Marine Areas 9 and 10
Mark-Selective Recreational Chinook Fishery,
July 16-August 15, 2008

Post-season Report

REVISED DRAFT

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

The Washington Department of Fish and Wildlife (WDFW) implemented quota-based mark-selective Chinook fisheries (MSFs) in Marine Areas 9 and 10 for the second time from July 16 through August 15, 2008. 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 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 Areas 9 and 10 during their respective summer quota seasons in order to collect the data needed to provide in-season catch estimates (i.e., for assessing catch status relative to quotas[1]) and to estimate key parameters characterizing the fishery and its impacts on unmarked salmon. Sampling activities included dockside creel sampling, test fishing, and on-the-water effort surveys. 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/mark-status group), *iv*) the coded-wire tag- (CWT) and/or DNA-based stock composition of marked and unmarked Chinook mortalities[2], and *v*) the total mortality of marked and unmarked double index tag (DIT) CWT stocks.

Creel samplers staffed eight different access sites (4 in Area 9, 4 in Area 10; 2 total in each area on any given sampling day) on 24 of the 30 and 31 days, respectively, that Areas 9 and 10 were open to Chinook retention under mark-selective regulations. Samplers interviewed an estimated 24% and 29% of all anglers fishing in Areas 9 (n = 4,679 private, 304 charter) and 10 (n = 3,430 private, 632 charter), respectively. Additionally, they sampled 19% (Area 9) and 23% (Area 10) of all marked Chinook harvested in the two areas (n = 788 in Area 9, 232 in Area 10). Other PSSU staff conducted 11 on-the-water effort surveys (5 in Area 9, 6 in Area 10), and spent 43 days (255 hours) on the water pursuing Chinook using test-fishing methods, in support of Areas 9 and 10 monitoring efforts.

Based on the combination of sampling activities, we estimated that nearly 35,000 angler trips (20,399 in Area 9, 13,808 in Area 10) were completed by private and charter anglers in the two combined areas between July 16th and August 15th. With a season-wide CPUE of 0.198 Chinook retained per angler trip in Area 9 and 0.075 in Area 10, these anglers harvested a grand total of 4,045 and 1,031 marked Chinook in the two respective areas (5,076 total), nearly 2,000 fish shy of the combined-area quota (7,000). Anglers additionally released an estimated 9,242 Chinook (3,808 marked, 5,434 unmarked) in Area 9 and 1,212 Chinook (317 marked, 895 unmarked) in Area 10 (i.e., 10,454 releases overall). Overall, catch rates as well

[1] Areas 9 and 10 were managed to a combined-area landed catch total of 7,000 marked Chinook, with pre-season guidance emphasizing target catches of 4,000 in Area 9 and 3,000 in Area 10. If fisheries did not close due to catch totals meeting quotas, the latest day of scheduled fishing was August 15th, 2008, for both areas.

[2] 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.

as catch and effort totals were substantially lower during the 2008 compared to the 2007 Areas 9 and 10 summer quota seasons.

Over the two areas, harvested Chinook averaged 73 cm (range: 55 to 95 cm) in total length and were larger than the legal minimum size limit (≥22 in or 56 cm TL) in most instances (dockside marked Chinook observations, >99% of legal size). In both areas, more than four-fifths of all harvested individuals were 3-year olds (i.e., brood year 2005). In addition to taking length measurements and scale samples, ramp samplers recovered 97 CWTs from marked Chinook harvested in the Areas 9 (n = 70) and 10 (n = 27) fisheries. The majority of Area 9 tag recoveries (58%) were from Central Puget Sound (27%) and Hood Canal (31%) release sites. Among individual CWT release regions, Central Puget Sound fish were most abundant among Area 10 CWT recoveries.

During their one month of sampling in Areas 9 and 10 while they were open under mark-selective regulations, test fishers encountered 101 (66 in 9, 35 in 10) Chinook salmon, ~60% (59% in 9, 60% in 10) of which were marked and on average half (47% in 9, 74% in 10) of which were of legal size. With a "CPUE" (legal-marked Chinook *encounters* / angler trip) of 0.52 in Area 9 and 0.43 in Area 10, test fishers encountered legal-marked Chinook at a higher rate than private fleet anglers but at a rate similar to that of charter anglers. As was the case for private fleet anglers, test fishers experienced substantially lower catch rates during the 2008 compared to the 2007 summer quota season. Test-fishery Chinook total lengths averaged 47 cm (marked and unmarked mean, range: 14-85 cm) in Area 9 and 63 cm (range: 22-87 cm) in Area 10. Thus, Chinook total lengths were on average greater in Area 10 than Area 9, but highly variable in both areas. This was assumedly due to the presence of both juvenile resident and mature migrant Chinook in both Areas during the latter half of the season. For the entire one-month season, we estimated the season-wide size/mark-status composition at 35% legal-marked (LM), 12% legal-unmarked (LU), 24% sublegal-marked (SM), and 29% sublegal-unmarked (SU) in Area 9 and 51% LM, 23% LU, 9% SM, and 17% SU in Area 10.

By combining dockside-sampling results (i.e., legal-marked Chinook harvest estimates), test fishery encounters data, and charter census results, we generated size/mark-status group-specific estimates of encounters and mortalities for the two areas. In total, 13,290 Chinook were encountered (retained and released) during the Area 9 fishery, with 4,632 of these being legal-marked, 1,611 legal-unmarked, 3,222 sublegal-marked, and 3,826 sublegal-unmarked individuals; in Area 10, 2,246 Chinook were encountered (1,155 LM, 513 LU, 193 SM, and 385 SU). Among released encounters, an estimated 108 legal-marked, 317 legal-unmarked, 680 sublegal-marked, and 842 sublegal-unmarked Chinook (1,948 overall, 89% in Area 9, 11% in Area 10) were estimated to have died due to handling and release effects of the Areas 9 and 10 fisheries combined. Thus, in total, 5,865 marked (86% due to direct harvest) and 1,165 unmarked Chinook mortalities occurred as a result of the Areas 9 and 10 fisheries. Overall, estimated impacts were similar to (Area 9) or considerably less than (Area 10) what was expected based on pre-season Fishery Regulation Assessment Model runs (model run 2108). Finally, regarding impacts of MSFs on the coded-wire tag (CWT) program, we estimated that 16 and 6 unmarked Chinook belonging to double-index tag (DIT) groups may have died due to the handling-and-release impacts of respective Areas 9 and 10 fisheries.

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[3].

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 2006-07 fishing season, pilot *summer* selective Chinook seasons have occurred in Areas 5 and 6 for five years (2003-2007; WDFW 2008a) and in Areas 9, 10, 11, and 13 for one year (2007; WDFW 2007a and 2007b); pilot *winter* selective Chinook fisheries have occurred in Areas 8-1 and 8-2 for two complete seasons (2005-06 and 2006-07; WDFW 2008b). From July 16 to August 15, 2008, the Washington Department of Fish and Wildlife (WDFW) implemented a summer mark-selective Chinook fishery in Areas 9 and 10 for the second time. 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 Areas 9 and 10 selective Chinook fishery, WDFW's Puget Sound Sampling Unit was tasked with implementing an intensive monitoring program during the entirety of its one-month, summer 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 composition of marked and

[3]The regulations specific to the 2007-8 Areas 9 and 10 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 Areas 9 and 10 mark-selective fishery, and *iii*) held to a handling rule that prevented them from bringing unmarked and/or sublegal Chinook aboard their vessels.

unmarked Chinook mortalities[4], 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 Areas 9 and 10 monitoring activities. We first provide a brief review 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 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 and Fishery Description

Marine Area 9 is a relatively large area, encompassing approximately 200 square miles (512 km^2) of marine water in central Puget Sound. Area 9 starts at the mouth of Admiralty Inlet (i.e., its northern boundary is at the Partridge Point–Point Wilson line) and extends southward to the Apple Cove Point–Edwards Point line, including the marine waters extending south from Foulweather Bluff to the Hood Canal Bridge (**Figure 1-1**). Marine Area 10 is the catch area immediately south of Area 9, which includes the waters immediately adjacent to the largest population center in the Puget Sound Region (i.e., Seattle). Encompassing between 100 and 200 square miles (206-512 km^2) of marine water, Area 10 extends southward from the Apple Cove Point–Edwards Point line to an east-west line projected through the north tip of Vashon Island (**Figure 1-2**). During the summer, both areas draw appreciable local, tourist, and charter-based angling effort. In addition to Chinook salmon, these anglers pursue and encounter coho salmon (*O. kisutch*) and, during odd years, pink salmon (*O. gorbuscha*).

During summer 2008, the Areas 9 and 10 fisheries were managed on a quota basis, with a combined-area landed-catch goal of 7,000 marked Chinook. Pre-season management guidance emphasized target catch totals of 4,000 and 3,000 marked Chinook for areas 9 and 10, respectively, and a maximum season length of 31 days (i.e., July 16th-August 15th) if the quota was not achieved. As implemented, Area 10 was open continuously from July 16th to August 15th (31 days of fishing). While Area 9 opened and closed on the same dates, it was

[4] 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.

closed temporarily on August 11th so that the status of landed catch relative to the allocated quota could be evaluated (i.e., the Area 9 season was 30 days in length).

Monitoring Program Overview

Our sampling program for the Areas 9 and 10 fisheries incorporated comprehensive and complementary data collection strategies, including dockside angler interviews (with catch sampling), on-the-water (instantaneous) effort surveys, test-fishery-based sampling, and voluntary reports of completed trips provided by charter boats and private anglers (**Figure 2**). Although we provide a brief review the field and analytical methods associated with our sampling efforts here, we refer the reader to WDFW (2007b or 2008b) for additional detail.

Catch and Effort: Sampling and Estimation

We collected data on total catch (observed harvest and reported releases[5]) and total angling effort using a two-stage stratified cluster sample design. At the first stage, we selected five sample days from three temporal strata (weekday [Monday-Thursday], with $n = 2$ days sampled; Friday, with $n = 1$ day sampled; and weekend [Saturday-Sunday], with $n = 2$ days sampled) during each week of the fishery. On each selected sample day, we selected two access points (i.e., public ramps, boathouses, etc.) from our Areas 9 and 10 sample frames for creel sampling. Access site (i.e., cluster) selection was achieved at the second stage using a probability-proportional-to-size (PPS) sampling algorithm (the Yates-Grundy or "natural" method, Cochran 1977). The measure of size used in PPS sampling was equivalent to the fraction of total sample-frame effort attributed to a given site; this quantity was estimated using data collected during instantaneous on-the-water surveys (i.e., "boat surveys") conducted routinely during the course of the fishery. Our sample frame included all moderate-to-high-effort public boat launch facilities that are used to access Areas 9 and 10 (*Area 9*: Norton Street [Everett], Fort Casey [Keystone] State Park, Mukilteo State Park, and Port Townsend Boat Haven ramps; *Area 10*: Armeni, Kingston, Manchester, and Shilshole ramps). Given that some effort was excluded from our sample frame (i.e., private and/or low-effort access sites), we also estimated the out-of-frame effort proportion from boat survey data and accounted for this quantity in estimates of fishery-wide totals (e.g., catch and effort).

At access sites selected for sampling on scheduled sample days, samplers interviewed *all* anglers exiting the fishery. During interviews, samplers acquired data on trip duration, 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+ individuals for later lab processing. Additionally, samplers took length measurements (fork and total) and scale samples from landed Chinook.

[5] 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 (**Appendices G-1** and **G-2**), we focus exclusively on bias-corrected "Method 2" estimates of Chinook encounters (and releases) in our review of the Area 9 and 10 fishery.

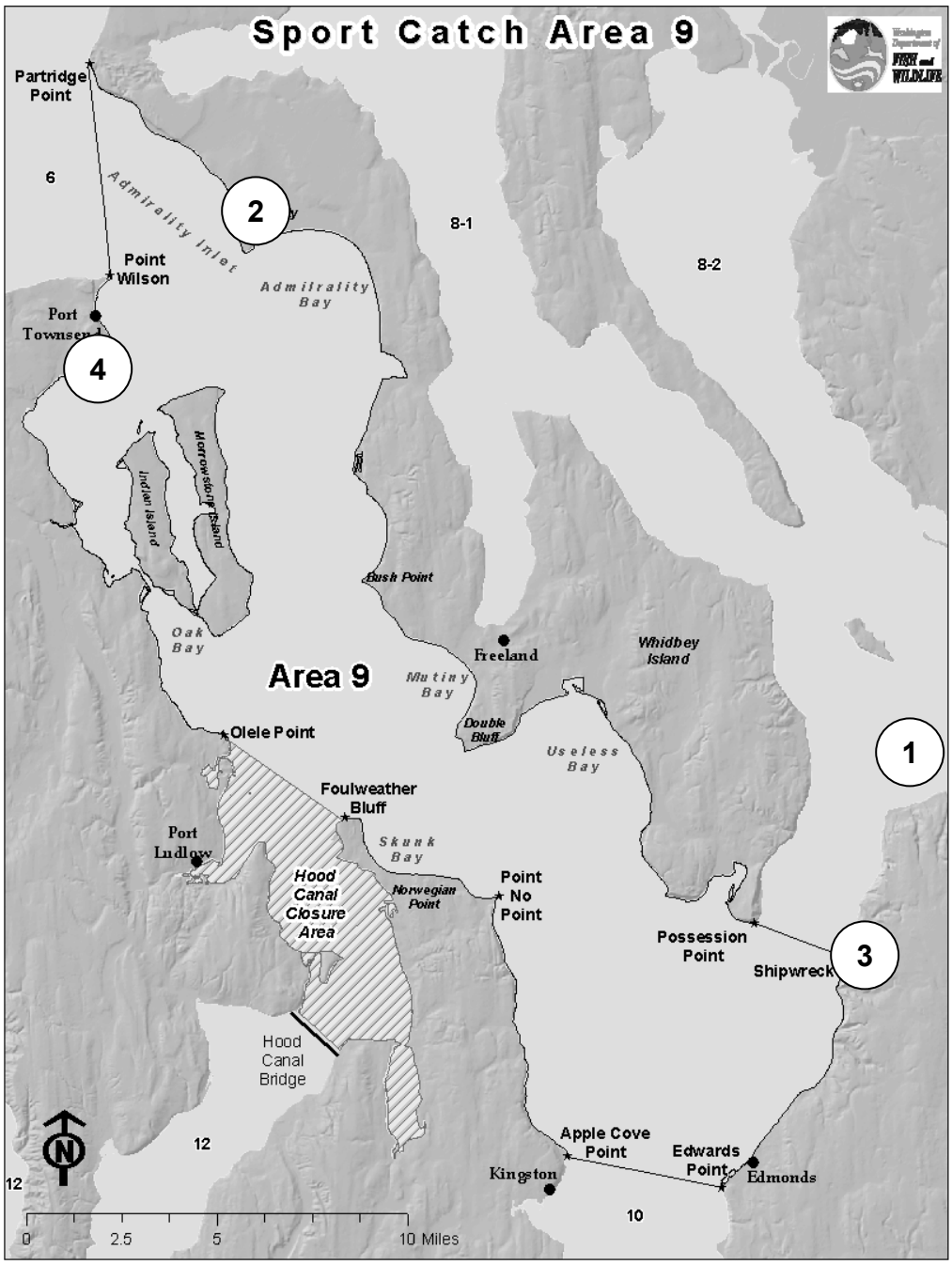

Figure 1-1. Map of Marine Catch Area 9 in Puget Sound, where the second season of the pilot selective Chinook fishery occurred from July 16-August 15, 2008. Circled numbers correspond to locations sampled during the Area 9 selective fishery (1 = Norton Street [Everett], 2 = Fort Casey [Keystone] State Park, 3 = Mukilteo State Park, and 4 = Port Townsend Boat Haven ramps).

