

THE 1999 SOUTHEAST ALASKA  
TROLL OBSERVER PROGRAM STUDY



By

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## **ABSTRACT**

An onboard observer and voluntary logbook program was conducted by the Alaska Department of Fish and Game (ADF&G) during the 1999 Southeast Alaska summer commercial troll fishery (July through September). The study estimated the number of legal and sublegal (<28 inches total length) chinook salmon incidentally hooked and released, and the maturity and sex composition of chinook salmon during chinook retention (CR) periods (Period one = July 1-6; Period two = August 18-22) and chinook non-retention (CNR) periods (Period one = July 7 - August 12; Period two = August 23 - September 30). A total of 211 observer days were logged during 89 fishing trips aboard 36 different power troll vessels. A total of 355 logbook days were logged during 154 fishing trips aboard 78 different power and hand troll vessels. An estimated 51,000 legal and 54,000 sublegal-size chinook salmon were hooked and released. Trollers encountered 1.9 sublegal and 2.4 legal chinook salmon per day during CNR periods, and 2.4 sublegal chinook salmon per day during CR periods. An estimated 73% of the chinook harvest from inside waters and 77% of the harvest from outside waters were maturing fish during the CR period one. An estimated 41% of the chinook harvest from inside waters and 71% of the harvest from outside waters were maturing fish during CR period two. Coded-wire-tags from 24 hatchery locations and one wild stock location were recovered from sublegal-sized chinook salmon (N=431) examined by onboard observers.

## **PREFACE**

The Chinook Technical Committee (CTC) of the Pacific Salmon Commission (PSC) calculates total mortality (the sum of landed and incidental mortality) from estimates of landed and incidental mortality. Currently, incidental mortality is estimated by multiplying an assumed post release mortality rate with estimates of the number of chinook salmon released. Prior to the initiation of this study, first funded in 1998 with federal funding resulting from a letter of agreement (LOA) among US parties of the Pacific Salmon Commission, estimates of the number of chinook salmon encountered (i.e., hooked and released) were calculated using data collected from 1985 through 1988. The primary objective of this observer program is to update estimated encounter rates through an onboard observer and logbook program, such that estimates will be within +/-25% of the true value 90% of the time. This report covers the second year of an anticipated four-year observer program.

Under the LOA, agencies are to utilize opportunities provided by an abundance-based management approach to minimize incidental mortality. To accomplish this objective, current estimates of incidental mortality are required. Estimation of the number of chinook salmon encountered is integral to estimation of incidental mortality in PSC fisheries, including the Southeast Alaska troll fishery. This study is intended to provide direct measures of encounter rates for the CTC chinook cohort analysis model.

Secondary objectives of the study are estimation of sex and maturity composition of the landed chinook harvest (within 5% of the true value 95% of the time), and estimation of the stock composition of sublegal fish through coded-wire-tag (CWT) recoveries. Troll-caught legal chinook salmon are eviscerated at sea, and sublegal chinook must be released at sea; therefore, sampling for sex composition, maturity, and CWTs for sublegal fish cannot be conducted by the port sampling program.

## INTRODUCTION

During the 1998 and 1999 troll fisheries, an onboard observer and logbook program was conducted by ADF&G to monitor the incidental hook and release of chinook salmon during the Southeast Alaska summer commercial troll season. Incidental catch of sublegal-sized chinook salmon occurs during the entire summer season due to regulations which prohibit trollers from retaining chinook salmon that are less than 28 inches in total length (sublegal). In addition, one or more chinook salmon non-retention (CNR) periods occurs each year to prevent exceeding the annual chinook catch ceiling determined by the PSC. During CNR periods, trollers target primarily coho salmon.

A pilot study to determine the feasibility of an observer program was conducted in 1978 (ADF&G 1979). An observer program was conducted from 1983-1989 during CNR periods (Davis et al. 1985, Davis et al. 1986, Davis et al. 1987, Seibel et al. 1988, Seibel et al. 1989). Since 1988, annual chinook salmon encounter estimates for CNR periods have been calculated using encounter rates derived from the observer studies conducted from 1985-1988. However, the Southeast Alaska troll fishery has changed since those studies occurred. The length and timing of the fishery has been modified to minimize the incidental catch of chinook salmon during CNR periods, and areas of frequent high chinook salmon abundance have been closed for most of the summer season to reduce encounter rates. The number of vessels participating in the fishery have declined. Trollers, increasingly dependant on coho salmon due to chinook quota reductions, have likely improved selective fishing techniques for coho salmon during CNR periods. Finally, ecological factors may have affected the regional distribution of immature chinook salmon and altered encounter rates in some areas.

