frees us from assuming that sampled and non-sampled angling parties have identical activity patterns within a given day. Given the difficulties associated with sampling the latter group, this assumption is more difficult to test than the i.i.d. assumption described above. Despite these advantages, additional analytical work (e.g. simulations) will likely be needed to fully understand the reliability of the present estimation method under different distributional assumptions.

2. *Computing individual f_{ij} estimates and defining stratum boundaries*

On all days *i* within stratum *j* when both aerial and dockside surveys occurred, f_{ij} was estimated according to

$$\hat{f}_{ij} = \frac{X_{ij}}{m_{ij}}, \tag{4}$$

where m_{ij} is the aerial boat count and X_{ij} is the number of boats counted during the aerial survey that ended their trips at sampled access sites, and were fishing at the time of the survey, as discerned from reported trip start and end times. Once all $\hat{f}_{i}$ values were available, we assessed whether stratum-specific (weekday and weekend; i.e., $\bar{f}_{j}$) or pooled (i.e., $\bar{f}$) sampling distributions were supported by the data collected during the season. Though our power was limited (<10% where evaluated), a variety of statistical comparisons indicated that

$\bar{f}_j$s were relatively homogeneous across strata ($P > 0.20$ for *t*, Mann-Whitney *U*, and median tests [Zar 1999]); thus, to maximize our sample size, we pooled data and constructed a single $\bar{f}_j$ sampling distribution.

3. *Estimating* $\bar{f}_j$ *and* $\mathrm{var}(\frac{1}{\bar{f}_j})$

We estimated $\bar{f}_j$ simply as the arithmetic mean of $\hat{f}_i$s computed for the season. To estimate the variance of its reciprocal, $\mathrm{var}(\frac{1}{\bar{f}_j})$, we assumed that $\hat{f}_i$s are i.i.d. Gamma(α,β) random variables; therefore $\bar{f}_j \sim$ Gamma($n\alpha$,$n\beta$), where α and β are the distribution's shape and scale parameters, respectively, and *n* is the number of flights that occurred during the season. The Gamma distribution was chosen for modeling $\bar{f}_j$ for two reasons: 1) an expression for the bias in total estimates produced by Equation 2 can be easily derived under this distributional assumption; 2) this distribution can accommodate skewness or mimic a normal distribution, while simultaneously keeping a positive range. With sample α and β values obtained using the Shenton and Bowman "almost unbiased" estimators (Johnson et al. 1994), $\mathrm{var}(\frac{1}{\bar{f}_j})$ was estimated as:

(5) $$\mathrm{var}(\frac{1}{\bar{f}_j}) = [\beta^2(\alpha - \frac{1}{n})^2(n\alpha - 2)]^{-1}$$

and α and β were estimated as:

(6) $$\hat{\alpha} = \frac{n-3}{2nR_n} + \frac{n+1}{6n} - \frac{(n+1)R_n}{18n} - \frac{(4n^2-10n+4)R_n^2}{135n(n+3)}$$

$$\hat{\beta} = \bar{f}_j\left[\frac{2nR_n}{n-1} - \frac{2nR_n^2}{2(n-1)} + \frac{4n(n+1)R_n^3}{9(n-1)(n+3)} - \frac{2n(7n^2-60n+7)R_n^4}{135(n-1)(n+3)(n+5)}\right]$$

where R_n is:

(7) $$R_n = \log\left[\frac{\bar{f}_j}{\sqrt[n]{\prod_{i=1}^{n}\hat{f}_{ij}}}\right]$$

Finally, given a Gamma distributional assumption, the relative bias ([expected – observed]/expected) in total estimates obtained from Equation 2 was computed using:

(8) $$Bias = \frac{1}{n\alpha - 1}\cdot 100$$

Given the data collected during the Area 7 February 1-April 15, 2009 fishery (**Appendix D**), we estimated α and β parameters at 6.64 and 0.064, respectively; given the $n = 12$ flights that occurred during the season, the α estimate indicates that total estimates may suffer from a slight negative bias (1%).

C. Assumptions required for unbiased estimation of fishery parameters

Statistical Assumptions

1) The sample fraction estimated for any given day ($\hat{f}_i$) varies as a function of flight time following a Gamma probability distribution function with a mean equal to the true fraction;
2) All days within temporally defined strata have independent and identical probability distributions of $\hat{f}_i$; this assumption applies to all days of the fishery if the mean sample fraction is estimated on a season-total level.

Behavioral and Sampling Assumptions

1) Salmon encounters (kept and released) per unit effort do not differ for anglers accessing the fishery from sampled and non-sampled access sites.
2) Party size (i.e., anglers/boat) does not differ for fishing vessels accessing the fishery from sampled and non-sampled sites.
3) The proportion of total recreational boating activity due to fishing is similar for parties accessing the fishery from sampled and non-sampled access sites.
4) Dockside samplers interview all boating parties active during flights that return to sampled sites, and aerial observers see all boats present in the area during flight surveys. Both sampling components are free from systematic errors in observation.
5) The proportion of total area-wide fishing effort returning to sampled sites (i.e., $\bar{f}_j$) does not differ between days when flights are and are not possible (i.e., "good" vs. "poor" weather days).

Appendix B. Mark-selective fishery impact estimation details.