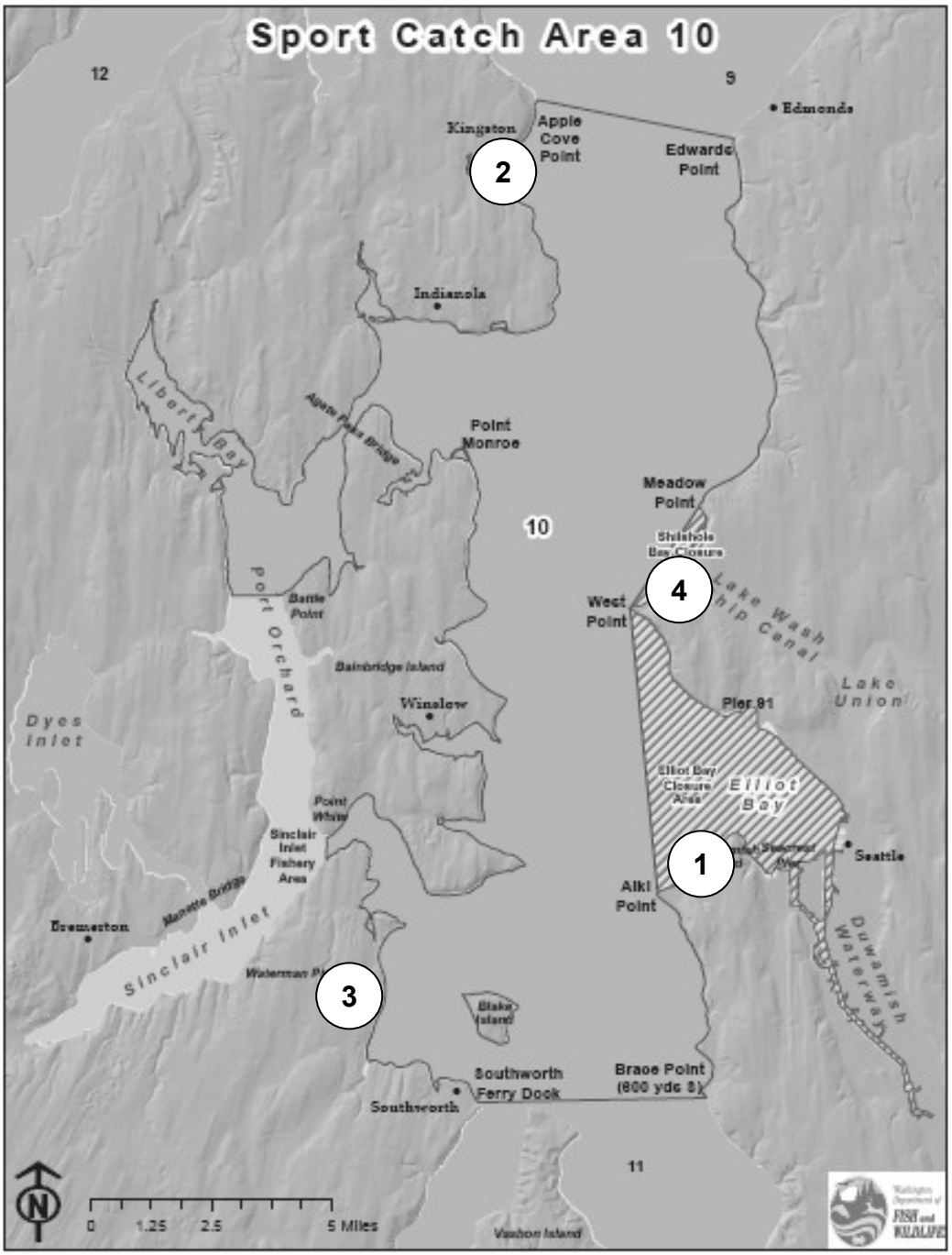

Figure 1-2. Map of Marine Catch Area 10 in Puget Sound, where the second season of the pilot selective Chinook fishery occurred from July 16-August 15, 2008. Circled numbers correspond to locations sampled during the Area 10 selective fishery (1 = Armeni, 2 = Kingston, 3 = Manchester, and 4 = Shilshole ramps).

By combining dockside interview data with estimated size measures, we generated daily estimates (and variances) of total fishing effort and landed Chinook catch (by mark-status group) for our sample frame using Murthy's population-total estimator (Murthy 1957, Cochran 1977, WDFW 2008b). We then expanded these estimates to account for the out-of-

frame effort proportion and then again to obtain stratum-wide totals (**Table 1**). To minimize the influence of recall bias on our assessment, we estimated Chinook releases as the difference between retained catch (i.e., from the Murthy estimator, 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 test fishery-based 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 2007b). 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 A** 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 reported releases for other salmon species, in appendices to this report (**Appendices G-1** and **G-2**).

As a final note, given the higher catch per unit effort (CPUE) of charter 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 and effort data for these anglers through a separate effort. We contacted all salmon charters known to be operating in Areas 9 and 10 during the summer months and coordinated with them so that they would provide us with routine (i.e., after each day of fishing), in-season updates of catch and effort. Given the quota nature of the 9 and 10 fisheries, however, our daily charter interviews emphasized acquiring *landed* catch and effort data. Thus, although we achieved a complete charter census for legal-marked Chinook encounters (retained *and* released) and effort, we had to estimate total releases for the three other size/mark-status categories due to incomplete accounts of salmon releases. To do this, we assumed that the charter legal-marked Chinook encounters-total was known exactly (i.e., with no variance) and that charter anglers experienced the same size/mark-status composition as did test fishers. Given these assumptions, we estimated total charter encounters (and variance) according to Equation 1 (Eqn. 2 for variance) in **Appendix A**, less the adjustment for legal-marked Chinook releases. We then apportioned this estimate, less LM encounters, into LU, SM, and SU class-specific estimates using the same methods as for the at-large private fleet (**Appendix A**). To arrive at fishery-wide estimates, charter totals and variances (i.e., for releases) were simply added to survey-based (private fleet) values at the appropriate step.

Test Fishery Methods

In order to obtain accurate estimates 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 mark-selective Chinook season (**Table 1**). Our test boat crew consisted of two WDFW technicians, each fishing with a single rod for five days a week (Monday-Friday). 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 appropriate, mark status (marked or unmarked). For Chinook salmon encounters only, test fishers additionally collected scale and DNA samples (~1-cm^2 piece of dorsal tissue).

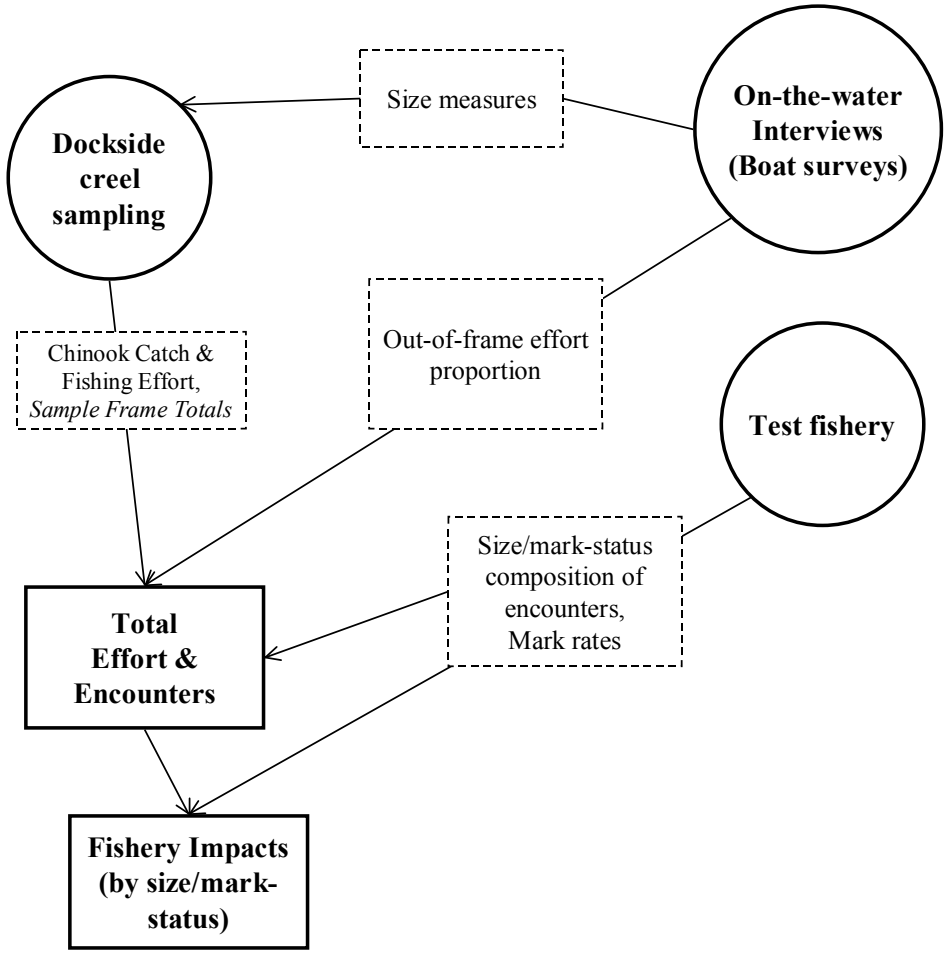

Figure 2. Conceptual diagram of the monitoring plan implemented in Areas 9 and 10 during the July 16-August 15, 2008 mark-selective Chinook season. Circles represent discrete sampling activities, dashed boxes represent parameters that are estimated using data from a given activity, and solid boxes depict key quantities estimated from the comprehensive plan. 'Encounters' includes both harvested and released Chinook salmon.

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 the previous post-season summer Areas 9 and 10 report, 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, 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 legal-marked Chinook release that occurs 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 A** 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 Areas 9 and 10 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). For quota purposes, finer-scale estimation is pursued when needed.
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 (30 days)	Though they were qualitatively examined, too few encounters occurred to rigorously assess mark rates on a finer time scale.
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 (30 days)	Estimated on a monthly time step but considered at the season-total level.
Coded-wire tag (CWT) Impacts Estimation	Marked/unmarked double-index tag (DIT) encounters and mortalities	N/A	N/A	Season (30 days)	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 Areas 9 and 10 fisheries on the CWT program, we estimated the total number of unmarked-tagged Chinook mortalities that may have occurred during the course of their respective one-month seasons. 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[6]. 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

Sampled Access Sites

Between July 16 and August 15, 2008, we sampled the recreational fleet via dockside creel surveys on a grand total of 24 days in each Area 9 and Area 10, visiting four different access sites in each of the two respective areas (**Table 2-1**, **2-2**). In Area 9, we sampled anglers at Everett (44% of site-days) and Port Townsend ramps (40% of all site-days) most frequently; remaining dockside sampling effort was split between Fort Casey (10%) and Mukilteo (6%) ramps. In Area 10, we sampled Shilshole Ramp on every scheduled sample day (50% of site-days). Ten to 20% of remaining sampling effort was spent at each Armeni (19%), Kingston (19%), and Manchester (13%) ramps. Our dockside sampling efforts were generally distributed across sites in a manner proportional to the level of effort originating at each (i.e., as estimated from boat survey data, described below; **Appendix C, D**).

In total, our Area 9 angler-interview efforts allowed us to directly sample 4,679 completed angler trips and 2,170 completed boat trips. In Area 10, we collected data on a total of 3,430 angler trips and 1,744 boat trips. These efforts also yielded samples from nearly 1,000 landed Chinook salmon over the two areas (**Appendix B**). In addition to interviewing anglers and sampling their catch within the context of this MSF-specific study, we obtained additional

[6] 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.

samples from baseline recreational sampling activities that were ongoing during the Areas 9 and 10 seasons.

On-the-Water Survey Summary

During the 30-day period that Area 9 was open under mark-selective regulations, we conducted 1,797 on-the-water interviews (i.e., total anglers intercepted [*n* = 864 boats]) over a total of three weekday and two weekend boat surveys (**Appendix C-1**). In Area 10, we conducted 6 total surveys (2 weekend, 4 weekday) and intercepted 847 anglers (*n* = 488 boats; **Appendix C-2**). These surveys yielded quantitative details about the set of sites anglers used to access Areas 9 and 10 and thus allowed us to estimate the proportion of effort originating at each of our sample-frame sites (i.e., size measures; **Appendix D**) during both weekday and weekend strata. As suggested above, Everett (Norton St.) Ramp was the sample-frame site that anglers most frequently reported using to access Area 9, followed by Port Townsend, Fort Casey, and Mukilteo ramps. Pooled over all surveys, nearly half (56%) of all anglers interviewed during Area 9 boat surveys indicated that their trip would end at either a private or never-sampled launch site (**Appendix C-1**). In Area 10, one out of four anglers interviewed reported using Shilshole Ramp to access the fishery (**Appendix C-2**); 51% of all anglers encountered reported using private and/or never-sampled access sites. Boat surveys revealed a modest level of variability in the relative "size" of sampled access sites (**Appendix D**); we incorporated this variation into our PPS site-selection framework.

Table 2-1. Sampling calendar for the summer 2008 Area 9 mark-selective Chinook fishery. Shaded cells are days when dockside creel sampling was conducted (Site abbreviations: Ev = Norton [Everett], Mu = Mukilteo, FC = Fort Casey, and PT = Port Townsend Boat Haven ramps). B = boat survey, TF = test fishing. Note that Area 9 was closed temporarily on August 11th for an in-season catch assessment.

Stat Week	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.	Sun.
29	14 **(JULY)**	15	16 ***Opening Day*** Sites: Ev, PT B, TF	17 Sites: Ev, PT TF	18 Sites: Ev, PT TF	19 Sites: Ev, PT B	20 Sites: Ev, PT
30	21 TF	22 Sites: Mu, PT TF	23 Sites: Ev, PT TF	24 B, TF	25 Sites: Ev, FC TF	26 Sites: Ev, PT	27 Sites: Ev, PT B
31	28 Sites: Ev, PT TF	29 Sites: Mu, FC	30 TF	31 TF	1 **(AUGUST)** Sites: Ev, FC TF	2 Sites: Ev, PT	3 Sites: Ev, PT
32	4 Sites: Ev, FC TF	5 TF	6 B, TF	7 Sites: Mu, PT TF	8 Sites: Ev, PT TF	9 Sites: Ev, FC	10 Sites: Ev, PT
33	11 ***Temporary Closure*** TF	12 Sites: Ev, PT TF	13 Sites: Ev, PT TF	14 Sites: Ev, PT TF	15 ***Closing Day*** Sites: EV, PT TF	16	17

Table 2-2. Sampling calendar for the summer 2008 Area 10 mark-selective Chinook fishery. Formatting follows that described above (Site abbreviations: Ar = Armeni, Ki = Kingston, Ma = Manchester, and Sh = Shilshole ramps).

SW	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.	Sun.
29	14 **(JULY)**	15	16 ***Opening Day*** Sites: Ki, Sh TF	17 Sites: Ar, Sh B, TF	18 Sites: Ar, Sh TF	19 Sites: Sh Ki	20 Sites: Ar, Sh B
30	21 TF	22 Sites: Ki, Sh TF	23 Sites: Ki, Sh B, TF	24 TF	25 Sites: Ar, Sh TF	26 Sites: Ki, Sh B	27 Sites: Ma, Sh
31	28 Sites: Ki, Sh TF	29 Sites: Ma, Sh	30 TF	31 TF	1 **(AUGUST)** Sites: Ar, Sh	2 Sites: Ki, Sh	3 Sites: Ma, Sh
32	4 Sites: Ki, Sh TF	5 TF	6 TF	7 Sites: Ma, Sh B, TF	8 Sites: Ar, Sh TF	9 Sites: Ar, Sh	10 Sites: Ma, Sh
33	11 B, TF	12 Sites: Ar, Sh TF	13 Sites: Sh, Ki TF	14 Sites: Ar, Sh TF	15 ***Closing Day*** Sites: Ma, Sh TF	16	17

Fishery Characteristics

Estimates of Fishing Effort and Chinook Catch

Across the Areas 9 and 10 summer seasons combined, charter and private anglers completed an estimated total of nearly 35,000 angler trips between July 16 and August 15, 2008. Approximately 60% of this effort occurred in Area 9 and 40% in Area 10 (**Table 3-1** and **3-2**). A total of twelve charter operators reported taking clients fishing in the two areas during their summer quota seasons. Charter anglers accounted for a minor portion of the Area 9 effort (1%) total. In contrast, charter activity constituted 5% of the Area 10 effort total.

For private fleet anglers, both areas exhibited similar trends in angling effort over their month-long seasons (**Figure 3**). In particular, effort levels were initially high in both areas and then declined as each fishery progressed. This pattern contrasts sharply with what was observed during the 2007 Areas 9 and 10 summer MSF season, where effort remained high and/or increased over the course of the fishery. In addition, per day open, total angling effort estimated for the 2008 fisheries averaged 60 and 66% of what was estimated for Areas 9 and 10, respectively, during 2007.