The primary objective of the current observer/logbook program is to update estimates of chinook salmon catch and release encounters in the Southeast Alaska summer troll fishery. Secondary objectives included collecting a variety of other data (sex composition and maturity data) that can only be gathered while onboard a fishing vessel at sea because trollers eviscerate their catch shortly after it comes aboard. In addition, observers collected CWT samples and random genetic stock identification (GSI) tissue samples from sublegal chinook salmon.

Following the 1998 season, the project field coordinator made several suggestions for improving the observer program (Bloomquist et. al 1999). All of these recommendations were incorporated into the 1999 study.

## METHODS

The ADF&G notified Southeast Alaska trollers about the observer and logbook program through the Alaska Trollers Association, public meetings in trolling communities, an ADF&G news release, and port sampling staff. A total of eight observers were hired, and they operated out of several Southeast fishing communities, including Sitka, Elfin Cove, Hoonah, Yakutat, Ketchikan, Petersburg, and Craig. Other ADF&G staff participated as observers when available. Vessel operators were paid one hundred dollars a day for taking on an observer. All boats that took observers were required to have Coast Guard inspection certification and standard safety gear. ADF&G supplied each observer with a survival suit, strobe light, and sampling equipment. Observer and logbook effort was to be distributed as similar as possible to vessel effort in the fishery.

### ***Observer Catch Data***

Trollers were asked to fish as they normally would, and observers were instructed to observe and gather data with as little interference as possible with the standard fishing operations of the vessel. Observers were expected to work on deck during all hours that fishing occurred. Data collection included: the catch, and catch and release, of legal and sublegal chinook, coho, pink, sockeye, and chum salmon, the location(s) fished (statistical area), and the number of hours fished per area per day. Sublegal chinook salmon were retained for CWT and GSI sampling. The Alaska Department of Public Safety, Division of Fish and Wildlife Protection, was notified of boats with observers. About 200 observer days were allocated for in the project funding. All encountered sublegal chinook salmon were retained for CWT and GSI sampling, when possible. The preseason goal for GSI sampling (cheek muscle, eye retinal fluid, and liver tissue) was 400 sublegal chinook salmon.

### ***Logbooks***

Logbooks were issued in order to boost sample sizes in all areas. Logbooks were distributed at area ADF&G offices and through ADF&G port sampling staff throughout the region. Each troller who fully completed and turned in a logbook was compensated \$115 dollars. Trollers were required to record at least three days of data, including the number of each species of salmon caught by day and by area fished, the number of hours fished in each day and area, and the number of legal and sublegal-size salmon that were hooked and released. Logbooks were distributed to power troll and hand troll vessels too small to accommodate an observer, and to large power troll vessels in order to supplement observer data. About 300 logbook days were allocated for in the project funding.

### ***Chinook Encounter Data Analyses***

Log linear regressions were fit to predict legal and sublegal chinook encounter rates using fishing period, one of six geographic areas (big-six area, Figure 1), fishing vessel, and observer type (logbook or onboard observer). Due to low sample size and effort in some big-six areas, the three outer coast (outside) big-six areas (Areas 1 through 3; Figure 1) and the three inside waters (inside) big-six areas (Areas 4 through 6) were pooled separately to form both an inside and an outside strata.

Encounter estimates between observer type (logbook versus observer) for both legal and sublegal chinook salmon were compared by strata and period using a general linear model.

### ***Comparison of Historical Catch and Release Estimates***

Beginning in 1998, the observer program study treated the daily observations from a particular boat trip as subsampling units of the primary sampling unit, the boat trip. Prior studies from 1983-1989 had used the daily observations as the primary sampling unit (Bloomquist et. al, 1999).

The number of legal and sublegal chinook salmon encountered per boat day and per boat trip was collected for inside and outside area strata during the CNR period. These encounter rates were expanded to estimate the total number of area strata encounters based on the total number of boat days of effort for

each area strata. The total encounters for the period were obtained by summing the area strata estimates. In addition, estimates of sublegal encounters were made for the two CR periods using the same method. The estimated variance for the total number of chinook salmon encounters was constructed by summing the individual variance estimates from each strata. The variances were then used to estimate confidence intervals. Due to the low numbers of participating hand troll vessels, the power troll estimates of encounters were expanded to the total estimates based on the ratio of the total troll effort to the power troll effort within each period/area strata. The estimates and their associated variances were computed using a ratio estimator with subsampling as outlined in Cochran (1977). The exact formulation as it was applied to this problem appears below. The estimate of encounters for each stratum was constructed as follows:

$$\begin{aligned}\hat{Y}_R &= X \frac{\hat{Y}_u}{\hat{X}_u}, \\ \hat{Y}_u &= \left(\frac{N}{n}\right) \sum_{i=1}^n M_i \bar{y}_i = \left(\frac{N}{n}\right) \sum_{i=1}^n \hat{Y}_i, \\ \hat{X}_u &= \left(\frac{N}{n}\right) \sum_{i=1}^n M_i \bar{x}_i = \left(\frac{N}{n}\right) \sum_{i=1}^n \hat{X}_i, \\ \bar{y}_i &= \sum_{j=1}^{m_i} \frac{y_{ij}}{m_i}, \\ \bar{x}_i &= \sum_{j=1}^{m_i} \frac{x_{ij}}{m_i}.\end{aligned}$$