Below are definitions and equations for all quantities used in estimating mark-selective fishery impacts from the combination of creel survey information, test fishery results, and (where applicable) charter and/or derby accounts. The estimation sequence builds from monthly[6] estimators of encounters-by-class (i.e., the four size [legal, sublegal] × mark-status [marked, unmarked] groups) to season-wide impact estimates. Where appropriate, the encounters (kept and released) for charter, derby, and/or other fishery components that were assessed via a complete census (i.e., totals without variance) are simply added to relevant total private-fleet estimates.

A. Total and Class-specific Encounters Estimation

The first step towards quantifying mark-selective fishery impacts by size/mark-status class is to estimate total Chinook encounters ($\hat{E}_i$, includes retained + released Chinook; See *Monthly Encounters* below) for each month of the fishery. Secondarily, encounters are apportioned to the appropriate size/mark-status group using encounters-composition data collected in the test fishery (See *Test-fishery Encounter Composition* on following page).

Monthly Encounters

$\hat{E}_i$ = Total Chinook encounters for month *i*, which is estimated by combining creel estimates of legal-marked Chinook harvest ($\hat{K}_{LM\,i}$, defined on subsequent page) with a test fishery-based estimate of the proportion of the fishable Chinook population that is of legal size and marked ($\hat{p}_{LM\,i}$,defined on subsequent page). Given the potential for negative bias in $\hat{E}_i$ if anglers release any of the legal-marked Chinook that they encounter, the $\hat{E}_i$ estimator also includes a "correction" to account for this phenomenon (i.e., 1-$p_{\text{LM-R}}$, where $p_{\text{LM-R}}$ is the estimated legal-marked Chinook release rate)[7]. $\hat{E}_i$ and its variance are estimated as:

$$(1) \qquad \hat{E}_i = \frac{\hat{K}_{LM}}{\left[\hat{p}_{LM}(1-p_{LM-R})\right]}$$

$$(2) \qquad \text{var}(\hat{E}_i) = \frac{1}{[(1-p_{LM-R})^2]} * \left[\frac{\hat{K}_{LM\,i}^{\,2}}{\hat{p}_{LM\,i}^{\,2}} * \left(\frac{\text{var}(\hat{K}_{LM\,i})}{\hat{K}_{LM\,i}^{\,2}} + \frac{\text{var}(\hat{p}_{LM\,i})}{\hat{p}_{LM\,i}^{\,2}} \right) \right]$$

[6] **Note:** For fisheries characterized by short-duration seasons (i.e., ~ 1 month), the "monthly" estimators described in this appendix are synonymous season-total estimators.

[7] Equations 1 and 2 were modified based on a recent state–tribal evaluation of sources of bias in estimates of total Chinook encounters in mark-selective fisheries. Based on a review of relevant data, the current operational $p_{\text{LM-R}}$ (combined intentional and unintentional LM Chinook release rate) applied in the bias-corrected $\hat{E}_i$ estimator is 0.13. See Conrad and McHugh (2008) for further detail.

Test-fishery Encounter Composition

$\hat{p}_{LM\,i}$ = the test-fishery estimate of the proportion of Chinook encounters that are legal-sized (*L*) and marked (*M*) during month *i*

$\hat{p}_{LU\,i}$ = the estimated proportion of encounters that are legal-sized (*L*) and unmarked (*U*)

$\hat{p}_{SM\,i}$ = the estimated proportion of encounters that are sublegal-sized (*S*) and unmarked (*M*)

$\hat{p}_{LU\,i}$ = the estimated proportion of encounters that are sublegal-sized (*S*) and unmarked (*U*)

For each *XY* combination (where *X* = *L* or *S* and *Y* = *M* or *U*), $\hat{p}_{XY\,i}$ and its variance is estimated as:

(3) $\hat{p}_{XY\,i} = n_{XY\,i} / n_i$, and

(4) $\text{var}(\hat{p}_{XY\,i}) = [\hat{p}_{XY\,i}(1 - \hat{p}_{XY\,i})]/(n_i - 1)$,

where n_i = the total number of fish encountered by test boats during month *i*.

Encounters by Size/Mark-status Class

$\hat{E}_{LM\,i}$= estimated legal (*L*), marked (*M*) encounters during month *i*

$\hat{E}_{LU\,i}$= estimated legal (*L*), unmarked (*U*) encounters during month *i*

$\hat{E}_{SM\,i}$= estimated sublegal (*S*), marked (*M*) encounters during month *i*

$\hat{E}_{SU\,i}$= estimated sublegal (*S*), marked (*U*) encounters during month *i*

For each *XY* combination (where *X* = *L* or *S* and *Y* = *M* or *U*) excluding *LM*, $\hat{E}_{XY\,i}$ and an estimate of its variance are obtained from:

(5) $\hat{E}_{XY\,i} = \hat{E}_i * \hat{p}_{XY\,i}$

(6) $\text{var}(\hat{E}_{XY\,i}) = \text{var}(\hat{E}_i) * \hat{p}_{XY\,i}^{\,2} + \hat{E}_i^{\,2} * \text{var}(\hat{p}_{XY\,i}) - \text{var}(\hat{E}_i) * \text{var}(\hat{p}_{XY\,i})$

B. Estimating Retained and Released Numbers by Size/Mark-status Class

Before total mortality can be estimated for each class (LM, SM, LU, SU), class-specific encounters must be separated into retention and release categories. First, given that harvest is estimated only to mark-status class for creel survey purposes (i.e., Murthy estimates or otherwise), estimates of marked and unmarked Chinook retention must be assigned to size classes (See *Apportioned Estimates of Retention to Size Classes* on subsequent page); this is done using mark-status-specific size composition data from dockside sampling (See *Dockside Observations for Apportioning Retained Catch to Class* on subsequent page). Subsequently, size/mark-status group-specific releases are estimated as the difference between class-specific encounters and retention (See *Estimating Release Numbers by Class* on subsequent page).