Chinook salmon catch rates (CPUE, landed Chinook per angler trip) averaged 0.198 (0.198 for private, 0.227 for Charter) in Area 9 and 0.075 in Area 10 (0.065 for private, 0.272 for charter) landed Chinook per angler trip. Thus, like effort, CPUE was considerably higher in Area 9 than Area 10. In both areas, however, catch rates were considerably lower than was observed during the 2007 Areas 9 and 10 summer quota seasons (combined-area CPUE: 0.145 in 2008 vs. 0.240 in 2007; WDFW 2007a). Further, while there was a season-wide peak in CPUE during the last week of July in Area 9 (CPUE = 0.331), CPUE remained low and varied little between July 16th and August 15th in Area 10 (**Figure 4**). Finally, Area 9 charter anglers experienced success rates (i.e., CPUE) similar to those of the private fleet (private = 0.198, charter 0.227), whereas in Area 10, charter anglers were 4.2 times more successful than private fleet anglers (private CPUE = 0.065, charter CPUE = 0.272).

Given observed patterns in effort and catch rates, we estimated that anglers harvested a grand total of 5,081 Chinook salmon in the combined Area 9/10 fishery (4,047 [98% private, 2% charter] in Area 9, 1034 [17% private, 83% charter] in Area 10; **Tables 3-1** and **3-2**). Thus, while the Area 9 total catch target of 4,000 harvested Chinook was met, neither the Area 10 target (3,000 harvested Chinook) nor the combined-area quota of 7,000 harvested Chinook was reached by the scheduled maximum date of the fishery (August 15th). In both areas, virtually all (>99%) Chinook harvested were marked. For private fleet anglers fishing in Area 9, weekly harvest totals were variable and averaged 796 (range: 146-1,046); Area 10 weekly catch totals were lower and more stable, averaging 172 (range: 107-252). See **Figure 5** for a graphical display of temporal harvest patterns. Finally, in addition to Chinook salmon, anglers harvested 1,142 (242 in 9 and 484 in 10) coho salmon (*O. kisutch*) during the July 16-Augst 15, 2008 Areas 9 and 10 fisheries (**Appendix G-1** and **G-2**).

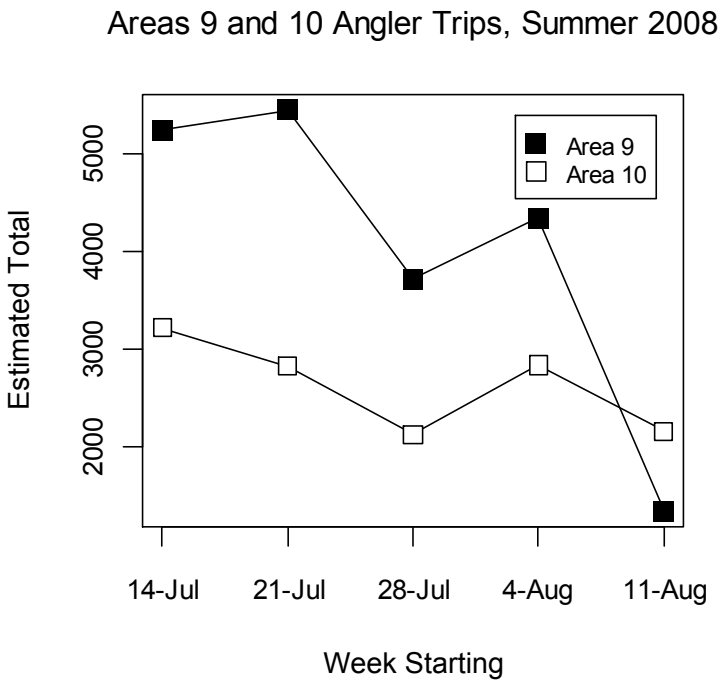

Figure 3. Temporal patterns in private fleet (i.e., excluding charters) fishing effort during the Areas 9 and 10, July 16-August 15, 2008, mark-selective Chinook fisheries. Note that the fishery did not begin until Wednesday, July 16th (statistical week 29).

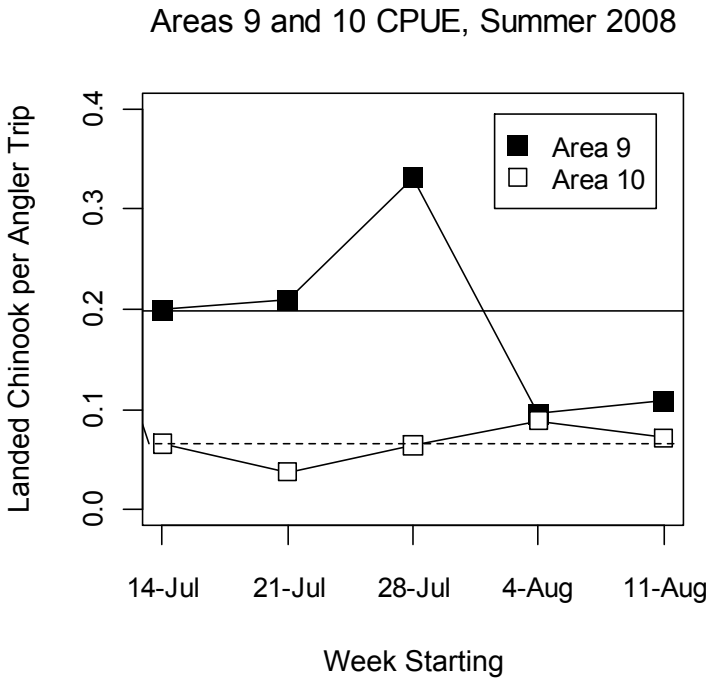

Figure 4. Temporal patterns in CPUE (landed Chinook per angler trip) during the Areas 9 and 10 July 16-August 15, 2008 mark-selective Chinook fisheries. The horizontal solid and dashed lines correspond to the season-wide CPUE for Areas 9 and 10, respectively. Note that the fishery did not begin until Wednesday, July 16th (statistical week 29).

Table 3-1. Estimates of total fishing effort and the total number of salmon kept and released during the Area 9, July 16-August 15, 2008 selective fishery. Values may not add exactly due to rounding error.

Stat Week	Stratum Start	Stratum End	Effort[1]		Retained Chinook[1]		Released Chinook[2]		Chinook Encounters Total
			Boats	Anglers	AD	UM[3]	AD	UM	
29	16-Jul	20-Jul	2,393	5,241	1,043	3	985	1,402	3,433
30	21-Jul	27-Jul	2,548	5,446	1,137	0	1,074	1,530	3,741
31	28-Jul	03-Aug	1,710	3,721	1,233	0	1,164	1,660	4,057
32	04-Aug	10-Aug	2,086	4,343	416	0	393	560	1,368
33	11-Aug	15-Aug	664	1,344	146	0	138	197	481
Creel subtotal:			9,400	20,095	3,976	3	3,753	5,348	13,080
Charter subtotal[4]:			--	304	69	0	55	86	209
Grand Total:			9,400	20,399	4,045	3	3,808	5,434	13,290
Standard Error:			287	616	489	1	1,262	1,320	3,151
CV (%):			3%	3%	12%	41%	33%	24%	24%
95% CI:			8,837-9,964	19,192-21,606	3,085-5,004	1-5	1,335-6,282	2,848-8,021	7,114-19,466

[1] Estimated boats, anglers, and retained salmon catch were estimated via the Murthy estimator method.
[2] Released Chinook were estimated as the difference between total Chinook encounters generated using a bias-corrected "Method 2" estimator. See **Appendix A** and Conrad and McHugh (2008) for additional details.
[3] The 3 UM Chinook included were actually of undetermined mark status; they are assumed to be unmarked for impact-estimation purposes.
[4] Angler trips and legal-marked encounters (kept or released) were the result of a complete census for charter anglers; sublegal-marked and all unmarked releases were estimated for charter anglers based on test-fishery size/mark-status composition data. The charter-based boat trip total is unavailable.

Table 3-2. Estimates of total fishing effort and the total number of salmon kept and released during the Area 10, July 16-August 15, 2008 mark-selective fishery. Values may not add exactly due to rounding error.

Stat Week	Stratum Start	Stratum End	Effort[1]		Retained Chinook[1]		Released Chinook[2]		Chinook Encounters Total
			Boats	Anglers	AD	UM	AD	UM	
29	16-Jul	20-Jul	1,580	3,221	209	3	70	183	466
30	21-Jul	27-Jul	1,449	2,828	107	0	36	95	238
31	28-Jul	03-Aug	1,118	2,127	136	0	46	121	302
32	04-Aug	10-Aug	1,487	2,838	252	0	84	224	561
33	11-Aug	15-Aug	1,175	2,162	155	0	52	138	344
Creel subtotal:			6,810	13,176	859	3	288	762	1,911
Charter subtotal[3]:			0	632	172	0	29	134	334
Grand Total:			6,810	13,808	1,031	3	317	895	2,245
Standard Error:			408	768	63	1	137	217	402
CV (%):			6%	6%	6%	41%	43%	24%	18%
95% CI:			6,011-7,609	12,302-15,314	907-1,155	1-5	48-585	470-1,321	1,457-3,034

[1] Estimated boats, anglers, and retained salmon catch were estimated via the Murthy estimator method.
[2] Released Chinook were estimated as the difference between total Chinook encounters generated using a bias-corrected "Method 2" estimator. See **Appendix A** and Conrad and McHugh (2008) for additional details.
[3] Angler trips and legal-marked encounters (kept or released) were the result of a complete census for charter anglers; sublegal-marked and all unmarked releases were estimated for charter anglers based on test-fishery size/mark-status composition data. The charter-based boat trip total is unavailable.

In addition to harvesting nearly 5,100 Chinook salmon, we estimated that anglers participating in the Areas 9 and 10 MSFs caught and released an additional 4,125 marked (92% in Area 9, 8% in Area 10) and 5,434 unmarked Chinook salmon (86% in Area 9 and 14% in Area 10; **Tables 3-1** and **3-2**, **Figure 5**)[7]. On a season-total level, anglers released an estimated 0.9 marked and 1.3 unmarked Chinook per marked, harvested fish in Area 9; in Area 10 they released an estimated 0.3 marked and 0.9 unmarked Chinook per marked, harvested fish.

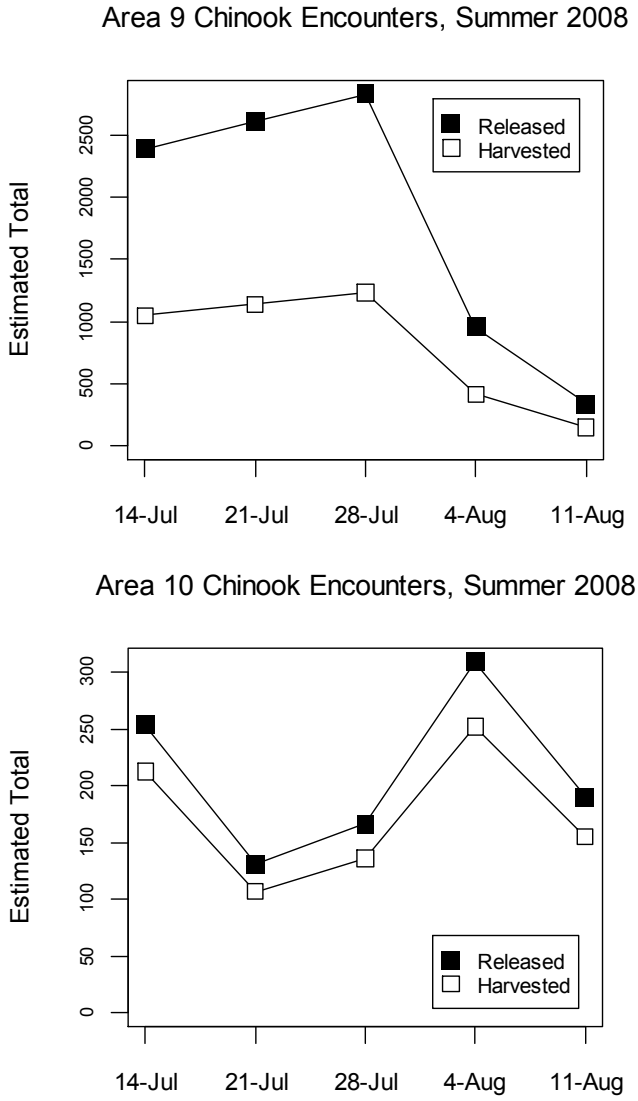

Figure 5. Temporal patterns in total Chinook harvest and releases during the Areas 9 (*upper panel*) and 10 (*lower panel*), July 16-August 15, 2008, mark-selective Chinook fisheries. Note that the fishery did not begin until Wednesday, July 16th (statistical week 29).

[7] Total Chinook releases were estimated using the bias-corrected "Method 2" encounters estimation approach (Conrad and McHugh 2008). For Murthy estimates of Chinook releases based solely on angler-reported releases (i.e., "Method 1" estimates), as well as estimates of harvest and releases for other salmon species, see **Appendix G-1** and **G-2**.

Combining harvest and release estimates, we estimated that anglers encountered a grand total of 13,290 and 2,245 Chinook in Area 9 and 10, respectively, during their one-month mark-selective seasons (**Table 3-1**, **3-2**). For additional discussion of fishery impacts from a total encounters perspective, see the subsequent section titled *Overall Fishery Impacts*.

Characteristics of Harvested Chinook

Length and Age.—During the combined Areas 9 and 10 mark-selective fishery, 1,023 (790 in Area 9 and 233 in Area 10) retained Chinook were sampled at dockside (**Table 4**). All of these fish were measured and examined for the presence of a CWT. Marked Chinook harvested from Area 9 averaged 72.9 cm TL (range: 55.0-94.0, SD = 7.0) and were similar to those caught in Area 10 (average: 72.9 cm TL [range: 54.3-94.5, SD = 6.9]; **Figure 6**; t = -0.02, df = 382, P-value = 0.987). Further, legally harvestable ($\geq$ 22 in [56 cm] *and* marked) Chinook comprised over 99% of the sampled total for the two respective areas.

Table 4. Summary of length samples collected during dockside angler interviews from retained Chinook salmon, Areas 9 and 10, July 16-August 15, 2008.

		Number Sampled		
Marine Area	**Mark Type**	**Legal-size**	**Sublegal-size**	**Total**
9	Marked	786	2	788
	Unmarked	2	0	2
	Undetermined	0	0	0
	Total	788	2	790
10	Marked	231	1	232
	Unmarked	1	0	1
	Undetermined	0	0	0
	Total	232	1	233

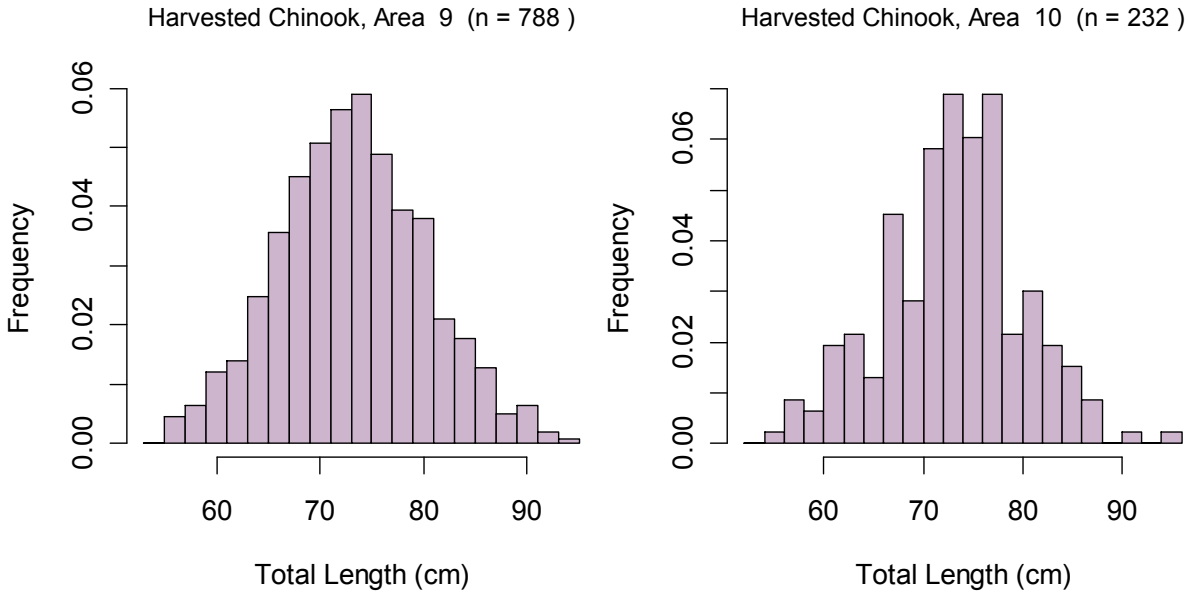

Figure 6. Length-frequency distributions of retained marked Chinook sampled at dockside during the Areas 9 (*left panel*) and 10 (*right panel*) July 16-August 15, 2008 mark-selective Chinook fisheries.