Where:

- $\hat{Y}_R$  = Ratio estimate of the total number of chinook salmon encounters.
- $X$  = The total number of boat days of effort.
- $\hat{Y}_u$  = The estimated total number of chinook salmon encounters from sampled boat trips.
- $\hat{X}_u$  = The estimated total number of boat days from sampled boat trips.
- $N$  = The total number of boat trips.
- $n$  = The number of boat trips that were sampled.
- $M_i$  = The trip length in days for sampled boat trip  $i$ .
- $m_i$  = The number of days subsampled from boat trip  $i$ .
- $\bar{y}_i$  = The average number of chinook salmon encounters from sampled boat trip  $i$ .
- $y_{ij}$  = The number of chinook salmon encounters from sampled boat trip  $i$  and subsampled day  $j$ .
- $\hat{Y}_i$  = The estimated total number of chinook salmon encounters from sampled boat trip  $i$ .
- $\bar{x}_i$  = The average number of boat days from sampled boat trip  $i$ .
- $x_{ij}$  = The number of boat days from sampled boat trip  $i$  and subsampled day  $j$ .
- $\hat{X}_i$  = The estimated total number of boat days from sampled boat trip  $i$ .

The variance of the estimated number of chinook salmon encounters in a particular stratum was computed as follows:



$$v(\hat{Y}_R) \doteq \frac{N^2(1-f_1)}{n} \frac{\sum (\hat{Y}_i - \hat{R}\hat{X}_i)^2}{n-1} + \frac{N}{n} \sum \frac{M_i^2(1-f_{2i})s_{d'2i}^2}{m_i},$$

$$s_{d'2i}^2 = \frac{1}{M_i-1} \sum_{i=1}^{M_i} [(y_{ij} - \hat{R}x_{ij}) - (\bar{y}_i - \hat{R}\bar{x}_i)]^2,$$

where:

$$f_1 = \frac{n}{N},$$

$$\hat{R} = \frac{\hat{Y}_u}{\hat{X}_u},$$

$$f_{2i} = \frac{m_i}{M_i}.$$

This new estimation method was also applied retroactively to the data collected from the 1985-1988 sampling programs. Although data was collected in 1983, 1984, and 1989, the sample data could not be located for 1983 and 1984, and the 1989 sample data was incomplete.

Previous encounter estimates were obtained from several sources. The 1981-1984 estimates are from an unpublished 1987 ADF&G report on associated fishing induced mortality of chinook salmon. The 1985-1988 estimates were based on observer studies conducted in those years (Davis et al. 1985, Davis et al. 1986, Davis et al. 1987, Seibel et al. 1988, Seibel et al. 1989). Data from a 1989 limited survey of the CNR fishery indicated the encounter rates were similar to those which had occurred in previous years. For this reason, in 1989, the number of encounters was estimated by multiplying the 1985-1988 average CNR encounters per gear day by the gear days for 1989. The number of legal and sublegal encounters during the CNR fishery in 1990-1998 were estimated from a linear regression on the number of boat days of CNR effort. The “new method” estimates are all derived directly from observer data for those years using the 1998 analysis method.

### ***Chinook Maturity and Sex Composition***

Chinook sex determinations were made by direct examination of the gonads. Maturity measurements consisted of egg diameter measurements (nearest 0.5 mm) and milt sac width measurements (nearest .5 mm). A single “representative” egg was measured from a location approximately in the middle of a skein on each female. Milt sac width was measured at what visually appeared to be the widest section along the length of one sac. Only one maturity measurement was taken per fish.

Kissner (1973) identified females as maturing if they had an egg diameter measurement greater than 2.0 mm in May and June, or if they had an egg diameter measurement greater than 2.25 mm in late July and August. In this study, sampling constraints prohibited obtaining an average egg diameter measurement of high precision (numbers were often rounded to the nearest 0.5 mm), thereby making 2.0 mm a more appropriate point for designating maturity. Females with 2 mm egg diameters were assigned to the mature and immature categories according to the proportion of mature vs. immature fish present in the

immediately adjacent size categories. For example, if there were 20 fish in the 1.5 mm to < 2.0 mm category and there were 10 fish in the > 2.0 mm to 2.5 mm category, then 67% of the fish with 2.0 mm egg diameters would be classified as immature and 33% as mature.