Dockside Observations for Apportioning Retained Catch to Class

$\hat{d}_{LMK}$ = the estimated proportion of retained (kept, *K*), marked (*M*) Chinook salmon that were legal (*L*); based on *season-wide*[8] dockside observations of marked Chinook (as is $\hat{d}_{SMK}$)

$\hat{d}_{SMK}$ = the estimated proportion of retained (kept, *K*), marked (*M*) Chinook that were sublegal (*S*)

The proportion of retained, marked fish in size class *X* (*X* = *L* or *S*) and its variance are estimated as:

$$(8) \qquad \hat{d}_{XMK} = n_{XMK} / n_{MK}$$

$$(9) \qquad \mathrm{var}(\hat{d}_{XMK}) = [\hat{d}_{XMK} * (1 - \hat{d}_{XMK})] / (n_{MK} - 1) \qquad ,$$

where n_{MK} and n_{XMK} are *season-wide* total dockside counts of marked fish and the subset of marked fish in size-class *X*, respectively.

$\hat{d}_{LUK}$ = the estimated proportion of retained (kept, *K*), unmarked (*U*) Chinook salmon that are legal (*L*); estimated from *season-wide* dockside observations of unmarked Chinook (as is $\hat{d}_{SUK}$)

$\hat{d}_{SUK}$ = the estimated proportion of retained (kept, *K*), unmarked (*U*) Chinook that are sublegal (*S*)

The proportions of retained, unmarked fish belonging to legal and sublegal size classes and their respective variances are estimated as above (Eqns. 8 and 9) but using *season-wide* dockside observations on unmarked (*U*), not marked Chinook salmon.

Apportioned Estimates of Retention to Size Classes

$\hat{K}_{LM\,i}$ = the estimated number of legal (*L*), marked (*M*) Chinook kept in month *i*

$\hat{K}_{LU\,i}$ = the estimated number of legal (*L*), unmarked (*U*) Chinook kept in month *i*

The number of kept, marked encounters, marked fish in size class *X* (*L* or *S*) and its variance is estimated as:

$$(10) \qquad \hat{K}_{XM\,i} = \hat{d}_{XMK} * \hat{N}_{MK\,i}$$

$$(11) \qquad \mathrm{var}(\hat{K}_{XM\,i}) = \mathrm{var}(\hat{N}_{MK\,i}) * \hat{d}_{XMK}^{\,2} + \hat{N}_{MK\,i}^{\,2} * \mathrm{var}(\hat{d}_{XMK}) - \mathrm{var}(\hat{N}_{MK\,i}) * \mathrm{var}(\hat{d}_{XMK})$$

where $\hat{d}_{XMK}$ and its variance are from 7 and 8 above and $\hat{N}_{MK\,i}$ is the survey estimate of retained marked fish for month *i* defined in Eqn. 1.

$\hat{K}_{SM\,i}$ = estimated number of sublegal (*S*), marked (*M*) Chinook kept in month *i*

$\hat{K}_{SU\,i}$ = estimated number of sublegal (*S*), unmarked (*U*) Chinook kept in month *i*

[8] Due to small sample sizes for observed, harvested Chinook—particularly for sublegal and/or unmarked classes—dockside length data are pooled across the season to estimate $\hat{d}_{XYK}$.

The number of retained, unmarked fish belonging to legal and sublegal size classes is estimated according to Eqns. 10 and 11 above but using unmarked fish proportions and monthly retention estimates.

Estimating Release Numbers by Class

$\hat{R}_{LM\,i}$= the estimated number of legal (*L*), marked (*M*) Chinook released in month *i*

$\hat{R}_{LU\,i}$= the estimated number of legal (*L*), unmarked (*U*) Chinook released in month *i*

$\hat{R}_{SM\,i}$= the estimated number of sublegal (*S*), marked (*M*) Chinook released in month *i*

$\hat{R}_{SU\,i}$= the estimated number of sublegal (*S*), unmarked (*U*) Chinook released in month *i*

For each size/mark-status class (i.e., *XY* combination [*X* = *L* or *S* and *Y* = *M* or *U*]), the number of fish encountered and released is estimated as the difference between total size/mark-status class encounters ($\hat{E}_{XY\,i}$) and retention ($\hat{K}_{XY\,i}$) during month *i*. The estimator and its variance are:

$$\hat{R}_{XY\,i} = \hat{E}_{XY\,i} - \hat{K}_{XY\,i} \quad (12)$$

$$\mathrm{var}(\hat{R}_{XY\,i}) = \mathrm{var}(\hat{E}_{XY\,i}) + \mathrm{var}(\hat{K}_{XY\,i}) \quad (13)$$

C. Estimating Total (and Class-specific) Monthly and Season-wide Mortality

The application of assumed mortality rates (See *Assumed Mortality Rates for Retained and Released Chinook* below) to class-specific estimates of total retention and releases constitutes the final step in quantifying mark-selective fishery impacts.