Though scales were collected from all of the 1,020 marked Chinook sampled at dockside, only 887 (87%; n = 688 in Area 9 and n = 199 in Area 10) of these could be successfully aged. Based on these scales, we found that the age composition of Chinook harvest was similar for both areas 9 and 10 (**Appendix E**). The majority of the retained Chinook were age-3 individuals (83 and 85% in 9 and 10, respectively); age-4 fish each constituted the remaining 14-17% of the harvest total for the two areas. Further, 95% of all retained Chinook were subyearling outmigrants.

CWT Samples.—In total, 97 (70 in Area 9, 27 in Area 10) coded-wire tags were recovered from the Areas 9 and 10 fisheries. In Area 9, approximately 60% of these recoveries came from a combination of Hood Canal and Central Puget Sound hatcheries (**Table 5-1**). An equal proportion of the remaining 40% of Area 9 CWT recoveries were from release sites in the North and South Puget Sound regions. As for individual hatcheries, tag recoveries from the Hoodsport Hatchery were most abundant (21% of fishery total), followed by Samish Hatchery (11% of total) and Soos Creek Hatchery (10% of total). Additionally, one tag from each the Columbia Basin (Spring Creek Hatchery) and Fraser Basin (Chilliwack Hatchery) was recovered in Area 9. Thirty-one of all Area 9 CWT recoveries were from double index tag (DIT) releases.

Just over one third (10 of 27 or 37%) of all Area 10 CWT recoveries originated from Central Puget Sound release sites (**Table 5-2**). Roughly similar numbers of the 17 remaining tagged Chinook sampled in Area 10 landings were from Hood Canal, South Puget Sound, and North Puget Sound release groups. For any single release site, Big Soos Creek (Soos Creek Hatchery) tags had the greatest representation (15% of total). Finally, 14 of the 27 CWTs were associated with DIT releases. See **Appendix F** for individual-level details on CWT recoveries.

Table 5-1. Summary of coded-wire tags recovered from Chinook salmon harvested during the Area 9 July 16-August 15, 2008 mark-selective Chinook fisheries. The field "No. DITs" corresponds to the number of tags that belonged to double-index tag groups.

Release Region[1]	Release Site	Rearing Location	CWTs Recovered	No. DITs
British Columbia-Fraser River	Chilliwack River	Chilliwack River Hatchery	1 (1.4%)	1
Hood Canal	Purdy Creek	George Adams Hatchery	4 (5.7%)	4
	Finch Creek	Hoodsport Hatchery	15 (21.4%)	0
	Skokomish River	Ricks Pond	3 (4.3%)	0
Puget Sound-Central	Big Soos Creek	Soos Creek Hatchery	7 (10.0%)	7
	Gorst Creek	Gorst Creek Rearing Pond	1 (1.4%)	0
	Green River	Icy Creek Hatchery	4 (5.7%)	0
	Grovers Creek	Grovers Creek Hatchery	5 (7.1%)	5
	Grovers Creek Hatchery	Grovers Creek Hatchery	1 (1.4%)	1
	Issaquah Creek	Issaquah Hatchery	1 (1.4%)	0
Puget Sound-North	Friday Creek	Samish Hatchery	8 (11.4%)	8
	N.F. Nooksack River	Kendall Creek Hatchery	1 (1.4%)	1
	Tulalip Creek	Bernie Gobin Hatchery	1 (1.4%)	0
	Skagit River	Unreported	1 (1.4%)	0
	Whitehorse Springs	Whitehorse Pond	2 (2.9%)	0
Puget Sound-South	Chambers Creek	Chambers Cr. & Garrison Hatchery	1 (1.4%)	0
		Garrison Hatchery	4 (5.7%)	0
		Lakewood Hatchery	2 (2.9%)	0
	Clear Creek	Nisqually Hatchery	3 (4.3%)	3
	Kalama Creek	Kalama Creek Hatchery	4 (5.7%)	0
Columbia Basin	Spring Creek	Spring Creek NFH	1 (1.4%)	1
		Grand Total	**70**	**31**

[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).

Table 5-2. Summary of coded-wire tags recovered from Chinook salmon harvested during the Area 10 July 16-August 15, 2008 mark-selective Chinook fisheries. The field "No. DITs" corresponds to the number of tags that belonged to double-index tag groups.

Release Region[1]	Release Site	Rearing Location	CWTs Recovered	No. DITs
Hood Canal	Purdy Creek	George Adams Hatchery	2 (7.4%)	2
	Finch Creek	Hoodsport Hatchery	2 (7.4%)	0
	Skokomish River	Ricks Pond	1 (3.7%)	0
Puget Sound-Central	Big Soos Creek	Soos Creek Hatchery	4 (14.8%)	4
	Gorst Creek	Gorst Creek Rearing Pond	1 (3.7%)	0
	Grovers Creek	Grovers Creek Hatchery	3 (11.1%)	3
	Grovers Creek Hatchery	Grovers Creek Hatchery	2 (7.4%)	2
Puget Sound-North	Friday Creek	Samish Hatchery	3 (11.1%)	3
	Wallace River	Wallace River Hatchery	1 (3.7%)	0
	Whitehorse Springs	Whitehorse Pond	1 (3.7%)	0
Puget Sound-South	Chambers Creek	Chambers Cr. & Garrison Hatchery	2 (7.4%)	0
		Lakewood Hatchery	2 (7.4%)	0
	Kalama Creek	Kalama Creek Hatchery	1 (3.7%)	0
	Voights Creek	Voights Creek Hatchery	2 (7.4%)	0
		Grand Total	**27**	**14**

[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 Types

Test fishers were scheduled to fish in both Areas 9 and 10 on every weekday between July 16 and August 15, 2008. In total, they spent approximately 250 hours (128 in 9, 126 in 10) and 43 days (21 in 9, 22 in 10) on the water pursuing Chinook salmon in the two areas (**Tables 2-1**, **2-2**, **6-1**, and **6-2**). Based on dockside interview results for anglers reporting successful Chinook salmon encounters (n = 787 responses in Area 9 and 447 responses in Area 10 [i.e., to our fishing methods question]), gear schedules were prescribed to help ensure that samplers fished using the same methods in approximately the same proportions as the private fleet. During the 30 days that Areas 9 was open, test fishers trolled using downriggers 99% of the time and spent their remaining time (1%) using mooching techniques (i.e., the "weight-and-bait" method). Their private fleet counterparts pursued Chinook mainly by trolling with downriggers (92% of respondents) or divers (1% of respondents) and, to a lesser extent (6%), by mooching or jigging (1%). Area 9 test fishers trolled with downriggers, jigged, and

mooched for 95%, 4%, and 1% of their time, respectively, whereas 86%, 13%, and 1% of private effort consisted of downrigger trolling, mooching, and jigging respectively.

Encounters, Mark Rates, and Size/Mark-status Composition

During their respective mark-selective seasons, test fishers encountered 66 Chinook in Area 9 (23 legal-sized and marked [LM], 8 legal-sized and unmarked [LU], 16 sublegal-sized and marked [SM], and 19 sublegal-sized and unmarked [SU]; **Table 6-1**) and 35 Chinook in Area 10 (18 LM, 8 LU, 3 SM, and 6 SU; **Table 6-2**). In Area 9, 59% of all Chinook encountered were marked (74% for legal-sized fish only), whereas Area 10 Chinook had a 60% overall mark rate (69% for legal-sized fish only). Thus, mark rates were high overall and similar for the two areas. In contrast, the proportion of test fishery encounters that were of legal size (marked and unmarked combined) was higher in Area 10 (74%) than Area 9 (47%). For both areas, test fisher "CPUE" (LM Chinook encountered per angler trip; 0.52 in Area 9, 0.43 in Area 10) was slightly higher than that of the average private fleet angler. As was evident for the private fleet, these catch rates were substantially lower than those experienced by test fishers during the Areas 9 and 10 2007 summer seasons (2.39 in Area 9, 0.64 in Area 10; WDFW 2007a).

Table 6-1. Chinook encounters by size/mark-status group for the July 16-August 15, 2008 Area 9 test fishery. Values in parentheses reflect the variance about proportional season-total contributions of a particular size/mark-status group to total Chinook encounters.

Stat	Fishing Effort		Legal		Sublegal		
Week	Days	Hours	AD	UM	AD	UM	Total
29	3	28.4	2	4	2	1	9
30	5	23.1	4	0	0	0	4
31	4	21.0	10	2	6	2	20
32	5	30.7	2	0	2	2	6
33	5	25.1	5	2	6	14	27
Total	**22**	**128.3**	**23**	**8**	**16**	**19**	**66**
Size/mark-status composition:			0.35 (0.003)	0.12 (0.002)	0.24 (0.003)	0.29 (0.003)	
Legal size mark rate:			0.74 (0.006)				
Overall mark rate:			0.59 (0.004)				

Table 6-2. Chinook encounters by size/mark-status group for the July 16-August 15, 2008 Area 10 test fishery. Values in parentheses reflect the variance about proportional season-total contributions of a particular size/mark-status group to total Chinook encounters.

Stat	Fishing Effort		Legal		Sublegal		
Week	Days	Hours	AD	UM	AD	UM	Total
29	3	14.8	1	2	0	0	3
30	5	28.0	2	1	0	0	3
31	3	20.9	3	0	0	0	3
32	5	32.3	3	4	1	5	13
33	5	30.3	9	1	2	1	13
Total	**21**	**126.3**	**18**	**8**	**3**	**6**	**35**
Size/mark-status composition:			0.51 (0.007)	0.23 (0.005)	0.09 (0.002)	0.17 (0.004)	
Legal size mark rate:			0.69 (0.009)				
Overall mark rate:			0.60 (0.007)				

In terms of within-season patterns, the mark rate of legal-sized Chinook remained high (>60% on average) between July 16th and August 15th but was somewhat variable on a weekly basis (due in part to small weekly sample sizes; **Table 6**, **Figure 7**). Area 9 test fishery Chinook exhibited a pronounced rise-to-peak trend in mark rate, with the highest value (100%) being observed during the second week of the fishery. In Area 10, where weekly sample sizes were somewhat lower, no seasonal mark-rate trend was evident. In contrast to mark rates, the mean total length of Chinook encountered by test fishers appeared to vary systematically between mid-July and mid-August in both areas (**Figure 7**): in Area 9, the size trend mirrored the seasonal mark-rate pattern; in Area 10, mean total length decreased continuously from the start to the close of the fishery. Combining length and mark-rate information, the legally harvestable fraction of encountered Chinook (i.e., marked and $\geq$22 in [56 cm]) averaged 0.45 (range: 0.19-1.00) in Area 9 and 0.58 (range: 0.23-1.00) in Area 10, and varied over the season in a manner similar to the overall mark rate trend (**Figure 7**). As a final note, although trends were evident in the size/mark-status composition of test fishery encounters, they were not strong enough to warrant stratifying the Areas 9 and 10 datasets for our overall impacts assessment, particularly given the small sample sizes.

Based on VTRs returned by private anglers fishing in Areas 9 (n = 45 VTRs with 113 encounters) and 10 (n = 15 VTRs with 49 encounters) during the July 16-August 15 season, comparisons of the size/mark-status composition between the test fishery and fleet were equivocal (**Table 7**). In Area 9, there were apparent differences in the overall size/mark-status composition (χ^2 = 12.5, df = 3, P = 0.006; **Table 6-1** vs. **Table 7**) between the two angler groups. Though a similar four-group size/mark-status test could not be performed using Area 10 data (i.e., due to the low [<5] expected frequencies for legal-unmarked Chinook in the test fishery), legal fractions differed (test fishery: 74% vs. VTR: 30%; χ^2 = 4.4, df = 1, P < 0.001) between groups whereas the overall mark rate did not (test fishery: 59% vs. VTR: 73%, P = 0.286). Finally, it is worth noting that while Area 9 VTRs came from a reasonable cross section of anglers (n = 15 different respondents reporting on 45 separate trips; no single angler contributed more than 19% to the encounters total), the Area 10 VTR dataset was modest and heavily influenced by one respondent (i.e., among n = 6

anglers submitting data on 15 separate trips, 57% of all Chinook encounters were due to a single respondent).

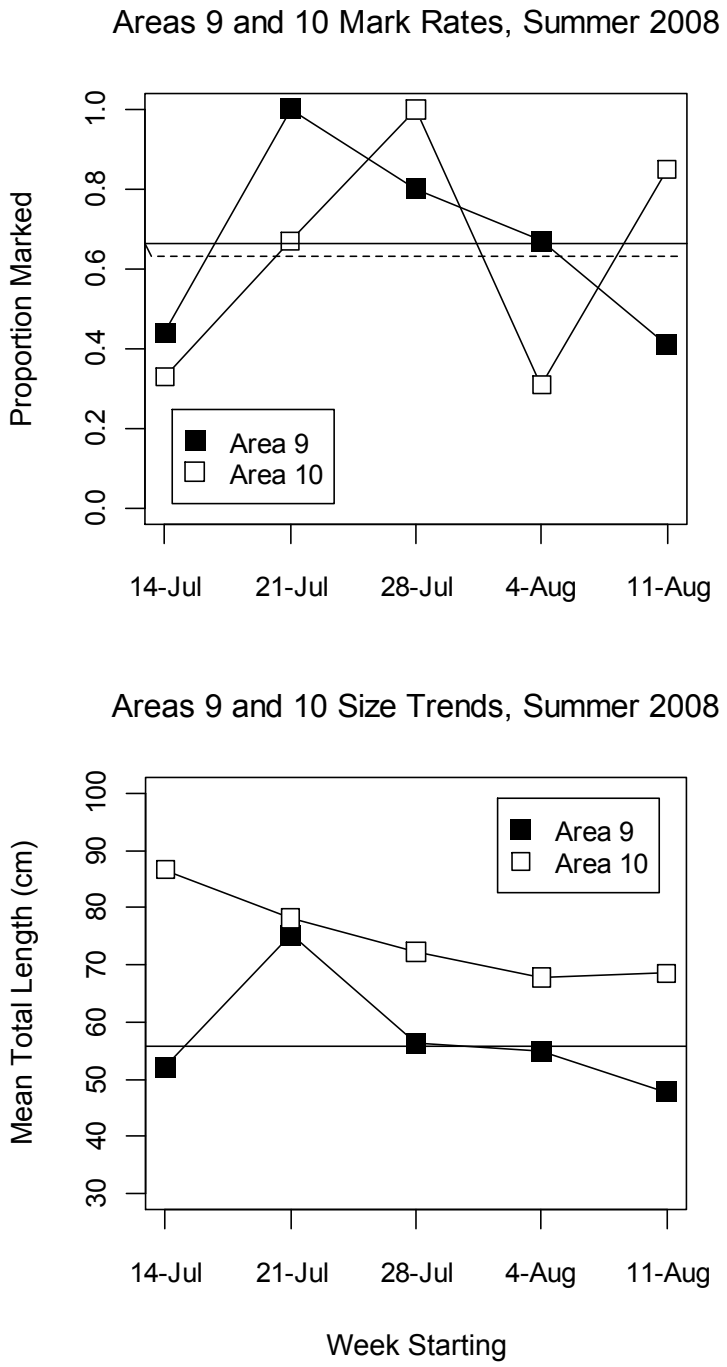

Figure 7. Trends in Chinook mark rates (all size classes, *upper panel*) and average total lengths (marked fish only, *lower panel*) encountered by test fishers during the Areas 9 and 10 July 16-August 15, 2008 mark-selective Chinook fishery. The horizontal solid and dashed lines in the upper panel correspond to the average weekly mark rates for Areas 9 and 10, respectively. The solid horizontal line in the lower panel corresponds to the legal size limit (22 in [56 cm]). Note that the fishery did not begin until Wednesday, July 16th (statistical week 29).

Table 7. Total Chinook encountered (retained and released) by private anglers logging their trips on voluntary trip reports (VTRs), with estimates of legal, sublegal, and overall mark rates, Areas 9 and 10, summer 2008.