Use of male gonad width measurements as an index of male maturity was not found in the fisheries literature. The width measurements gathered in 1999 were easy to obtain and sampling could be conducted aboard a boat under conditions where the use of a scale or volumetric measuring device would have been impractical. A single milt sac from each of a total of 511 male chinook were measured, and showed a bimodal distribution (Figure 2). Males with gonad width measurements greater than 10.0 mm were classified as mature. Males with 10.0 mm gonad width were assigned to the mature and immature categories according to the proportion of mature vs. immature fish present in the immediately adjacent size categories, in the same manner previously described for assigning female maturity categories.

Maturing fish were presumed to spawn during the 1999 calendar year. Immature fish included all fish that would not spawn in 1999. Gonad development is highly accelerated during the last few months prior to spawning, while very little development occurs during the previous periods of the chinook life cycle (Rich 1925). Therefore, the distribution of gonad size measurements in ocean-caught chinook is approximately bimodal between fish considered to be current year spawners and those that will not spawn this year. However, some error may be expected in the assessment of fall spawners, because accelerated gonad development would not be expected to begin until the early summer.

## RESULTS

### *Season Overview*

The 1999 summer troll chinook catch (94,500 fish) was the third lowest summer harvest, and the troll coho catch (2.3 million fish) the third highest harvest, since the signing of the Pacific Salmon Treaty (PST) in 1985. The 1999 summer troll fishery consisted of two fishing periods each for chinook and coho salmon. The CR periods occurred from July 1 - July 6, and from August 18 - August 22, during which 78,000 and 16,000 chinook salmon were harvested, respectively. The coho retention periods occurred from July 1 - August 12, and from August 17 - September 30, during which 1.5 million and 782,000 coho salmon were harvested, respectively (Table 1). Two CNR periods occurred from July 7 through August 12, and from August 23 through September 30. By Alaska Board of Fisheries (BOF) regulation, areas considered to be of high chinook salmon abundance were closed following the first CR period.

### *Observer and Logbook Analyses*

Estimated boat days of effort during the summer troll fishing season increased by about 7% from 1998 to 1999 (Table 1). About 75% of the effort occurred during CNR periods and 25% during CR periods. Total number of trips sampled increased from 176 trips in 1998 to 240 trips in 1999 (36% increase; Table 2). Observer days increased from 184 days in 1998 to 211 days in 1999 (17% increase). Log book observer days increased from 223 days in 1998 to 355 days in 1999 (59% increase). As a percentage of estimated boat-days of effort, the program sampled 1.7% of the CR fishing effort in 1998 and 4.0% in 1999, and 1.0% of the CNR fishing effort in 1998 and 1.4% in 1999. The distribution of observer and logbook effort generally approximated that of the fleet by period, except for period 4 (Figure 3). Logbook sampling

enhanced the sample size in Area 5, in particular, where sample size by observer trips only would otherwise have been very small in proportion to fishing effort (Figure 4).

Unlike 1998, when no differences were detected between observer type ( $\alpha=0.05$ ), some significant differences were seen in 1999. For legal-sized fish, no differences in encounter estimates were detected between observer type during CNR periods. However, during CR periods, logbook encounter estimates were significantly greater than observer estimates. Some possible explanations for this are the small sample size of observer trips during CR periods (21) versus 55 logbook trips during the same periods. Also, by design, the logbook sampling was expanded in 1999 to cover areas where little power troll observer data was collected in 1998. During the CR periods, about 38% of the observer trips were from the inside stratum, versus only 27% of the logbook trips.

For sub-legal chinook salmon, no significant differences were detected between logbook and observer estimates during CR periods. During CNR periods, significant differences were not detected in outside areas, but were detected in inside areas. Inside areas, particularly Areas 4 and 5, include both waters open to the outer coastal waters, and inner coastal waters. During CR periods, little effort occurs in the inner coastal waters of the inside areas. However, during the CNR periods, effort increases as trollers follow coho salmon to inside waters. For example, in Area 4, for example, although both observer and logbook data were collected in the outer coastal portion of the area (Cross Sound) during CNR periods, only logbook data was collected in inside portions of the area (Icy Strait and Chatham Strait). Such differences in sampling location could be the primary influence between differences between the logbook and observer data, particularly for sub-legal chinook salmon, which are known to be encountered in small, localized areas. However, since most of the summer troll fishing effort and harvest occurs in the outer coastal areas, the effect of these strata differences in sub-legal estimates will be relatively minor when expanded to the entire Southeast Alaska region.