Assumed Mortality Rates for Retained and Released Chinook

m_K = retention mortality rate, 100% for all retained Chinook
sfm_L = release mortality rate for legal (*L*) Chinook, assumed to be a constant 15%
sfm_S = release mortality rate for sublegal (*S*) Chinook, assumed to be a constant 20%

Retention-mortality Estimates

$\hat{M}_{LMK\,i}$= estimated mortality due to legal (*L*), marked (*M*) Chinook harvest in month *i* (=$\hat{K}_{LM\,i}$).

$\hat{M}_{LUK\,i}$= estimated mortality due to harvest of legal (*L*), unmarked (*U*) Chinook in month *i* (=$\hat{K}_{LU\,i}$).

$\hat{M}_{SMK\,i}$= estimated mortality due to harvest of sublegal (*S*), marked (*M*) Chinook in month *i* (=$\hat{K}_{SM\,i}$).

$\hat{M}_{SUK\,i}$= estimated mortality due to harvest of sublegal (*S*), marked (*M*) Chinook in month *i* (=$\hat{K}_{SU\,i}$).

Release-mortality Estimates

$\hat{M}_{LMR\,i}$= estimated post-release mortality for legal (*L*), marked (*M*) Chinook in month *i*

$\hat{M}_{LURi}$= estimated post-release mortality for legal (*L*), unmarked (*U*) Chinook in month *i*

$\hat{M}_{SMRi}$= estimated post-release mortality for sublegal (*S*), marked (*M*) Chinook in month *i*

$\hat{M}_{SURi}$= estimated post-release mortality for sublegal (*S*), unmarked (*U*) Chinook in month *i*

All class-specific (*XY* [*X* = *L* or *S*, *Y* = *M* or *U*]) release mortality estimates are obtained from:

(14) $\hat{M}_{XYR_i} = \hat{R}_{XY_i} * sfm_Y$

(15) $\text{var}(\hat{M}_{XYR_i}) = \text{var}(\hat{R}_{XY_i}) * sfm_Y^{\,2}$

Season-wide Total and Class-specific Mortality Estimation

$\hat{M}_{total}$ = total season-wide Chinook salmon mortality; this parameter and its variance [$\text{var}(\hat{M}_{total})$] are computed as the sum of all monthly retention and release mortality estimates [i.e., $\hat{M}_{total} = \sum_{i=1}^{\max i}(\hat{M}_{XYK_i} + \hat{M}_{XYR_i})$] and variances [$\text{var}(\hat{M}_{total}) = \sum_{i=1}^{\max i}[\text{var}(\hat{M}_{XYK_i}) + \text{var}(\hat{M}_{XYR_i})]$], respectively, for all four size/mark-status groups (*X* = *L* or *S*, *Y* = *M* or *U*). Season total estimates for subgroups of interest (e.g., unmarked, sublegal Chinook, $\hat{M}_{SU-total}$) are obtained by summing monthly estimates (and variances) across the season for just that group.

D. Characterizing Precision of Estimates

The precision of estimates generated from creel surveys and the preceding fishery impact estimation scheme is characterized using estimates of a parameter's standard error (*SE*), coefficient of variation (*CV* or relative standard error), and approximate 95% confidence interval. For any parameter estimate $\hat{\theta}$ (e.g., $\hat{M}_{total}$, $\hat{K}_{LM\,i}$, $\hat{E}_i$, etc.), these metrics are estimated using:

(16) $SE(\hat{\theta}) = \sqrt{\text{var}(\hat{\theta})}$

(17) $CV(\hat{\theta}) = [SE(\hat{\theta}) / \hat{\theta}] * 100$

(18) $CI = \hat{\theta} \pm 1.96 * SE(\hat{\theta})$

Figure A1. (*On following page*) Graphical representation of the approach used to estimate monthly encounters and mortalities by size/mark-status category in mark-selective Chinook fisheries. Boxes depict abundance estimates (encounters, mortalities) whereas the mathematical operations depicted on intermediate connector lines are estimator formulae yielding quantities found in subsequent boxes (moving from left to right). Parameter definitions, complete formulae, and variances are defined in the preceding pages. For short-duration fisheries (~ 1 month or less), monthly and season-total values are equivalent; for all others, season-total impacts are equivalent to the sum of monthly impact estimates (and variances).