Area	Size Class	Mark Status	29	30	31	32	33	Total	% Marked
Area 9	Legal	Marked	20	8	18	4	2	52	72.2%
(*n* = 45 VTRs, 84 angler-trips)		Unmarked	9	0	5	4	2	20	
	Sublegal	Marked	1	1	2	27	0	31	75.6%
		Unmarked	1	1	2	5	1	10	
	Total Encounters		31	10	27	40	5	113	73.5%
Area 10	Legal	Marked	1	2	4	3	2	12	80.0%
(*n* = 15 VTRs & 33 angler-trips)		Unmarked	1	0	1	1	0	3	
	Sublegal	Marked	4	0	12	8	0	24	70.6%
		Unmarked	1	2	5	2	0	10	
	Total Encounters		7	4	22	14	2	49	73.5%

Chinook Size and Age

During the period that mark-selective Chinook fisheries were open, marked and unmarked Chinook salmon sampled by test fishers in Areas 9 and 10 exhibited disjunct, bimodal size distributions. Two separate size classes of fish—one ranging ~60-80 cm and the other ~10-40 cm in total length—appeared to have been caught in recreational test fisheries; this pattern was especially obvious for unmarked Chinook and more striking in Area 9 than in Area 10 (**Figure 8**). As indicated above, most of the smaller Chinook were encountered later in the season (see also **Figure 7** and **Table 7**). In Area 9, Chinook (marked and unmarked combined) averaged 47 cm (SD = 25 cm) and ranged from 14-85 cm in total length (TL), whereas in Area 10 they averaged 63 cm TL (SD = 22 cm; range: 22-87 cm). Thus, there was considerable difference in the average size of Chinook caught in the two areas, with Area 10 encounters being significantly larger than Area 9 Chinook (Mann-Whitney *U*-test[8], $P = 0.001$). Within areas, marked Chinook were on average 18 cm (i.e., 55 vs. 37 cm) larger than unmarked Chinook in Area 9 (Mann-Whitney *U*-test, $P = 0.022$) and 19 cm in Area 10 (marked mean TL 71 cm vs. unmarked mean TL 52 cm; Mann-Whitney *U*-test, $P = 0.061$).

Of the 101 Chinook encountered and sampled by test fishers during the one-month Areas 9 and 10 fisheries, 86 (60 [35 AD, 25 UM] in Area 9; 26 [17 AD, 9 UM]) in Area 10 had scales that were successfully read. As the length-frequency data suggest (see above), marked and unmarked Chinook salmon encountered by test fishers had slightly different age structures, with age-1 (brood year 2007) individuals comprising a smaller fraction of the former than the latter mark-status group in both areas (**Appendix E**). Between areas (pooled over mark-status groups), Area 9 encounters were composed of a greater fraction of yearling and two year-old Chinook than were those in Area 10. Though brood-year 2005 (i.e., age-3) had the strongest representation of any single brood (38% in Area 9, 54% in Area 10), no single age class made up an overwhelming majority of test fishery encounters. As a final note regarding the age

[8] Due to the non-normal length–frequency distribution observed in the two areas, a non-parametric two-sample test was selected over the two-sample *t*-test.

composition of test fishery encounters, approximately one-fifth of all Chinook sampled by test fishers were yearling outmigrants.

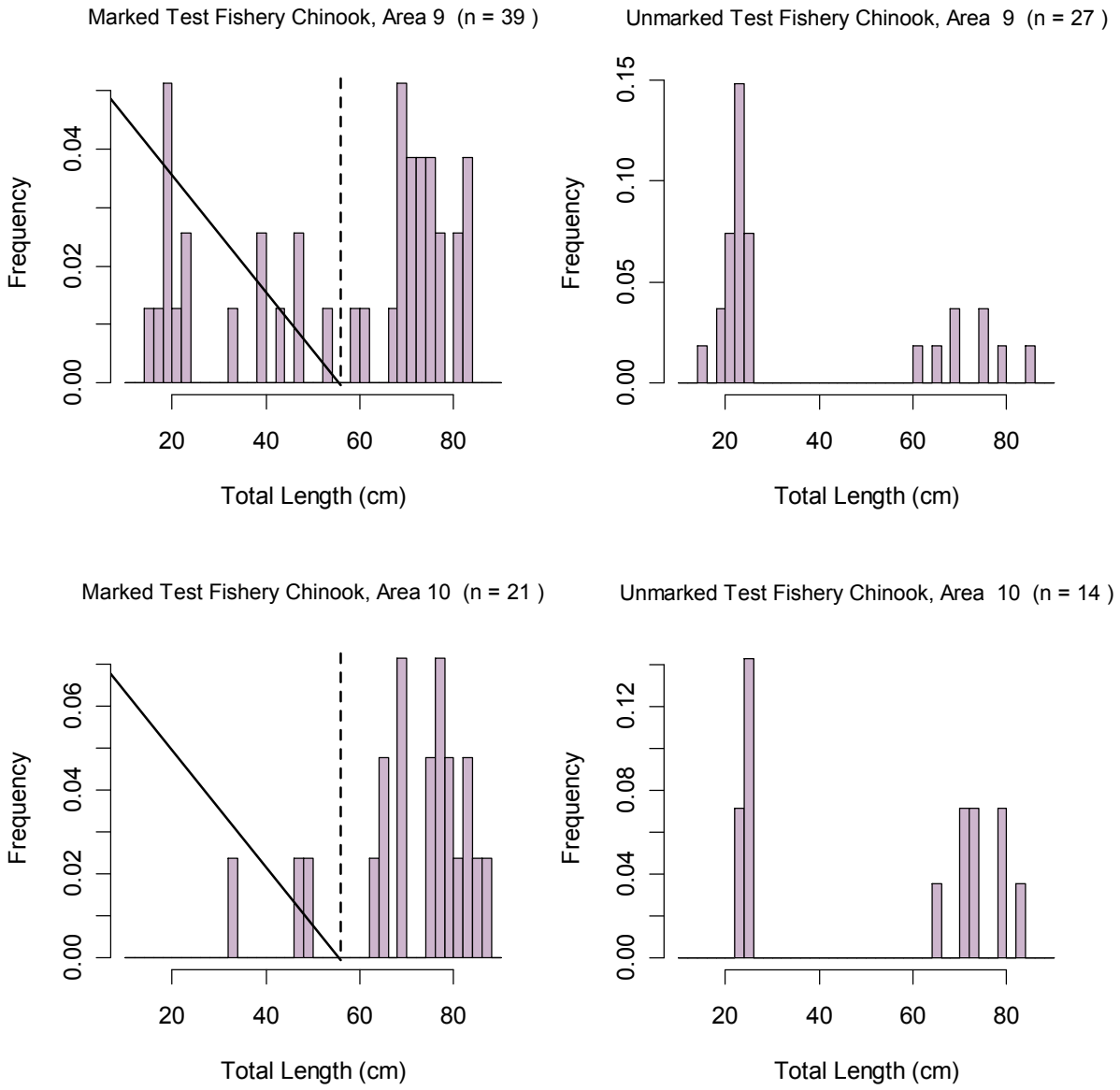

Figure 8. Length-frequency distributions of marked (*left column*) and unmarked (*right column*) Chinook encountered by test fishers during the Areas 9 (*upper row*) and 10 (*lower row*) July 16-August 15, 2008 mark-selective Chinook fishery. The dashed vertical line in the length-frequency histograms for marked Chinook corresponds to the legal size limit (22 in or 56 cm). *Note*: *y* axis ranges differ between panels.

Other Fish Species Encountered

Though they fished exclusively for Chinook, test fishers encountered 248 individuals belonging to at least eight other species (i.e., encounters were also logged for two genus- or family-level categories) during their areas 9 and 10, summer 2008 sampling efforts. Over the two areas combined, coho salmon (51 in Area 9, 55 in Area 10), Pacific sandab (66 in Area 9,

3 in Area 10), and spiny dogfish (26 in Area 9, 4 in Area 10), ranked greatest to least, dominated non-Chinook test fishery encounters (**Table 8**).

Table 8. Test fishery catches of species other than Chinook salmon during the Areas 9 and 10 summer 2008 mark-selective Chinook fisheries.

Common Name (Scientific Name)	Area 9 Total	Area 10 Total
coho salmon (Oncorhynchus kisutch)	51	55
unidentified flatfish (Family: Bothidae, Pleuronectidae)	0	22
rock sole (Lepidopsetta bilineata)	0	5
Pacific sandab (Citharichthys sordidus)	66	3
lingcod (Ophiodon elongatus)	1	0
white seaperch (Phanerodon furcatus)	1	0
unidentified rockfish (Sebastes sp.)	2	0
copper rockfish (Sebastes caurinus)	10	0
quillback rockfish (Sebastes maliger)	1	1
spiny dogfish (Squalus acanthias)	26	4
Grand total (*n* = 8 species)	**158**	**90**

Overall Fishery Impacts

Total Encounters and Mortalities

We derived size/mark-status group-specific estimates of Chinook encounters from a combination of dockside sampling results (i.e., size/mark-status group-specific harvest estimates derived from data in **Tables 3-1**, **3-2**, and **4**; see **Appendix A** for computational details) and test fishery size/mark-status composition data (**Table 6-1**, **6-2**). In total, we estimated that anglers fishing in Area 9 encountered a total of 4,632 LM, 1,611 LU, 3,222 SM, and 3,826 SU Chinook (13,290 total) between July 16 and April 15, 2008 (**Tables 9** and **10**). For Area 10, we estimated encounters at 1,115 LM, 513, LU, 193 SM, and 385 SU (2,246 total; **Tables 9** and **10**). Given estimates of harvest and the assumed selective fishing mortality (*sfm*) mortality rates of 0.15 for legal-sized and 0.20 for sublegal-sized Chinook, these encounters translated into 5,786 (Area 9) and 1,244 (Area 10) mortalities for the two areas (**Tables 9** and **Table 11**). Seventy and 83% of estimated mortality was due to the direct harvest of legal-marked Chinook harvest in the two respective areas. Unmarked Chinook mortality totaled 1,166 fish (1,009 in Area 9, 156 in Area 10) over the two areas, which corresponds to 0.2 unmarked mortalities per legal-marked Chinook kept. In addition, given the 66 (23 LM, 8 LU, 16 SM, 19 SU) and 35 (18 LM, 8 LU, 3 SM, 6 SU) Chinook caught and released in the respective Areas 9 and 10 test fisheries during their respective fisheries, an estimated 18 (12 in Area 9 and 6 in Area 10) Chinook may have died as a result of our sampling activities.

Table 9. Summary of season-wide fishery impact estimates for the Areas 9 and 10 mark-selective Chinook fisheries, July 16-August 15, 2008. Values may not add up perfectly due to rounding error.

Area 9	**Encounters (E):**	**13,290**	(Creel estimates: 3,976 Marked Retained + 3 Unmarked Retained + 9,102 Released; Charters: Charters: 69 Marked Retained + 0 Unmarked Retained + 140 Released)							
	V(E):	**9,929,133**								
Size/mark group	**Encounters**	**No. Retained**	**No. Rel'd**	**Rel. Mort. Rate**	**Rel. Mort.**	**Total Mortality**	**Var**	**SE**	**95% CI**	**CV (%)**
Legal marked	4,632	4,035	597	0.15	89	4,124	250,828	501	3143 - 5106	12
Legal unmarked	1,611	3	1,608	0.15	241	244	9,228	96	56 - 432	39
Sublegal marked	3,222	10	3,212	0.20	642	653	41,618	204	253 - 1052	31
Sublegal unmarked	3,826	0	3,826	0.20	765	765	53,257	231	313 - 1217	30
All groups combined	**13,290**	**4,048**	**9,242**		**1,738**	**5,786**	**354,932**	**596**	**4618 - 6954**	**10**

Area 10	**Encounters (E):**	**2,246**	(Creel estimates: 859 Marked Retained + 3 Unmarked Retained + 1,050 Released Charters: 172 Marked Retained + 0 Unmarked Retained + 162 Released)							
	V(E):	**161,979**								
Size/mark group	**Encounters**	**No. Retained**	**No. Rel'd**	**Rel. Mort. Rate**	**Rel. Mort.**	**Total Mortality**	**Var**	**SE**	**95% CI**	**CV (%)**
Legal marked	1,155	1,027	128	0.15	19	1,046	4,186	65	920 - 1173	6
Legal unmarked	513	3	510	0.15	76	79	614	25	31 - 128	31
Sublegal marked	193	4	189	0.20	38	42	395	20	29281	48
Sublegal unmarked	385	0	385	0.20	77	77	795	28	22 - 132	37
All groups combined	**2,246**	**1,034**	**1,212**		**210**	**1,244**	**5,991**	**77**	**1093 - 1396**	**6**

Table 10. Comparison of modeled (i.e., using FRAM, model run 2108) and estimated total Chinook encounters for the Areas 9 and 10 July 16-August 15, 2008 mark-selective Chinook fisheries.

Marine Area	Data Source	Group	Total Encounters	Legal	Sublegal	Landed Only
9	FRAM Encounters	Unmark.	5,056	2,271	2,785	136
		Mark.	12,025	4,110	7,915	3,864
		Total	17,081	6,381	10,700	4,000
		% Mark.	70	64	74	97
	Estimated (Creel) Encounters	Unmark.	5,436	1,611	3,826	3
		Mark.	7,854	4,632	3,222	4,045
		Total	13,290	6,242	7,048	4,048
		% Mark.	59	74	46	100
10	FRAM Encounters	Unmark.	5,731	3,066	2,665	184
		Mark.	8,536	2,996	5,540	2,816
		Total	14,267	6,062	8,205	3,000
		% Mark.	60	49	68	94
	Estimated (Creel) Encounters	Unmark.	898	513	385	3
		Mark.	1,348	1,155	193	1,031
		Total	2,246	1,668	578	1,034
		% Mark.	60	69	33	100
Both Areas	FRAM Encounters	Unmark.	10,787	5,337	5,450	320
		Mark.	20,561	7,106	13,455	6,680
		Total	31,348	12,443	18,905	7,000
		% Mark.	66	57	71	95
	Estimated (Creel) Encounters	Unmark.	6,334	2,124	4,210	6
		Mark.	9,202	5,787	3,415	5,076
		Total	15,536	7,910	7,625	5,082
		% Mark.	59	73	45	100

FRAM versus Creel Comparison

Relative to field data, pre-season Fishery Regulation Assessment Model (FRAM, model run 2108) runs provided a reasonably accurate depiction of fishery impacts—measured as encounters or mortalities—for Area 9 but not Area 10. For instance, field estimates of total and legal-only Chinook encounters and mortalities differed from FRAM by less than 30% (**Table 10** and **11**, **Figure 10-1**). Though this may not be surprising for legal-marked Chinook given that Area 9 was managed on a quota basis (e.g., field estimates were within 5% of predictions for this sub-group), this characterization of FRAM's accuracy encompassed observed-versus-predicted comparison results for unmarked Chinook too. Although estimated sublegal-unmarked impacts were comparable to predictions, FRAM tended to over-predict impacts to the sublegal-marked Chinook category in Area 9. In contrast to Area 9, FRAM predicted that the Area 10 MSF would have a substantially greater impact on both marked and unmarked Chinook than field data indicate actually occurred during its one-month season (**Table 10** and **11**, **Figure 10-2**). At the low end, FRAM-predicted legal-

marked encounters were 160% greater than our post-season estimates; at the high end, FRAM predicted that unmarked Chinook harvest would 61 times (6,000+%) greater than was estimated to have occurred during the Area 10 fishery. Finally, observed mark rates were comparable to those modeled in FRAM for overall and legal-sized Chinook, but not sublegal-sized Chinook (i.e., FRAM predicted values that were substantially higher than what observed; **Table 11**), in both areas.

Table 11. Comparison of modeled (i.e., using FRAM, model run 2108) and estimated total Chinook mortalities for Areas 9 and 10 July 16-August 15, 2008 mark-selective Chinook fishery.

Marine Area	Mortality Category	FRAM Chinook Mortalities			Estimated Chinook Mortalities		
		Unmark.	Mark.	Total	Unmark.	Mark.	Total
9	Total (Landed + Released	1,020	5,678	6,698	1,009	4,777	5,786
	Released Legal	327	231	558	241	89	331
	Released Sublegal	557	1,583	2,140	765	642	1,408
	Landed Only	136	3,864	4,000	3	4,045	4,048
10	Total (Landed + Released	1,158	4,092	5,250	156	1,088	1,244
	Released Legal	441	168	609	76	19	96
	Released Sublegal	533	1,108	1,641	77	38	115
	Landed Only	184	2,816	3,000	3	1,031	1,034
Both Areas	Total (Landed + Released	2,178	9,770	11,948	1,166	5,865	7,031
	Released Legal	768	399	1,167	318	109	426
	Released Sublegal	1,090	2,691	3,781	842	680	1,522
	Landed Only	320	6,680	7,000	6	5,076	5,082

Estimated CWT-DIT Impacts

Of the 70 coded-wire tags recovered during the summer 2008 Area 9 mark-selective Chinook fishery, 31 belonged to double-index tag (DIT) release groups (**Table 12-1**). Based on the release details associated with these tags and their unmarked sister groups, we obtained an estimate of the unmarked-to-marked 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 9 fishery. In total, we estimated that 163 unmarked-DIT Chinook were caught and released during the fishery. Given an *sfm* rate of 0.10, we estimate that as many as 16 of these unmarked-DIT Chinook may have died as a result of the one-month Area 9 winter mark-selective fishery. Similarly, based on the 14 DIT CWTs recovered in Area 10 during its MSF season, we estimated that 58 unmarked-DIT Chinook were encountered during the fishery, of which 6 may have died as a result of handling-and-release impacts associated with this fishery (**Table 12-2**).