Thus, the differences in the chinook encounter estimates from the logbooks and observers, although different for some strata, are assumed to be complimentary; therefore, the data from the logbooks and observer observation types were pooled for each time/area strata.

### *Chinook Salmon Catch and Release Estimates*

Approximately 3,800 legal and 1,400 sublegal chinook salmon were observed during the 1999 season through a total of 243 trips. Logbooks accounted for 74% of the legal chinook observations, 70% of the sublegal chinook observations, and 63% of the trips (Table 2).

Estimates for the total number of catch and release encounters in the 1999 troll fishery were 51,100 legal-sized fish during CNR periods and 53,600 sublegal-sized fish during both CR and CNR periods (Table 3). The confidence interval of legal encounters during the CR periods encompassed the actual reported harvest during the CR periods for both 1998 and 1999 (Table 4).

### *Encounter Rate Comparisons*

Weighting of chinook encounter estimates by trip (new estimation method) showed no consistent increase or decrease in encounter rate when compared to those estimates weighted by days fished (old estimation method; Table 5). The 1999 CNR encounter rate for legal-sized fish was similar to estimates from 1998

and 1985 (Table 6). The 1999 CNR sublegal encounter rate was greater than 1998, but less than all other years.

### *Chinook Salmon Maturity and Sex Composition*

The sex composition estimates in period one were 39% male for the inside stratum and 46% male for the outside stratum (Table 7). The sex composition estimates were 47% male for the inside and 38% for the outside strata in period two.

During the first CR period, the majority of the fish observed were mature in both inside and outside strata (Table 8). During the second CR period, most of the fish observed were mature in the outside strata, but immature in the inside strata.

### *Coded-Wire Tag Recoveries*

A total of 48 heads from marked sublegal-size chinook salmon were recovered from a total of 434 sublegal fish examined on observer boats (Table 9). Of these, two heads contained no tags, two heads contained undefined tags, and five heads were lost.

Only 431 sublegal chinook salmon were examined out of a total estimated 52,900 sublegal chinook salmon encountered, for a sampling rate of less than 1%, and therefore too low for reliable estimates of stock composition estimates. For hatchery stocks, based on the sum of tag ratios for each state or province divided by the sum of the tag ratios for all recoveries (N=39), stocks from British Columbia accounted for 40% of the total tag ratios, followed by Alaska (28%), Washington (22%), Oregon (10%) and Idaho (1%).

Only two tag locations were found in the sublegal chinook samples that were not found in the legal-sized chinook samples - Taku River wild stock and Kincolith hatchery stock (Table 10). Due to the small number of sublegal chinook salmon examined and the small number of CWT recoveries in comparison to the large number of stocks available to the troll fishery, the recoveries from the sublegal chinook sampling probably do not include many of the coded-wire-tagged stocks hooked and released in the fishery.

## **DISCUSSION**

### *Estimation of Chinook Encounters*

Following the 1998 season, Bloomquist et al. (1999) recommended increasing the sampling in the program to achieve objective precision criteria. Sample sizes were increased in 1999, but precision decreased for all encounter estimates. In 1998, the program estimated the number of legal-sized chinook salmon encountered by power trollers within the objective precision criteria (+/- 25%), but not the sublegal chinook salmon. In 1999, neither the number of legal or sub-legal chinook salmon were estimated within the objective precision criteria, despite the increased sample size. The increased relative error in the estimates may be a reflection of the year to year variability of localized availability of chinook and

coho salmon to the troll fishery, annual differences in the length of the CR period (e.g., 53 days in 1998 and 11 days in 1999), and the variability in the conduct of the troll fleet, some of whom target primarily chinook salmon, some who target primarily coho salmon, and some who target both. Therefore, increased sampling may not significantly increase precision due to these factors. A more realistic precision criteria for the year 2000 study is probably an average of the encounter estimates for legal and sublegal chinook salmon by fishing period for 1998 and 1999 (about +/-35%).

### *Sex Composition and Maturity*

In 1998, chinook salmon maturity was determined by visual estimation. Due to the large uncertainty surrounding male maturity determination, confidence interval estimates were not calculated. In 1999, physical measurements of both eggs and milt sacs were made, and confidence intervals calculated for male, female, and pooled maturity estimates. Pooled maturity estimates were within the +/- 5% precision goal in 1999.

Confidence intervals for sex composition estimates for all periods and areas averaged about +/- 10% in both 1998 and 1999, and were higher than the 5% objective precision goals. Therefore, expected precision during the 2000 study will likely range from 5% to 10%.