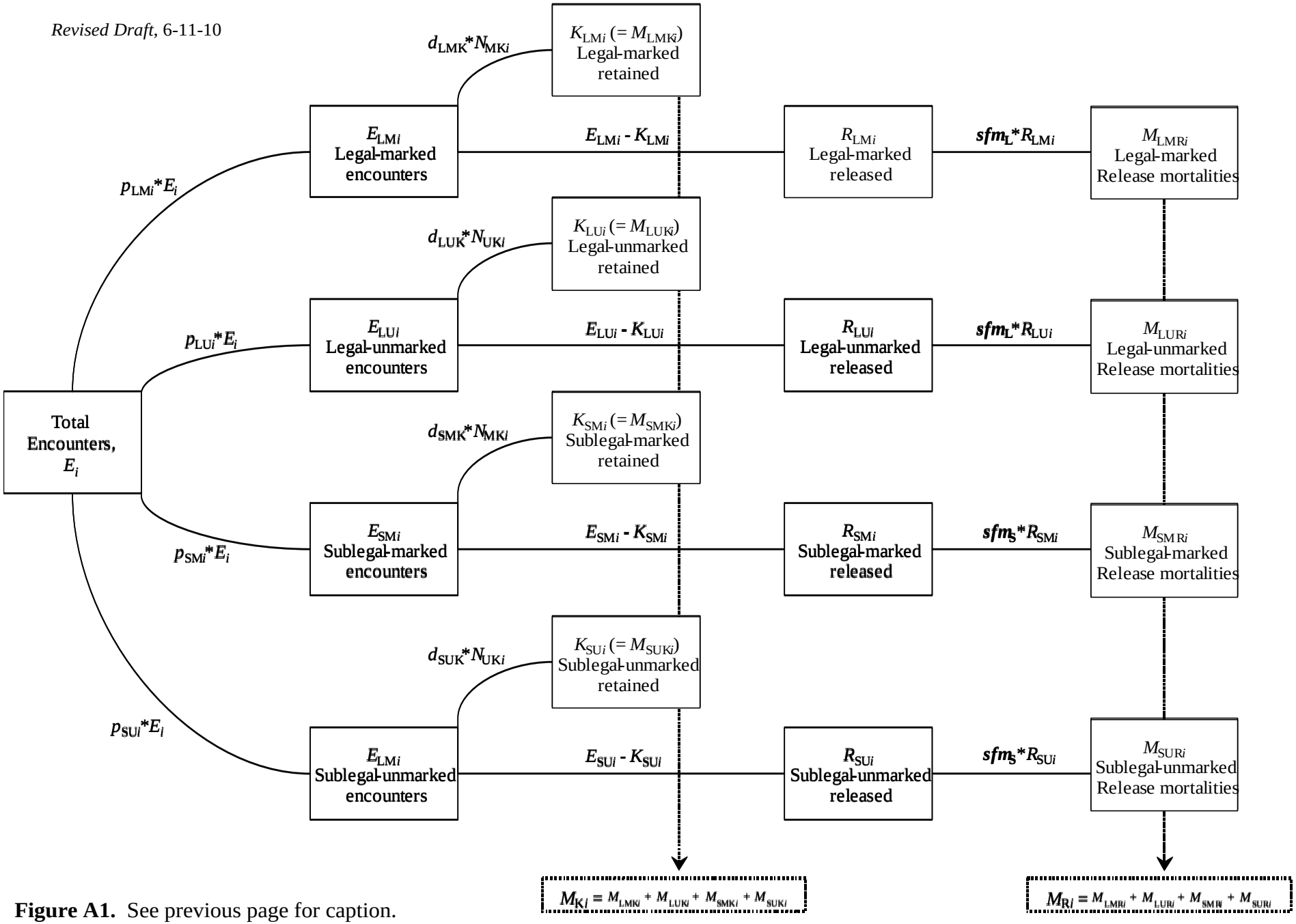

Figure A1. See previous page for caption.

Appendix C. Monthly sample rates (Total retained Chinook sampled [1/] / Estimated retained Chinook) in the winter 2009 Area 7 mark-selective Chinook fishery, February 1 through April 15, 2009.

Time period			Estimated Retained Chinook			Number Retained Chinook Sampled [1/]			Sample Rate
Month	**Stat. Weeks**	**Dates**	**Marked**	**Un-marked**	**Total**	**Marked**	**Un-marked**	**Total**	
February	5-9	Feb 1 - Mar 1	1,009	7	1,016	462	4	466	45.9%
March	10-13	Mar 2 - Mar 29	222	2	224	191	0	191	85.3%
April	14-16	Mar 30 - Apr 15	189	0	189	60	0	60	31.7%
Season Total			**1,420**	**9**	**1,429**	**713**	**4**	**717**	**50.2%**

[1/] Number of retained Chinook sampled includes all retained Chinook inspected for CWT's, from all sites sampled during the winter 2009 Area 7 selective Chinook fishery (i.e., the four sample-frame sites included in the creel estimates, Roche Harbor Derby samples, and the fish sampled as part of baseline sampling in the Area).

Appendix D. Summary of aerial overflight and dockside data used to estimate the fraction of Area 7 effort captured in the four-site sample frame. See Appendix A for computational details and notation.

		Aerial Survey Details			Dockside Sampling Details			
Survey Date	Stratum	Start Time	End Time	Total Boats, m_{ij}	Total Boats, Σy_{ijk}	Fishing Boats	Active Boats, X_{ij}	Sample Fraction, f_{ij}
01-Feb	Weekend	11:12	12:12	108	102	86	89	0.824
14-Feb	Weekend	10:50	11:50	118	79	48	58	0.492
19-Feb	Weekday	11:24	12:27	48	37	28	30	0.625
21-Feb	Weekend	11:20	12:22	127	126	103	116	0.913
27-Feb	Friday	11:00	12:03	67	58	35	46	0.687
13-Mar	Friday	10:56	12:07	84	43	31	36	0.429
17-Mar	Weekday	11:35	12:40	15	12	5	6	0.400
21-Mar	Weekend	11:12	12:17	137	65	48	52	0.380
29-Mar	Weekend	10:58	12:14	116	66	41	44	0.379
04-Apr	Weekend	10:51	11:57	155	88	51	60	0.387
10-Apr	Friday	10:58	12:05	54	30	15	19	0.352
11-Apr	Weekend	11:07	12:07	69	45	20	24	0.348
			Mean	91.50	62.58	42.58	48.33	0.52
			S.D.	41.83	32.33	28.21	30.50	0.20
			CV (%)	45.72%	51.66%	66.25%	63.10%	37.94%

Appendix E. Age composition of retained (dockside samples, inclusive of derby samples) and encountered (test fishery samples) Chinook salmon, Area 7 mark-selective Chinook fishery, February 1-April 15, 2009.