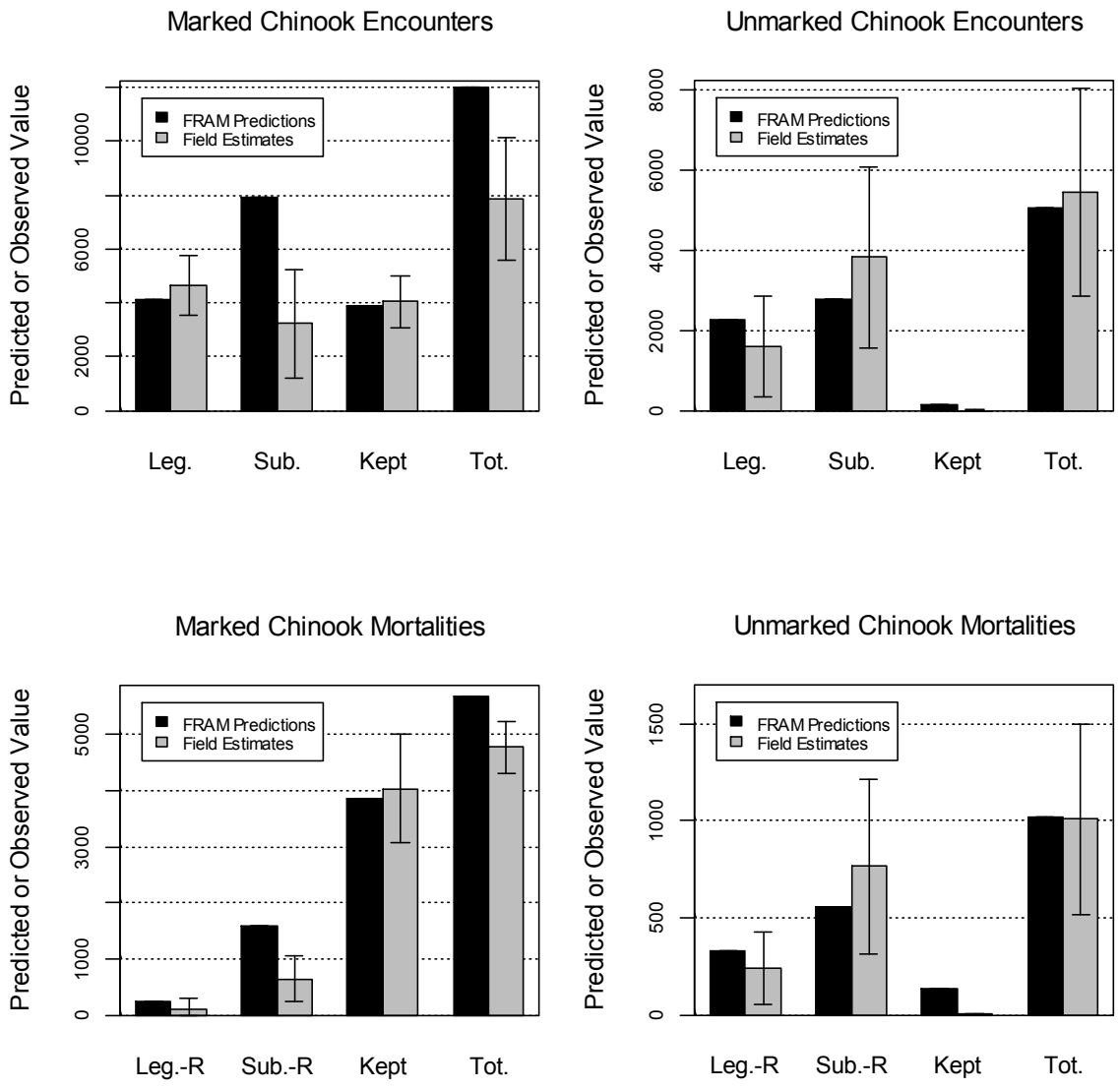

Figure 10-1. Comparison of modeled (i.e., using FRAM, model run 2108) and estimated total Chinook encounters and mortalities for the Area 9 July 16-August 15, 2008 mark-selective Chinook fishery. Error bars represent approximate 95% confidence intervals for field estimates.

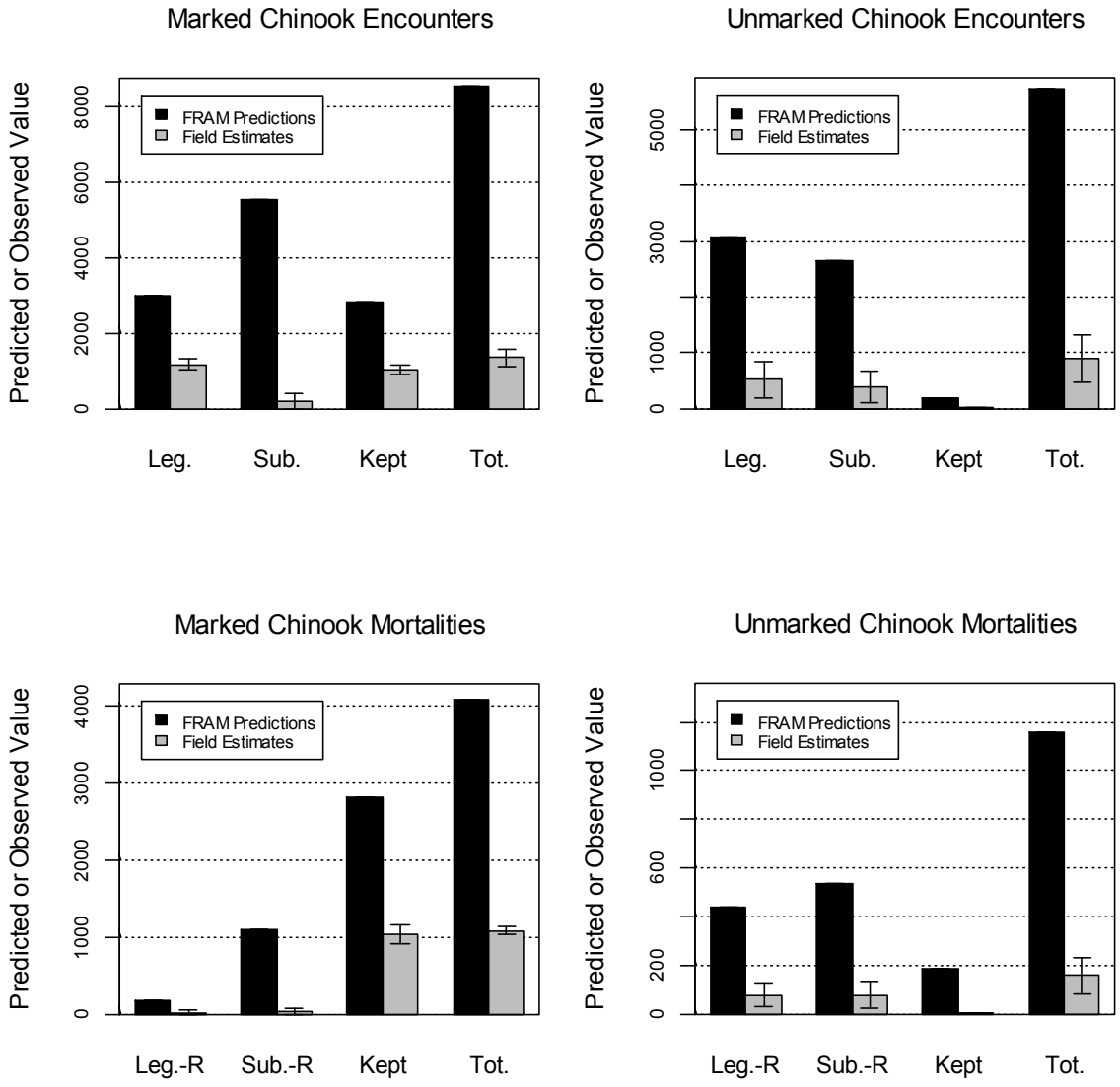

Figure 10-2. Comparison of modeled (i.e., using FRAM, model run 2108) and estimated total Chinook encounters and mortalities for the Area 10 July 16-August 15, 2008 mark-selective Chinook fishery. Error bars represent approximate 95% confidence intervals for field estimates.

Table 12-1. 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 9 July 16-August 15, 2008 mark-selective Chinook fishery.

Hatchery	Brood Year	DITs Obs'd	AD DIT Harvest		UM DIT Enc.	UM DIT Mortality	
			Est.	var(Est.)		Est.	var(Est.)
George Adams Hatchery	2005	4	17.3	62.91	17.26	1.73	0.63
Grovers Creek Hatchery	2004	1	3.5	8.62	3.93	0.39	0.11
	2005	5	22.5	86.84	29.38	2.94	1.48
H-Chilliwack R. Hatchery	2005	1	4.0	11.67	4.01	0.40	0.12
Kendall Creek Hatchery	2005	1	6.0	30.49	6.07	0.61	0.12
Nisqually Hatchery	2004	1	6.1	31.28	6.18	0.62	0.32
	2005	2	12.4	64.50	13.95	1.40	0.82
Samish River Hatchery	2005	8	41.0	181.83	37.23	3.72	1.50
Soos Creek Hatchery	2005	7	37.6	174.00	38.48	3.85	1.83
Spring Creek NFH	2005	1	6.0	30.49	6.09	0.61	0.31
TOTAL		**31**	**156.3**	**682.64**	**162.60**	**16.26**	**7.23**

Table 12-2. 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 10 July 16-August 15, 2008 mark-selective Chinook fishery.

Hatchery	Brood Year	DITs Obs'd	AD DIT Harvest		UM DIT Enc.	UM DIT Mortality	
			Est.	var(Est.)		Est.	var(Est.)
George Adams Hatchery	2004	1	3.5	8.68	3.47	0.35	0.09
	2005	1	3.5	8.68	3.49	0.35	0.09
Grovers Creek Hatchery	2004	2	8.4	28.16	9.52	0.95	0.36
	2005	3	9.6	21.78	12.57	1.26	0.37
Samish River Hatchery	2004	3	11.1	32.59	10.08	1.01	0.27
Soos Creek Hatchery	2004	2	9.4	34.63	9.36	0.94	0.34
	2005	2	9.6	36.80	9.87	0.99	0.39
TOTAL		**14**	**55.2**	**171.31**	**58.37**	**5.84**	**1.90**

ACKNOWLEDGEMENTS

This review of the summer 2008 Areas 9 and 10 mark-selective Chinook fisheries is a result of the dedicated efforts of several individuals. Slim Simpson (Central Sound Sampling Supervisor) and his sampling crew collected creel, test-fishery, and on-the-water survey data throughout the season in Areas 9 and 10. Larry Bennett (Peninsula Sampling Supervisor) and his sampling staff conducted creel surveys in northern Area 9. In addition, Steve Axtell (Northern Sampling Supervisor) and his staff conducted on-the-water surveys in northeastern Area 9. Toby Black and Mike Tillotson conducted test fishing throughout Area 9 as well as on-the-water surveys in the southern portion of Area 9. Charles Cooper and Dustin Wagner conducted test fishing and boat survey activities in Area 10. Additionally, Scott Walker and Mike Elam conducted on-the-water surveys in the northwestern portion of Area 9 and the western portion of Area 10.

Dockside samplers stationed in southern Area 9 included Sue Kraemer (lead sampler at Everett Ramp), Adam Fischer, Aaron Park, Josha Nathan, and April Bosley. In northern Area 9, dockside samplers included Marcus Thompson and Ken Wall. Dockside samplers stationed on the eastern side of Area 10 included Courtney Adkins, Keira Heggie, and Seana Freih, while Cara Crowley and Mary Raymond sampled on the Kitsap side of Area 10.

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Finally, this document benefitted greatly from the thorough reviews of Bob Conrad at the Northwest Indian Fisheries Commission and WDFW staff. Their collective critiques helped us to improve the quality of this final draft.

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APPENDICES

Appendix A. 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[9] 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 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)[10]. $\hat{E}_i$ and its variance are estimated as:

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

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

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

[10] 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

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

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

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

$\hat{p}_{LUi}$ = 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*), $\hat{p}_{XYi}$ and its variance is estimated as:

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

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

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

Encounters by Size/Mark-status Class

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

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

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

$\hat{E}_{SUi}$ = 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*, $\hat{E}_{XYi}$ and an estimate of its variance are obtained from:

(5) $\hat{E}_{XYi} = \hat{E}_i * \hat{p}_{XYi}$

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

Since the $\hat{E}_{LMi}$ estimate derived according to Eqn. 5 above is equivalent to that obtained by expanding $\hat{K}_{LMi}$ by the constant 1 - $p_{\text{LM-R}}$, its variance is estimated as:

(7) $\text{var}(\hat{E}_{LMi}) = \text{var}(\hat{K}_{LMi})/(1 - \hat{p}_{LM=R})^2$

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*[11] 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:

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

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

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:

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

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

[11] 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 $\hat{d}_{XYK}$.

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

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

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

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

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

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

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

$\hat{R}_{SUi}$ = 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 ($\hat{E}_{XYi}$) and retention ($\hat{K}_{XYi}$) during month *i*. The estimator and its variance are:

$$\hat{R}_{XYi} = \hat{E}_{XYi} - \hat{K}_{XYi} \quad (12)$$

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

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 (reincarnation is rare among fishes)
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

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

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

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

Release-mortality Estimates

$\hat{M}_{LMRi}$ = 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) $\hat{M}_{XYRi} = \hat{R}_{XYi} * sfm_Y$

(15) $\text{var}(\hat{M}_{XYRi}) = \text{var}(\hat{R}_{XYi}) * sfm_Y^2$

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., $\hat{M}_{total} = \sum_{i=1}^{\max i} (\hat{M}_{XYKi} + \hat{M}_{XYRi})$] and variances [$\text{var}(\hat{M}_{total}) = \sum_{i=1}^{\max i} [\text{var}(\hat{M}_{XYKi}) + \text{var}(\hat{M}_{XYRi})]$], 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., $\hat{M}_{total}$, $\hat{K}_{LMi}$, $\hat{E}_i$, 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).