### *Sub-legal Chinook Stock Composition*

Accurate estimation of the complete stock composition of the sub-legal chinook catch is unlikely using only CWT data under the current sampling program, given the number of probable stocks available to the troll fishery, and the small proportion of fish tagged for many stocks. CWT data will continue to be collected by onboard observers as part of a companion GSI sampling program (Seeb et. al, 1999), which is likely to provide better stock composition information that can be obtained from the CWT data.

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Table 1. Chinook and coho salmon catch and boatdays of effort by period in the 1998 and 1999 summer seasons of the Southeast Alaska troll fishery.

Year	Fishing Period	Chinook	Coho	Effort (boat days)
1998	CR Period (7/1-7/12)	102,773	472,134	4,991
	CNR Period (7/13-8/11)	0	733,075	11,914
	Second CR Period (8/20-9/30)	35,967	430,010	7,549
	1998 Totals:	138,740	1,635,219	24,454
1999	CR Period (7/1-7/6)	78,058	160,744	2,515
	CNR Period (7/7-8/12)	0	1,317,568	14,004
	Second CR Period (8/18-8/22)	16,394	260,734	2,109
	Second CNR Period (8/23-9/30)	0	521,292	7,577
	1999 Totals:	94,452	2,260,338	26,205

Table 2. Number of trips and observed number of legal and sublegal chinook salmon encountered during the 1998 and 1999 Southeast Alaska summer troll fishery observer program.

Year	Data Type	Vessels	Trips	Boatdays	Legal	Sublegal
1998	Log Book	60	103	223	1,225	394
	Observer	36	73	184	1,678	292
	Total	93	176	407	2,903	686
1999	Log Book	78	154	355	2,820	1,021
	Observer	36	89	211	1,014	435
	Total	111	243	566	3,834	1,456

Table 3. Chinook salmon catch and release estimates for legal and sublegal sized fish during the 1998 and 1999 summer seasons of the Southeast Alaska troll fishery.

Year	Summer Period	Legal Encounters	90% Confidence Interval	Sublegal Encounters	90% Confidence Interval
1998	Retention Periods			28,436	18,941 to 37,930
	Non-Retention Period	29,462	22,577 to 36,346	11,400	7,563 to 15,238
	1998 Total:	29,462	22,577 to 36,346	39,836	29,596 to 50,077
1999	Retention Periods			11,603	5,743 to 17,463
	Non-Retention Periods	51,087	35,139 to 67,036	42,034	27,057 to 57,011
	1999 Total:	51,087	35,139 to 67,036	53,637	37,554 to 69,720

Table 4. Chinook salmon encounter estimates for legal sized fish during chinook retention periods, and the reported harvest during retention periods, for the 1998 and 1999 summer seasons of the Southeast Alaska troll fishery.

Year	Summer Period	Legal Encounters	90% Confidence Interval	Reported Harvest
1998	Retention Periods	126,961	60,380 to 193,543	139,000
1999	Retention Periods	70,761	42,929 to 98,594	94,500

Table 5. Southeast Alaska chinook salmon encounter estimates during chinook non-retention periods for the old estimation method, which used the fishing day as the sample unit versus the new estimation method, which treated the trip as the sample unit, 1981-1999.

OLD ESTIMATES			NEW ESTIMATES		
YEAR	LEGAL	SUBLEGAL	YEAR	LEGAL	SUBLEGAL
1981	18,225	18,578	1981		
1982	89,100	90,827	1982		
1983	74,925	76,378	1983		
1984	87,075	88,763	1984		
1985	118,191	131,011	1985	84,489	174,498
1986	78,763	104,820	1986	98,477	156,453
1987	191,956	171,156	1987	171,254	215,586
1988	60,930	91,200	1988	57,976	79,604
1989	150,600	162,900	1989		
1990	100,617	107,718	1990		
1991	110,978	118,809	1991		
1992	123,725	132,456	1992		
1993	103,945	111,281	1993		
1994	121,716	130,305	1994		
1995	79,862	85,498	1995		
1996	78,949	84,521	1996		
1997	60,158	64,403	1997		
1998	40,648	43,516	1998	29,462	11,400
1999	73,545	78,735	1999	51,087	42,034



Table 6. Comparison of chinook salmon catch and release encounter rates during chinook non-retention (CNR) and chinook retention (CR) periods, 1985-1999.