Source	Mark-status group [1/]	Age Composition [2/] 3.1	3.2	4.1	4.2	5.1	5.2	7.1	Total
Dockside samples	AD	57 (9%)	1 (0%)	544 (85%)	23 (4%)	8 (1%)	8 (1%)	1 (0%)	642
Test Fishery	AD	5 (19%)	2 (8%)	18 (69%)	1 (4%)	0 (0%)	0 (0%)	0 (0%)	26
Test Fishery	UM	2 (14%)	0 (0%)	10 (71%)	1 (7%)	0 (0%)	1 (7%)	0 (0%)	14

[1/] AD = Adipose fin-clipped (marked); UM = Adipose fin in tact (unmarked).
[2/] Gilbert-Rich age notation, "Total Age". "Age at outmigration", inclusive of time spent in incubation.

Appendix F. Coded-wire tags recovered from Chinook salmon during the Area 7 February 1 - April 15, 2009 mark-selective Chinook fishery.

Recov Date	Tag Code	Brood Yr	ReleaseSite	Rearing Hatchery	Release Agency	DIT Code	FKL (cm)	Sex	Mark
2/1/2009	632889	2004	CASCADE R 03.1411	MARBLEMOUNT HATCHERY	WDFW	632888	85		AD Fin Clp
2/1/2009	633364	2005	CASCADE R 03.1411	MARBLEMOUNT HATCHERY	WDFW		69		AD Fin Clp
2/1/2009	633391	2006	CLEAR CR 11.0013C	NISQUALLY HATCHERY	NISQ	210736	54		AD Fin Clp
2/1/2009	633369	2005	FRIDAY CR 03.0017	SAMISH HATCHERY	WDFW	633368	69		AD Fin Clp
2/1/2009	633369	2005	FRIDAY CR 03.0017	SAMISH HATCHERY	WDFW	633368	71		AD Fin Clp
2/1/2009	633389	2006	FRIDAY CR 03.0017	SAMISH HATCHERY	WDFW	633390	56		AD Fin Clp
2/1/2009	633172	2005	NOOKSACK R -NF 01.0120	KENDALL CR HATCHERY	WDFW	633171	70	Male	AD Fin Clp
2/1/2009	210571	2005	TULALIP CR 07.0001	BERNIE GOBIN HATCH	TULA		70		AD Fin Clp
2/1/2009	633381	2005	WALLACE R 07.0940	WALLACE R HATCHERY	WDFW	633380	75		AD Fin Clp
2/1/2009	210684	2005	WHITEHORSE SPRINGS	WHITEHORSE POND	COOP		75		AD Fin Clp
2/4/2009	633369	2005	FRIDAY CR 03.0017	SAMISH HATCHERY	WDFW	633368	68		AD Fin Clp
2/4/2009	210684	2005	WHITEHORSE SPRINGS	WHITEHORSE POND	COOP		75		AD Fin Clp
2/6/2009	633382	2005	FINCH CR 16.0222	HOODSPORT HATCHERY	WDFW		73	Female	AD Fin Clp
2/6/2009	633285	2005	GROVERS CR 15.0299	GROVERS CR HATCHERY	SUQ	210682	71	Female	AD Fin Clp
2/6/2009	633172	2005	NOOKSACK R -NF 01.0120	KENDALL CR HATCHERY	WDFW	633171	72	Female	AD Fin Clp
2/6/2009	185812	2005	R-COWICHAN R UP	H-COWICHAN R	CDFO		73		AD Fin Clp
2/7/2009	632889	2004	CASCADE R 03.1411	MARBLEMOUNT HATCHERY	WDFW	632888	73		AD Fin Clp
2/7/2009	633176	2005	CASCADE R 03.1411	MARBLEMOUNT HATCHERY	WDFW	633480	77	Female	AD Fin Clp
2/7/2009	633364	2005	CASCADE R 03.1411	MARBLEMOUNT HATCHERY	WDFW		76		AD Fin Clp
2/7/2009	633867	2006	CASCADE R 03.1411	MARBLEMOUNT HATCHERY	WDFW		52		AD Fin Clp
2/7/2009	633369	2005	FRIDAY CR 03.0017	SAMISH HATCHERY	WDFW	633368	71		AD Fin Clp
2/7/2009	633285	2005	GROVERS CR 15.0299	GROVERS CR HATCHERY	SUQ	210682	74		AD Fin Clp
2/7/2009	633383	2005	ISSAQUAH CR 08.0178	ISSAQUAH HATCHERY	WDFW		67		AD Fin Clp
2/7/2009	633885	2006	ISSAQUAH CR 08.0178	ISSAQUAH HATCHERY	WDFW		54	Male	AD Fin Clp
2/7/2009	633172	2005	NOOKSACK R -NF 01.0120	KENDALL CR HATCHERY	WDFW	633171	67		AD Fin Clp
2/7/2009	210571	2005	TULALIP CR 07.0001	BERNIE GOBIN HATCH	TULA		63	Male	AD Fin Clp
2/7/2009	633381	2005	WALLACE R 07.0940	WALLACE R HATCHERY	WDFW	633380	64	Male	AD Fin Clp
2/7/2009	210690	2005	WHITE R 10.0031	WHITE RIVER HATCHERY	MUCK		71		Unmarked
2/7/2009	210684	2005	WHITEHORSE SPRINGS	WHITEHORSE POND	COOP		78		AD Fin Clp
2/7/2009	210684	2005	WHITEHORSE SPRINGS	WHITEHORSE POND	COOP		80		AD Fin Clp
2/8/2009	633364	2005	CASCADE R 03.1411	MARBLEMOUNT HATCHERY	WDFW		74		AD Fin Clp
2/8/2009	633364	2005	CASCADE R 03.1411	MARBLEMOUNT HATCHERY	WDFW		67		AD Fin Clp
2/8/2009	633364	2005	CASCADE R 03.1411	MARBLEMOUNT HATCHERY	WDFW		74		AD Fin Clp
2/8/2009	633369	2005	FRIDAY CR 03.0017	SAMISH HATCHERY	WDFW	633368	73		AD Fin Clp
2/8/2009	210677	2005	SKAGIT R 03.0176		WDFW		80		AD Fin Clp
2/9/2009	632889	2004	CASCADE R 03.1411	MARBLEMOUNT HATCHERY	WDFW	632888	78		AD Fin Clp
2/9/2009	210571	2005	TULALIP CR 07.0001	BERNIE GOBIN HATCH	TULA		68		AD Fin Clp
2/13/2009	633172	2005	NOOKSACK R -NF 01.0120	KENDALL CR HATCHERY	WDFW	633171	75		AD Fin Clp
2/14/2009	633364	2005	CASCADE R 03.1411	MARBLEMOUNT HATCHERY	WDFW		79		Undetmd AD
2/14/2009	633289	2005	DESCHUTES R +CAPITOL	PERCIVAL COVE+TUMWATER FA	WDFW		66		AD Fin Clp
2/15/2009	633372	2005	BIG SOOS CR 09.0072		WDFW	633371	73		AD Fin Clp
2/15/2009	633285	2005	GROVERS CR 15.0299	GROVERS CR HATCHERY	SUQ	210682		Female	AD Fin Clp
2/15/2009	185744	2006	R-BIG QUALICUM R	H-BIG QUALICUM R	CDFO		61		AD Fin Clp
2/15/2009	633375	2005	VOIGHT CR 10.0414	VOIGHTS CR HATCHERY	WDFW		78		AD Fin Clp
2/15/2009	633468	2005	WALLACE R 07.0940	WALLACE R HATCHERY	WDFW		66	Female	AD Fin Clp
2/18/2009	633381	2005	WALLACE R 07.0940	WALLACE R HATCHERY	WDFW	633380	71	Male	AD Fin Clp
2/18/2009	210684	2005	WHITEHORSE SPRINGS	WHITEHORSE POND	COOP		81	Male	AD Fin Clp
2/19/2009	633382	2005	FINCH CR 16.0222	HOODSPORT HATCHERY	WDFW		76		AD Fin Clp