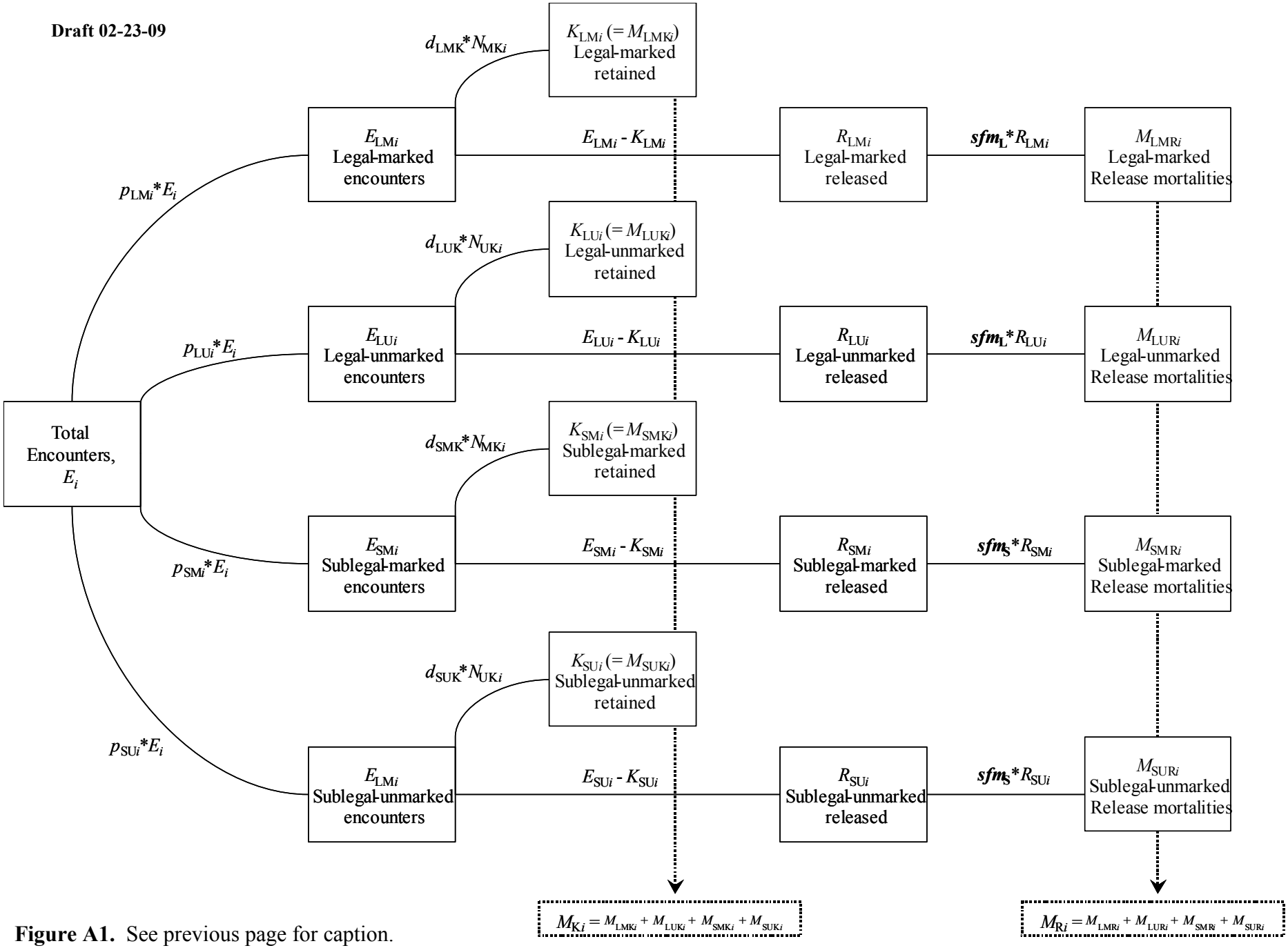

Figure A1. See previous page for caption.

Appendix B. Sample rates for the Areas 9 and 10 (July 16-August 15, 2008) selective Chinook fisheries. Note: sample counts and totals are for adipose-clipped (i.e., marked) Chinook only.

Angler Group	Stat. Week	Area 9			Area 10		
		Number of AD Chinook Sampled	Estimated Chinook Retained	Sample Rate	Number of AD Chinook Sampled	Estimated Chinook Retained	Sample Rate
Fleet	29	300	1043	28.8%	60	209	28.7%
	30	179	1137	15.7%	37	107	34.6%
	31	204	1233	16.5%	51	136	37.6%
	32	68	416	16.4%	51	252	20.2%
	33	37	146	25.3%	33	155	21.3%
Charter	All	0	69	0.0%	0	172	0.0%
Total	**Total**	**788**	**4045**	**19.5%**	**232**	**1031**	**22.5%**

Appendix C-1. Total number of anglers intercepted in Area 9 during on-the-water surveys between July 16 and August 15, 2008. Grayed sites were included in the dockside sample frame.

Site Name	Weekday Anglers	Season-total (unadjusted) size measure, Weekday	Weekend Anglers	Season-total (unadjusted) size measure, Weekend
14th St (Ballard)	3	0.003	0	0.000
Anacortes Marina	0	0.000	3	0.004
Armeni Ramp	4	0.004	6	0.008
Bayside	11	0.011	8	0.011
Brownsville	10	0.010	0	0.000
Bush Point (Prvt)	10	0.010	3	0.004
Camano Is St PK	6	0.006	4	0.005
Cape George Ramp	4	0.004	0	0.000
Cultus Bay	4	0.004	0	0.000
Dagmars oanding	21	0.020	12	0.016
Dagmars Marina	1	0.001	0	0.000
Driftwood Key Marina	25	0.024	31	0.041
Driftwood Key Ramp	0	0.000	4	0.005
Edmonds Marina Dry Storage	12	0.012	23	0.030
Edmonds Marina Moorage	72	0.069	63	0.083
Edmonds Marina Sling	42	0.040	24	0.032
Eglon	11	0.011	4	0.005
Elliott Bay Marina	0	0.000	2	0.003
Everett Marina	31	0.030	28	0.037
Everett (Norton) Ramp	204	0.197	154	0.203
Fort Flagler	8	0.008	6	0.008
Fort Casey/Keystone	90	0.087	49	0.065
Fort Warden	24	0.023	19	0.025
Hudson Point	3	0.003	8	0.011
John Wayne	0	0.000	1	0.001
Kingston	30	0.029	41	0.054
Kingston Marina	2	0.002	18	0.024
Lagoon PLint	35	0.034	2	0.003
Langus Ramp (snL River)	0	0.000	2	0.003
Mats Mats Bay	2	0.002	0	0.000
Max Welton (Whidbey)	2	0.002	2	0.003
Mukilteo	83	0.080	52	0.069
Mutiny Bay	22	0.021	1	0.001
Port Hadlock Marina (Moorage)	10	0.010	1	0.001
Port Hadlock Ramp	3	0.003	4	0.005
Port oudlow	9	0.009	4	0.005
Port Townsed Moorage	4	0.004	14	0.018
Port Townsed Ramp	95	0.092	58	0.076
Port Townsed Salmon Club	22	0.021	13	0.017
Possession Ramp	6	0.006	10	0.013
Private Buoy/moorage/launch	74	0.071	39	0.051
Salsberry Ramp	14	0.013	26	0.034
Sandy Hook (Prvt)	5	0.005	1	0.001
Shilshole ramp	20	0.019	19	0.025
Uselsess Bay	4	0.004	0	0.000
Grand Total	**1038**	**1.000**	**759**	**1.000**

Appendix C-2. Total number of anglers intercepted in Area 10 during on-the-water surveys between July 16 and August 15, 2008. Grayed sites were included in the dockside sample frame.

Site Name	Weekday Anglers	Season-total (unadjusted) size measure, Weekday	Weekend Anglers	Season-total (unadjusted) size measure, Weekend
Alkai Ramp	0	0.000	1	0.003
Armeni Ramp	42	0.094	29	0.073
Bainbridge Ramp	0	0.000	1	0.003
Ballard Marina	0	0.000	2	0.005
Blake Island	1	0.002	0	0.000
Brownsville Marina	0	0.000	4	0.010
Brownsville Ramp	11	0.024	22	0.055
Des Moines Marina	3	0.007	2	0.005
Eagle Harbor	5	0.011	10	0.025
Eagle Harbor Moorage	1	0.002	0	0.000
Edmonds Beach Launch	2	0.004	0	0.000
Edmonds Marina Dry Storage	33	0.073	3	0.008
Edmonds Marina Moorage	64	0.143	26	0.065
Edmonds Marina Sling	23	0.051	24	0.060
Elliott Bay Marina	9	0.020	13	0.033
Evergreen Park	1	0.002	7	0.018
Everett (Norton)	13	0.029	0	0.000
Everett Wet	0	0.000	3	0.008
Indianola	0	0.000	4	0.010
Kingston	41	0.091	30	0.075
Kingston Marina	17	0.038	8	0.020
Lake Union	0	0.000	5	0.013
Manchester	28	0.062	37	0.093
Miller Bay	3	0.007	0	0.000
Mukliteo	0	0.000	2	0.005
Narrows Ramp	2	0.004	1	0.003
Port Orchard Marina	0	0.000	4	0.010
Port Orchard Ramp	6	0.013	2	0.005
Poulsbo Marina	0	0.000	3	0.008
Prvt Launch/Moorage	14	0.031	14	0.035
Redondo	1	0.002	0	0.000
Shillshole Marina (Prvt)	30	0.067	27	0.068
Shilshole Ramp	99	0.220	113	0.284
Yukon Hbr	0	0.000	1	0.003
Grand Total	**449**	**1.00**	**398**	**1.00**

Appendix D-1. Size measures of sites sampled during the Area 9 July 16-August 15, 2008 creel survey, by statistical week. WD and WE correspond to weekday and weekend strata, respectively.

Stat Week	Day Type	Prop'n Effort In Sample Frame	Area 9 Sampled Sites and Size Measures			
			Norton St. (Everett) Ramp	Fort Casey SP Ramp	Mukilteo SP Ramp	Port Townsend Boat Haven
29	WD	0.48	0.517	0.071	0.204	0.209
	WE	0.36	0.574	0.137	0.093	0.197
30	WD	0.43	0.386	0.315	0.118	0.181
	WE	0.51	0.377	0.185	0.269	0.169
31	WD	0.43	0.386	0.315	0.118	0.181
	WE	0.51	0.377	0.185	0.269	0.169
32	WD	0.44	0.343	0.261	0.187	0.209
	WE	0.51	0.377	0.185	0.269	0.169
33	WD	0.44	0.343	0.261	0.187	0.209
	WD mean	0.444	0.395	0.245	0.163	0.198
	WD SD	0.021	0.071	0.101	0.041	0.015
	WE mean	0.471	0.426	0.173	0.225	0.176
	WE SD	0.071	0.098	0.024	0.088	0.014

Appendix D-2. Size measures of sites sampled during the Area 10 July 16-August 15, 2008 creel survey, by statistical week. WD and WE correspond to weekday and weekend strata, respectively.

Stat Week	Day Type	Prop'n Effort In Sample Frame	Area 10 Sampled Sites and Size Measures			
			Armeni Ramp	Kingston Ramp	Manchester Ramp	Shilshole Ramp
29	WD	0.41	0.089	0.304	0.000	0.607
	WE	0.49	0.077	0.231	0.209	0.484
30	WD	0.47	0.130	0.210	0.170	0.490
	WE	0.56	0.186	0.076	0.153	0.585
31	WD	0.47	0.130	0.210	0.170	0.490
	WE	0.56	0.186	0.076	0.153	0.585
32	WD	0.51	0.269	0.148	0.204	0.380
	WE	0.56	0.186	0.076	0.153	0.585
33	WD	0.46	0.264	0.182	0.100	0.455
	WD mean	0.467	0.176	0.211	0.129	0.484
	WD SD	0.035	0.084	0.058	0.081	0.082
	WE mean	0.540	0.159	0.115	0.167	0.559
	WE SD	0.034	0.055	0.077	0.028	0.051

Appendix E. Age composition of retained (dockside samples) and encountered (test fishery samples) Chinook salmon, Areas 9 and 10, July 16-August 15, 2008. AD = marked or adipose-fin clipped Chinook, UM = unmarked (unclipped) Chinook.

Area	Source	Mark-status group	Age[1] Composition 1.1	2.1	2.2	3.1	3.2	4.1	4.2	5.1	Total
9	Dockside samples	AD	0 (0%)	1 (0%)	0 (0%)	561 (82%)	10 (1%)	95 (14%)	21 (3%)	0 (0%)	688
	Test Fishery	AD	7 (20%)	4 (11%)	2 (6%)	15 (43%)	4 (11%)	3 (9%)	0 (0%)	0 (0%)	35
	Test Fishery	UM	9 (36%)	0 (0%)	8 (32%)	4 (16%)	0 (0%)	2 (8%)	2 (8%)	0 (0%)	25
10	Dockside samples	AD	0 (0%)	1 (1%)	0 (0%)	164 (82%)	6 (3%)	24 (12%)	3 (2%)	1 (1%)	199
	Test Fishery	AD	0 (0%)	1 (6%)	1 (6%)	10 (59%)	0 (0%)	4 (24%)	1 (6%)	0 (0%)	17
	Test Fishery	UM	4 (44%)	0 (0%)	1 (11%)	4 (44%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	9

[1]Gilbert-Rich age notation, "Total Age". "Age at outmigration", inclusive of time spent in incubation.

Appendix F. CWTs recovered from Chinook salmon during the Area 9 and 10 July 16-August 15, 2008 mark-selective Chinook fishery.

Area	Recov Date	Tag Code	BY	ReleaseSite	RearingHatchery	Release Agency	DIT Code(s)	FL (cm)	Sex	RecovMark	ReleaseMark	Label
09	16-Jul	210592	04	GROVERS CR H	GROVERS CR H	SUQ	DIT: 632790	76		AD Fin Clp	AD Fin Clp	50702
09	16-Jul	632879	04	FINCH CR 16.0222	HOODSPORT H	WDFW		87	F	AD Fin Clp	AD Fin Clp	57701
09	16-Jul	632979	05	CHAMBERS CR 12.0007	GARRISON H	WDFW		69		AD Fin Clp	AD Fin Clp	50701
09	16-Jul	633285	05	GROVERS CR 15.0299	GROVERS CR H	SUQ	DIT: 210682	59		AD Fin Clp	AD Fin Clp	57202
09	16-Jul	633366	05	PURDY CR 16.0005	GEORGE ADAMS H	WDFW	DIT: 633365	72		AD Fin Clp	AD Fin Clp	25290
09	16-Jul	633366	05	PURDY CR 16.0005	GEORGE ADAMS H	WDFW	DIT: 633365	66		AD Fin Clp	AD Fin Clp	43453
09	16-Jul	633369	05	FRIDAY CR 03.0017	SAMISH H	WDFW	DIT: 633368	59		AD Fin Clp	AD Fin Clp	57175
09	17-Jul	210598	04	KALAMA CR 11.0017	KALAMA CR H	NISQ		74		AD Fin Clp	AD Fin Clp	57204
09	17-Jul	210671	05	KALAMA CR 11.0017	KALAMA CR H	NISQ		73		AD Fin Clp	AD Fin Clp	57203
09	17-Jul	210684	05	WHITEHORSE SPRINGS	WHITEHORSE POND	COOP		63		AD Fin Clp	AD Fin Clp	57231
09	17-Jul	633285	05	GROVERS CR 15.0299	GROVERS CR H	SUQ	DIT: 210682	76		AD Fin Clp	AD Fin Clp	57177
09	17-Jul	633467	05	GREEN R 09.0001	ICY CR H	WDFW		58		AD Fin Clp	AD Fin Clp	43454
09	19-Jul	210684	05	WHITEHORSE SPRINGS	WHITEHORSE POND	COOP		66		AD Fin Clp	AD Fin Clp	57234
09	19-Jul	632877	04	GREEN R 09.0001	ICY CR H	WDFW		82		AD Fin Clp	AD Fin Clp	50704
09	19-Jul	632877	04	GREEN R 09.0001	ICY CR H	WDFW		74		AD Fin Clp	AD Fin Clp	57174
09	19-Jul	632978	04	CHAMBERS CR 12.0007	LAKEWOOD H	WDFW		70		AD Fin Clp	AD Fin Clp	57233
09	19-Jul	633285	05	GROVERS CR 15.0299	GROVERS CR H	SUQ	DIT: 210682	79		AD Fin Clp	AD Fin Clp	43457
09	19-Jul	633369	05	FRIDAY CR 03.0017	SAMISH H	WDFW	DIT: 633368	69		AD Fin Clp	AD Fin Clp	57227
09	19-Jul	633372	05	BIG SOOS CR 09.0072		WDFW	DIT: 633371	66		AD Fin Clp	AD Fin Clp	43456
09	19-Jul	633372	05	BIG SOOS CR 09.0072		WDFW	DIT: 633371	67		AD Fin Clp	AD Fin Clp	57182
09	20-Jul	633369	05	FRIDAY CR 03.0017	SAMISH H	WDFW	DIT: 633368	69		AD Fin Clp	AD Fin Clp	43458
09	20-Jul	633382	05	FINCH CR 16.0222	HOODSPORT H	WDFW		72		AD Fin Clp	AD Fin Clp	50705
09	22-Jul	632786	04	CHAMBERS CR 12.0007	CHAMBERS CR + GARRISON	WDFW		72		AD Fin Clp	AD Fin Clp	43459
09	22-Jul	632870	04	CHAMBERS CR 12.0007	GARRISON H	WDFW		73		AD Fin Clp	AD Fin Clp	43460
09	23-Jul	632879	04	FINCH CR 16.0222	HOODSPORT H	WDFW		75		AD Fin Clp	AD Fin Clp	57230
09	23-Jul	633366	05	PURDY CR 16.0005	GEORGE ADAMS H	WDFW	DIT: 633365	73	M	AD Fin Clp	AD Fin Clp	43461
09	23-Jul	633372	05	BIG SOOS CR 09.0072		WDFW	DIT: 633371	58		AD Fin Clp	AD Fin Clp	57703
09	25-Jul	632880	04	GORST CR 15.0216	GORST CR REARING PND	SUQ		78		AD Fin Clp	AD Fin Clp	43462
09	25-Jul	632979	05	CHAMBERS CR 12.0007	GARRISON H	WDFW		73		AD Fin Clp	AD Fin Clp	50707
09	25-Jul	633369	05	FRIDAY CR 03.0017	SAMISH H	WDFW	DIT: 633368	67		AD Fin Clp	AD Fin Clp	50706
09	26-Jul	210591	04	SKAGIT R 03.0176		WDFW		83		AD Fin Clp	AD Fin Clp	57235
09	26-Jul	633286	05	CLEAR CR 11.0013C	NISQUALLY H	NISQ	DIT: 210681	77		AD Fin Clp	AD Fin Clp	43463
09	27-Jul	633469	05	FINCH CR 16.0222	HOODSPORT H	WDFW		57		AD Fin Clp	AD Fin Clp	57207
09	28-Jul	632874	04	SKOKOMISH R 16.0001	RICKS PD (LLTK)	WDFW		68		AD Fin Clp	AD Fin Clp	50708
09	29-Jul	633286	05	CLEAR CR 11.0013C	NISQUALLY H	NISQ	DIT: 210681	66		AD Fin Clp	AD Fin Clp	50709
09	1-Aug	052873	05	SPRING CR 29.0159	SPRING CR NFH	FWS	DIT: 052871, 052872, 052874	77		AD Fin Clp	AD Fin Clp	50710
09	1-Aug	633172	05	NOOKSACK R -NF 01.0120	KENDALL CR H	WDFW	DIT: 633171	65		AD Fin Clp	AD+OTOLITH	50712
09	1-Aug	633469	05	FINCH CR 16.0222	HOODSPORT H	WDFW		57		AD Fin Clp	AD Fin Clp	50711
09	2-Aug	632874	04	SKOKOMISH R 16.0001	RICKS PD (LLTK)	WDFW		80		AD Fin Clp	AD Fin Clp	57705