CNR	Year	Boatdays	Legal Chinook	Legals Per Day	Sublegal Chinook	Sublegals Per Day
	1985	35,725	84,489	2.3	174,498	4.9
	1986	34,173	98,477	2.9	156,453	4.6
	1987	37,214	171,254	4.6	215,586	5.8
	1988	27,275	57,976	2.1	79,604	2.9
	1998	11,928	29,462	2.5	11,400	1.0
	1999	21,581	51,150	2.4	41,682	1.9
CR	1998	11,400			28,436	2.3
	1999	4,624			11,213	2.4
Total:	1998	23,328	29,462		39,836	1.7
	1999	26,205	51,087		53,637	2.0

Table 7. Sex composition of chinook salmon sampled during the first and second chinook retention periods of the 1998 and 1999 summer troll fishery.

Year		Stratum	Proportion Male	95% C.I.	n
1998	7/1-7/12	Inside	39%	30% to 48%	119
		Outside	40%	36% to 44%	629
	8/20-9/30	Inside	47%	39% to 55%	173
		Outside	47%	38% to 56%	128
1999	7/1-7/6	Inside	39%	31% to 47%	169
		Outside	46%	41% to 51%	363
	8/18-8/22	Inside	47%	35% to 59%	76
		Outside	38%	28% to 48%	100

Table 8. Proportion of mature female and male chinook salmon in the catch of observer boats, 1998 and 1999.

Year	Period	Area	Females Mature	n	Males Mature	n	Combined Sexes Mature	95% C.I.	n		
1998	7/1-7/12	Inside	36%	73	11%	46	26%	a	119		
		Outside	90%	376	72%	237	83%		613		
	8/20-9/30	Inside	18%	92	5%	80	12%	a	172		
		Outside	83%	66	74%	50	79%		116		
1999	7/1-7/6	Inside	73%	103	74%	66	73%	66% to 80% 73% to 81% 30% to 52% 62% to 80%	169		
		Outside	77%	196	77%	166	77%		362		
	8/18-8/22	Inside	47%	40	34%	35	41%		75		
		Outside	68%	62	78%	37	71%		99		
	1999 Combined Periods/Combined Area:								75%	71% to 79%	705

<sup>a</sup> Confidence intervals were not calculated in 1998 due to an unknown (and presumably highly variable) amount of observer error in making visual determinations of male gonadal maturity. In 1999, visual estimation was replaced by physical measurement.

Table 9. The number of coded-wire-tag recoveries of sublegal chinook salmon (< 28 inches total length), the total tag ratio, and the contribution of the total tag ratio from a location to the sum of tag ratios from all tag recoveries, sampled from the 1999 Southeast Alaska summer troll fishery (N=431). The number of hatchery stocks represented by the CWT recoveries is likely much less than the number of stocks present and harvested during the Southeast Alaska summer fishery due to the low number of sublegal fish sampled and the tagged to untagged ratio of many stocks. One wild stock tag (Taku River) was also recovered.

State/ Province	Location	Tag Recoveries	Tag Ratio	Sum Tag Ratio	Contribution to Grand Total of Tag Ratio
AK	Hidden Falls	2	13	27	9%
	Medvejie	1	13	13	5%
	Whitman Lake	5	8	41	14%
AK Total		8		80	28%
BC	H-Kincolith Cdp	1	2	2	1%
	H-Kitimat River	2	14	27	10%
	H-Puntledge River	3	13	38	14%
	H-Quinsam River	4	7	30	10%
	H-Snootli Creek	1	15	15	5%
BC Total		11		112	40%
ID	Big Canyon Accl Pond	2	1	2	0%
ID Total		2		2	1%
OR	Cedar Creek Hatchery	1	5	5	2%
	Clackamas Hatchery	1	14	14	5%
	Marion Forks	1	1	1	0%
	McKenzie	1	1	1	0%
	Umatilla Hatchery	1	2	2	1%
	Willamette Hatchery	1	1	1	0%
	Youngs Bay Net Pens	1	3	3	1%
OR Total		7		27	10%
WA	Dryden Pond	1	1	1	0%
	Fallert Cr Hatchery	2	13	25	9%
	Lyons Ferry Hatchery	2	1	2	0%
	Priest Rapids Hatch.	1	26	26	9%
	Ringold Springs Hatc	1	3	3	1%
	Turtle Rock Hatchery	2	1	2	1%
	Wells Hatchery	1	1	1	0%
WA Total		10		61	22%
Grand Total		38		283	100%

Table 10. Coded-wire-tag recoveries by location for legal and sublegal (< 28 inches total length) chinook salmon sampled during the 1999 Southeast Alaska summer troll fishery. Wild stock locations are denoted by (W). All other locations are for hatchery releases.