Recov Date	Tag Code	Brood Yr	ReleaseSite	Rearing Hatchery	Release Agency	DIT Code	FKL (cm)	Sex	Mark
2/19/2009	633369	2005	FRIDAY CR 03.0017	SAMISH HATCHERY	WDFW	633368	70		AD Fin Clp
2/20/2009	210571	2005	TULALIP CR 07.0001	BERNIE GOBIN HATCH	TULA		73	Male	AD Fin Clp
2/21/2009	633364	2005	CASCADE R 03.1411	MARBLEMOUNT HATCHERY	WDFW		75		AD Fin Clp
2/21/2009	633382	2005	FINCH CR 16.0222	HOODSPORT HATCHERY	WDFW		67		AD Fin Clp
2/21/2009	633369	2005	FRIDAY CR 03.0017	SAMISH HATCHERY	WDFW	633368	72		AD Fin Clp
2/21/2009	633285	2005	GROVERS CR 15.0299	GROVERS CR HATCHERY	SUQ	210682	78		Undetmd AD
2/21/2009	210571	2005	TULALIP CR 07.0001	BERNIE GOBIN HATCH	TULA		69		AD Fin Clp
2/22/2009	633364	2005	CASCADE R 03.1411	MARBLEMOUNT HATCHERY	WDFW		77	Female	AD Fin Clp
2/22/2009	633382	2005	FINCH CR 16.0222	HOODSPORT HATCHERY	WDFW		78	Male	AD Fin Clp
2/22/2009	633387	2006	NOOKSACK R -NF 01.0120	KENDALL CR HATCHERY	WDFW	633388	72		AD Fin Clp
2/22/2009	052895	2006	SPRING CR 29.0159	SPRING CR NFH	FWS	052896, 054318, 054334	64	Female	AD Fin Clp
2/25/2009	633369	2005	FRIDAY CR 03.0017	SAMISH HATCHERY	WDFW	633368	74		AD Fin Clp
2/27/2009	633172	2005	NOOKSACK R -NF 01.0120	KENDALL CR HATCHERY	WDFW	633171	82		AD Fin Clp
2/28/2009	025641	2005	R-HARRISON R	H-CHEHALIS R	CDFO		73		AD Fin Clp
3/6/2009	025650	2005	R-HARRISON R	H-CHEHALIS R	CDFO		76		AD Fin Clp
3/6/2009	631387	2002	WALLACE R 07.0940	WALLACE R HATCHERY	WDFW	630933, 631388, 631541	110	Male	AD Fin Clp
3/6/2009	210684	2005	WHITEHORSE SPRINGS	WHITEHORSE POND	COOP		76		AD Fin Clp
3/12/2009	633471	2005	SKOKOMISH R 16.0001	RICKS PD (LLTK)	WDFW		64	Male	AD Fin Clp
3/21/2009	633364	2005	CASCADE R 03.1411	MARBLEMOUNT HATCHERY	WDFW		70		AD Fin Clp
3/28/2009	633372	2005	BIG SOOS CR 09.0072		WDFW	633371	76		AD Fin Clp
3/28/2009	632391	2004	CASCADE R 03.1411	MARBLEMOUNT HATCHERY	WDFW		88		AD Fin Clp
3/28/2009	633382	2005	FINCH CR 16.0222	HOODSPORT HATCHERY	WDFW		69		AD Fin Clp
3/28/2009	633369	2005	FRIDAY CR 03.0017	SAMISH HATCHERY	WDFW	633368	74		AD Fin Clp
3/28/2009	633285	2005	GROVERS CR 15.0299	GROVERS CR HATCHERY	SUQ	210682	71		AD Fin Clp
3/28/2009	633366	2005	PURDY CR 16.0005	GEORGE ADAMS HATCHRY	WDFW	633365	76		AD Fin Clp
3/28/2009	633366	2005	PURDY CR 16.0005	GEORGE ADAMS HATCHRY	WDFW	633365	73		AD Fin Clp
3/28/2009	052971	2005	SPRING CR 29.0159	SPRING CR NFH	FWS	052969, 052970, 052972	76		AD Fin Clp
3/28/2009	210571	2005	TULALIP CR 07.0001	BERNIE GOBIN HATCH	TULA		77		AD Fin Clp
3/28/2009	633375	2005	VOIGHT CR 10.0414	VOIGHTS CR HATCHERY	WDFW		77		AD Fin Clp
3/29/2009	633867	2006	CASCADE R 03.1411	MARBLEMOUNT HATCHERY	WDFW		54		AD Fin Clp
3/29/2009	210677	2005	SKAGIT R 03.0176		WDFW		76		AD Fin Clp
4/4/2009	633171	2005	NOOKSACK R -NF 01.0120	KENDALL CR HATCHERY	WDFW	633172	70		AD Fin Clp
4/13/2009	633364	2005	CASCADE R 03.1411	MARBLEMOUNT HATCHERY	WDFW		79		AD Fin Clp