Area	Recov Date	Tag Code	BY	ReleaseSite	RearingHatchery	Release Agency	DIT Code(s)	FL (cm)	Sex	RecovMark	ReleaseMark	Label
09	2-Aug	632972	04	ISSAQUAH CR 08.0178	ISSAQUAH H	WDFW		84		AD Fin Clp	AD Fin Clp	54608
09	2-Aug	633369	05	FRIDAY CR 03.0017	SAMISH H	WDFW	DIT: 633368	67		AD Fin Clp	AD Fin Clp	50713
09	2-Aug	633369	05	FRIDAY CR 03.0017	SAMISH H	WDFW	DIT: 633368	60		AD Fin Clp	AD Fin Clp	57208
09	2-Aug	633372	05	BIG SOOS CR 09.0072		WDFW	DIT: 633371	77		AD Fin Clp	AD Fin Clp	50252
09	2-Aug	633382	05	FINCH CR 16.0222	HOODSPORT H	WDFW		63		AD Fin Clp	AD Fin Clp	43464
09	2-Aug	633469	05	FINCH CR 16.0222	HOODSPORT H	WDFW		57		AD Fin Clp	AD Fin Clp	43465
09	3-Aug	210571	05	TULALIP CR 07.0001	BERNIE GOBIN H	TULA		69		AD Fin Clp	AD+OTOLITH	57212
09	3-Aug	210598	04	KALAMA CR 11.0017	KALAMA CR H	NISQ		80		AD Fin Clp	AD Fin Clp	57131
09	3-Aug	632879	04	FINCH CR 16.0222	HOODSPORT H	WDFW		81		AD Fin Clp	AD Fin Clp	54609
09	3-Aug	632879	04	FINCH CR 16.0222	HOODSPORT H	WDFW		85		AD Fin Clp	AD Fin Clp	57240
09	3-Aug	632979	05	CHAMBERS CR 12.0007	GARRISON H	WDFW		72		AD Fin Clp	AD Fin Clp	43469
09	3-Aug	633285	05	GROVERS CR 15.0299	GROVERS CR H	SUQ	DIT: 210682	76		AD Fin Clp	AD Fin Clp	57132
09	3-Aug	633285	05	GROVERS CR 15.0299	GROVERS CR H	SUQ	DIT: 210682	74		AD Fin Clp	AD Fin Clp	57152
09	3-Aug	633369	05	FRIDAY CR 03.0017	SAMISH H	WDFW	DIT: 633368	66		AD Fin Clp	AD Fin Clp	43466
09	3-Aug	633369	05	FRIDAY CR 03.0017	SAMISH H	WDFW	DIT: 633368	64		AD Fin Clp	AD Fin Clp	43467
09	3-Aug	633372	05	BIG SOOS CR 09.0072		WDFW	DIT: 633371	69		AD Fin Clp	AD Fin Clp	43470
09	3-Aug	633372	05	BIG SOOS CR 09.0072		WDFW	DIT: 633371	82		AD Fin Clp	AD Fin Clp	43471
09	3-Aug	633382	05	FINCH CR 16.0222	HOODSPORT H	WDFW		67		AD Fin Clp	AD Fin Clp	43468
09	3-Aug	633469	05	FINCH CR 16.0222	HOODSPORT H	WDFW		60		AD Fin Clp	AD Fin Clp	43472
09	4-Aug	632874	04	SKOKOMISH R 16.0001	RICKS PD (LLTK)	WDFW		70		AD Fin Clp	AD Fin Clp	57706
09	4-Aug	633372	05	BIG SOOS CR 09.0072		WDFW	DIT: 633371	76		AD Fin Clp	AD Fin Clp	43473
09	9-Aug	633467	05	GREEN R 09.0001	ICY CR H	WDFW		52		AD Fin Clp	AD Fin Clp	43474
09	10-Aug	210671	05	KALAMA CR 11.0017	KALAMA CR H	NISQ		78		AD Fin Clp	AD Fin Clp	50714
09	10-Aug	632783	04	CLEAR CR 11.0013C	NISQUALLY H	NISQ	DIT: 210589	77		AD Fin Clp	AD Fin Clp	54611
09	10-Aug	633382	05	FINCH CR 16.0222	HOODSPORT H	WDFW		57		AD Fin Clp	AD Fin Clp	50715
09	10-Aug	633469	05	FINCH CR 16.0222	HOODSPORT H	WDFW		55		AD Fin Clp	AD Fin Clp	54610
09	10-Aug	633469	05	FINCH CR 16.0222	HOODSPORT H	WDFW		58		AD Fin Clp	AD Fin Clp	57153
09	10-Aug	633469	05	FINCH CR 16.0222	HOODSPORT H	WDFW		59		AD Fin Clp	AD Fin Clp	57180
09	15-Aug	185240	05	R-CHILLIWACK R	H-CHILLIWACK R	CDFO	DIT: 185030, 185031, 185032	83		AD Fin Clp	AD Fin Clp	57136
09	15-Aug	632978	04	CHAMBERS CR 12.0007	LAKEWOOD H	WDFW		78		AD Fin Clp	AD Fin Clp	57154
09	15-Aug	633366	05	PURDY CR 16.0005	GEORGE ADAMS H	WDFW	DIT: 633365	62		AD Fin Clp	AD Fin Clp	50716
10	16-Jul	632897	04	PURDY CR 16.0005	GEORGE ADAMS HATCHRY	WDFW	DIT: 632966, 632967	80		AD Fin Clp	AD Fin Clp	57102
10	16-Jul	633285	05	GROVERS CR 15.0299	GROVERS CR H	SUQ	DIT: 210682	67		AD Fin Clp	AD Fin Clp	57101
10	16-Jul	633285	05	GROVERS CR 15.0299	GROVERS CR H	SUQ	DIT: 210682	69		AD Fin Clp	AD Fin Clp	57702
10	16-Jul	633366	05	PURDY CR 16.0005	GEORGE ADAMS HATCHRY	WDFW	DIT: 633365	72		AD Fin Clp	AD Fin Clp	25289
10	17-Jul	210592	04	GROVERS CR H	GROVERS CR H	SUQ	DIT: 632790	72		AD Fin Clp	AD Fin Clp	50486
10	17-Jul	632786	04	CHAMBERS CR 12.0007	CHAMBERS CR + GARRISON	WDFW		74		AD Fin Clp	AD Fin Clp	50487
10	17-Jul	633369	05	FRIDAY CR 03.0017	SAMISH H	WDFW	DIT: 633368	67		AD Fin Clp	AD Fin Clp	50488
10	18-Jul	632880	04	GORST CR 15.0216	GORST CR REARING PND	SUQ		70		AD Fin Clp	AD Fin Clp	57103
10	19-Jul	210598	04	KALAMA CR 11.0017	KALAMA CR H	NISQ		80		AD Fin Clp	AD Fin Clp	57105
10	26-Jul	633375	05	VOIGHT CR 10.0414	VOIGHTS CR H	WDFW		68		AD Fin Clp	AD Fin Clp	57127
10	26-Jul	633375	05	VOIGHT CR 10.0414	VOIGHTS CR H	WDFW		70		AD Fin Clp	AD Fin Clp	57128
10	27-Jul	633382	05	FINCH CR 16.0222	HOODSPORT H	WDFW		78		AD Fin Clp	AD Fin Clp	25293

Area	Recov Date	Tag Code	BY	ReleaseSite	RearingHatchery	Release Agency	DIT Code(s)	FL (cm)	Sex	RecovMark	ReleaseMark	Label
10	30-Jul	632786	04	CHAMBERS CR 12.0007	CHAMBERS CR + GARRISON	WDFW		72		AD Fin Clp	AD Fin Clp	25295
10	30-Jul	633285	05	GROVERS CR 15.0299	GROVERS CR H	SUQ	DIT: 210682	68		AD Fin Clp	AD Fin Clp	25294
10	3-Aug	633369	05	FRIDAY CR 03.0017	SAMISH H	WDFW	DIT: 633368	73	M	AD Fin Clp	AD Fin Clp	42278
10	3-Aug	633468	05	WALLACE R 07.0940	WALLACE R H	WDFW		60		AD Fin Clp	AD Fin Clp	54035
10	7-Aug	210592	04	GROVERS CR H	GROVERS CR H	SUQ	DIT: 632790	74		AD Fin Clp	AD Fin Clp	57119
10	8-Aug	633369	05	FRIDAY CR 03.0017	SAMISH H	WDFW	DIT: 633368	66		AD Fin Clp	AD Fin Clp	57120
10	10-Aug	632978	04	CHAMBERS CR 12.0007	LAKEWOOD H	WDFW		79		AD Fin Clp	AD Fin Clp	54869
10	10-Aug	632978	04	CHAMBERS CR 12.0007	LAKEWOOD H	WDFW		73		AD Fin Clp	AD Fin Clp	57134
10	10-Aug	633372	05	BIG SOOS CR 09.0072		WDFW	DIT: 633371	57		AD Fin Clp	AD Fin Clp	25297
10	11-Aug	632967	04	BIG SOOS CR 09.0072	SOOS CREEK H	WDFW	DIT: 632897, 632966	69		AD Fin Clp	AD Fin Clp	54873
10	12-Aug	632874	04	SKOKOMISH R 16.0001	RICKS PD (LLTK)	WDFW		75		AD Fin Clp	AD Fin Clp	25298
10	12-Aug	633372	05	BIG SOOS CR 09.0072		WDFW	DIT: 633371	67		AD Fin Clp	AD Fin Clp	25300
10	14-Aug	210684	05	WHITEHORSE SPRINGS	WHITEHORSE POND	COOP		68		AD Fin Clp	AD Fin Clp	57135
10	14-Aug	632967	04	BIG SOOS CR 09.0072	SOOS CREEK H	WDFW	DIT: 632897, 632966	83		AD Fin Clp	AD Fin Clp	50076
10	14-Aug	633469	05	FINCH CR 16.0222	HOODSPORT H	WDFW		53		AD Fin Clp	AD Fin Clp	50077

Appendix G-1. Fishery-total estimates of retained and released salmon (Chinook *and* other species) catch for the Area 9 July 16-August 15, 2008 mark-selective Chinook fishery. Displayed Chinook harvest values are equivalent to those displayed in **Table 3-1**. Whereas the Chinook release estimates displayed in **Table 3-1** 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.

			Retained Chinook		Other Sp. Retained				Released Chinook			Other Sp. Released				
Stat Week	Stratum Start	Stratum End	AD	UM[1]	AD Coho	UM Coho	Chum	Cutt. Trout	AD	UM	Unk	AD Coho	UM Coho	Unk Coho	Cutt. Trout	UnID'd
29	16-Jul	20-Jul	1,043	3	88	0	3	2	127	493	545	117	134	315	6	995
30	21-Jul	27-Jul	1,137	0	170	0	0	0	247	556	285	137	185	263	0	781
31	28-Jul	03-Aug	1,233	0	84	0	0	0	132	770	352	29	104	114	0	521
32	04-Aug	10-Aug	416	0	108	6	0	0	266	374	596	88	140	307	0	2,011
33	11-Aug	15-Aug	146	0	28	0	0	0	73	133	259	65	22	54	0	977
Creel subtotal:			3,976	3	478	6	3	2	846	2,326	2,038	435	583	1,053	6	5,286
Charter subtotal:			69	0	0	0	0	0	55	86	0	0	0	0	0	0
Grand Total:			4,045	3	478	6	3	2	901	2,412	2,038	435	583	1,053	6	5,286
Standard Error:			489	1	51	4	1	1	84	169	252	77	74	137	2	797
CV (%):			12%	41%	11%	59%	35%	35%	9%	7%	12%	18%	13%	13%	35%	15%
95% CI:			3,085-5,004	1-5	379-577	2-13	1-5	1-4	738-1,063	2,083-2,741	1,544-2,532	285-586	437-729	785-1,322	2-11	3,724-6,847

[1] The 3 UM Chinook included were actually of undetermined mark status; they are assumed to be unmarked for impact-estimation purposes.

Appendix G-2. Fishery-total estimates of retained and released salmon (Chinook *and* other species) catch for the Area 10 July 16-August 15, 2008 mark-selective Chinook fishery. Displayed Chinook harvest values are equivalent to those displayed in **Table 3-2**. Whereas the Chinook release estimates displayed in **Table 3-2** 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.

			Retained Chinook		Other Sp. Retained		Released Chinook			Other Sp. Released			
Stat Week	Stratum Start	Stratum End	AD	UM	AD Coho	UM Coho	AD	UM	Unk	AD Coho	UM Coho	Unk Coho	UnID'd
29	16-Jul	20-Jul	209	3	117	17	32	81	170	54	63	256	707
30	21-Jul	27-Jul	107	0	78	26	81	54	121	59	26	270	597
31	28-Jul	03-Aug	136	0	118	44	80	85	102	43	43	84	868
32	04-Aug	10-Aug	252	0	72	31	87	115	104	75	51	154	2,178
33	11-Aug	15-Aug	155	0	78	78	29	91	179	78	62	229	1,896
Creel subtotal:			859	3	462	196	308	427	675	309	245	992	6,246
Charter subtotal:			172	0	0	0	29	134	0	0	0	0	0
Grand Total:			1,031	3	462	196	337	561	675	309	245	992	6,246
Standard Error:			63	1	49	24	78	76	122	53	50	124	718
CV (%):			6%	41%	11%	12%	23%	13%	18%	17%	20%	13%	12%
95% CI:			907-1,155	1-5	366-558	149-243	188-485	431-690	436-914	204-413	148-342	749-1,236	4,838-7,654

Appendix H. Revised total and size/mark-status group-specific estimates of Chinook encounters for past summer seasons (Area 9: July 16-31, 2007; Area 10: July 16-28, 2007) of the Areas 9 and 10 mark-selective Chinook fisheries, with 2008 values. Revisions are based on the bias-corrected "Method 2" approach recommended by Conrad and McHugh (2008). LM = legal-sized, marked; LU = legal-sized, unmarked; SM = sublegal-sized, marked; SU = sublegal-sized, unmarked. Note that estimates include both private and charter anglers.

Area	Season	Retained Chinook				Released Chinook				Total Encounters
		LM	LU	SM	SU	LM	LU	SM	SU	
9	July 16-31, 2007	1,469	30	70	8	209	497	3,101	723	6,108
10	July 16-28, 2007	5,094	13	146	20	711	1,112	1,286	317	8,698
9	July 16-Aug 15, 2007	4,035	3	10	0	597	1,608	3,212	3,826	13,290
10	July 16-Aug 15, 2007	1,027	3	4	0	128	510	189	385	2,246