Appendix G. Fishery-total estimates of retained and released salmon (Chinook and other species) catch for private boats[1/] in the Area 7, February 1 - April 15, 2009 mark-selective Chinook fishery. Displayed Chinook harvest values are equivalent to those displayed in **Table 3**. Whereas the Chinook release estimates displayed in **Table 3** are based on the Conrad and McHugh (2008) method, values displayed here are based solely on angler-reported data. Values may not add exactly due to rounding error. AD = marked (i.e., adipose-clipped), UM = unmarked, UNK = unknown mark status.

Stat Week	Est. Effort		Est. Retained Catch			Est. Releases								
	Boats	Anglers	Chinook			Chinook				Coho				Unk. Salmon
			Mark	Unmark	Total	Mark	Unmark	Unk.	Total	Mark	Unmark	Unk.	Total	
5	195	446	173	2	175	8	94	4	105	0	0	0	0	0
6	471	1,021	205	2	207	10	108	12	129	0	0	0	0	0
7	395	837	179	3	181	13	85	20	118	0	0	0	0	0
8	485	1,068	192	2	194	8	84	19	111	0	0	0	0	0
9	276	564	118	0	118	10	46	4	60	0	0	0	0	0
10	220	438	97	0	97	14	54	4	71	0	0	0	0	0
11	255	512	60	0	60	6	52	0	58	0	0	0	0	0
12	265	529	25	0	25	2	17	0	19	0	0	2	2	2
13	296	640	40	0	40	9	31	3	43	0	0	0	0	0
14	444	921	122	0	122	9	60	3	71	0	0	0	0	0
15	230	427	45	0	45	0	63	0	63	0	0	0	0	0
16	34	68	21	0	21	0	9	0	9	0	0	0	0	0
Total	**3,565**	**7,471**	**1,277**	**9**	**1,285**	**86**	**703**	**69**	**857**	**0**	**0**	**2**	**2**	**2**
Grand Total Summary Statistics:														
Variance:	7,581	25,504	1,657	3	1,659	10	1,268	102	1,289	0	0	0.001	0.001	0.001
SE:	87	160	41	2	41	3	36	10	36	0	0	0.022	0.022	0.022
CV:	2.4%	2.1%	3.2%	19.1%	3.2%	3.7%	5.1%	14.8%	4.2%	-	-	1.2%	1.2%	1.2%
95% CI:	3,394-3,735	7,158-7,784	1,197-1,356	5-12	1,205-1,365	80-92	633-773	49-88	857-857	-	-	2-2	2-2	2-2

[1/] Catch and effort estimates shown in the above table are solely for private boats fishing in the 2009 winter mark-selective fishery in Area 7; see **Table 3** for charter boat and Roche Harbor Derby participants' catch and effort values.

Appendix H. Season-total estimates of Chinook encounters by size/mark status, and total estimates of angler effort, summarized for the previous and current seasons of the Area 7 winter mark-selective Chinook fishery.

Area	Season Dates	Effort (Angler Trips)	Retained Chinook				Released Chinook				Total Encounters
			LM	LU	SM	SU	LM	LU	SM	SU	
7	Feb 1 - 29, 2008	4,862	1,301	2	24	0	200	1,042	244	155	2,967
7	Feb 1 - April 15, 2009	8,167	1,406	9	14	0	210	708	139	17	2,501