State/Province	Location	Legal	Sublegal
AK	CRYSTAL LAKE	X	
	CRYSTAL LK/EARL WEST	X	
	DEER MOUNTAIN	X	
	ELMENDORF	X	
	FORT RICHARDSON	X	
	GASTINEAU	X	
	HIDDEN FALLS	X	X
	LITTLE PORT WALTER	X	
	MEDVEJIE	X	X
	NEETS BAY	X	
	SHELDON JACKSON	X	
	TAMGAS CREEK	X	
	(W) TAKU		X
	(W) UNUK R 101-75	X	
	WHITMAN LAKE	X	X
AK Total		14	4
BC	H-BIG QUALICUM RIVER	X	
	H-CHEHALIS RIVER/BC	X	
	H-CHILLIWACK RIVER	X	
	H-CONUMA RIVER	X	
	H-COWICHAN RIVER CDP	X	
	H-FORT BABINE CDP	X	
	H-GILLARD PASS PIP	X	
	H-KINCOLITH CDP		X
	H-KITIMAT RIVER	X	X
	H-LITTLE QUALICUM R	X	
	H-MASSET CDP	X	
	H-NITINAT RIVER	X	
	H-POWELL RIVER CDP	X	
	H-PUNTLEDGE RIVER	X	X
	H-QUESNEL RIVER	X	
	H-QUINSAM RIVER	X	X
	H-REED PT/IOCO	X	
	H-ROBERTSON CREEK	X	
	H-SAN JUAN RIVER CDP	X	
	H-SHOTBOLT BAY	X	
	H-SHUSWAP RIVER	X	
	H-SNOOTLI CREEK	X	X
	H-TAHSIS PIP	X	
	H-TERRACE CDP	X	
	H-TOFINO PIP	X	

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Table 10. (page 2 of 3)

State/Province	Location	Legal	Sublegal
BC Total		24	5
ID	BIG CANYON ACCL POND	X	X
ID Total		1	1
OR	BANDON HATCHERY	X	
	BONNEVILLE HATCHERY	X	
	BUTTE FALLS HATCHERY	X	
	CEDAR CREEK HATCHERY	X	X
	CLACKAMAS HATCHERY	X	X
	DEXTER PONDS	X	
	ELK RIVER HATCHERY	X	
	FALL CREEK	X	
	GARDINER CR (STEP)	X	
	MARION FORKS	X	X
	MCKENZIE	X	X
	PRIORLI CREEK HATCHE	X	
	ROCK CREEK	X	
	SALMON RIVER	X	
	SOUTH SANTIAM HATCH	X	
	TRASK HATCHERY	X	
	UMATILLA HATCHERY	X	X
	WILLAMETTE HATCHERY	X	X
	YAQUINA BAY SALMON R	X	
	YOUNGS BAY NET PENS	X	X
OR Total		20	7
WA	(M) COLUMBIA R - GENERAL	X	
	(M) MIXED COLUMBIA	X	
	(W) HANFORD REACH STOCK	X	
	(W) LEWIS R 27.0168	X	
	BATTLE CR HATCHERY	X	
	BONNEVILLE HATCHERY	X	
	CARLTON REARING POND	X	
	COUNTY LINE PONDS	X	
	COWLITZ SALMON HATCH	X	
	DRYDEN POND	X	X
	ELOCHOMAN HATCHERY	X	
	FALLERT CR HATCHERY	X	X
	GEORGE ADAMS HATCHRY	X	
	GRAYS RIVER HATCHERY	X	
	GROVERS CR HATCHERY	X	
	HOKO FALLS HATCHERY	X	

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Table 10. (page 3 of 3)

State/Province	Location	Legal	Sublegal
	KALAMA FALLS HATCHRY	X	
	KENDALL CR HATCHERY	X	
	KLICKITAT HATCHERY	X	
	LTL WHITE SALMON NFH	X	
	LYONS FERRY HATCHERY	X	X
	MAKAH NFH ON SOOES R	X	
	MARBLEMOUNT HATCHERY	X	
	PITTSBURG LANDING PD	X	
	PORTAGE BAY HATCHERY	X	
	PRIEST RAPIDS HATCH.	X	X
	PROSSER HATCHERY	X	
	QUINAULT LAKE HATCH.	X	
	QUINAULT NFH -COOK C	X	
	RINGOLD SPRINGS HATC	X	X
	SALMON R FISH CULTUR	X	
	SAMISH HATCHERY	X	
	SIMILKAMEEN HATCHERY	X	
	SOLDUC HATCHERY	X	
	SOOS CREEK HATCHERY	X	
	TURTLE ROCK HATCHERY	X	X
	WASHOUGAL HATCHERY	X	
	WELLS HATCHERY	X	X
	WILLAPA ALLIANCE NP2	X	
WA Total		39	7
Grand Total			

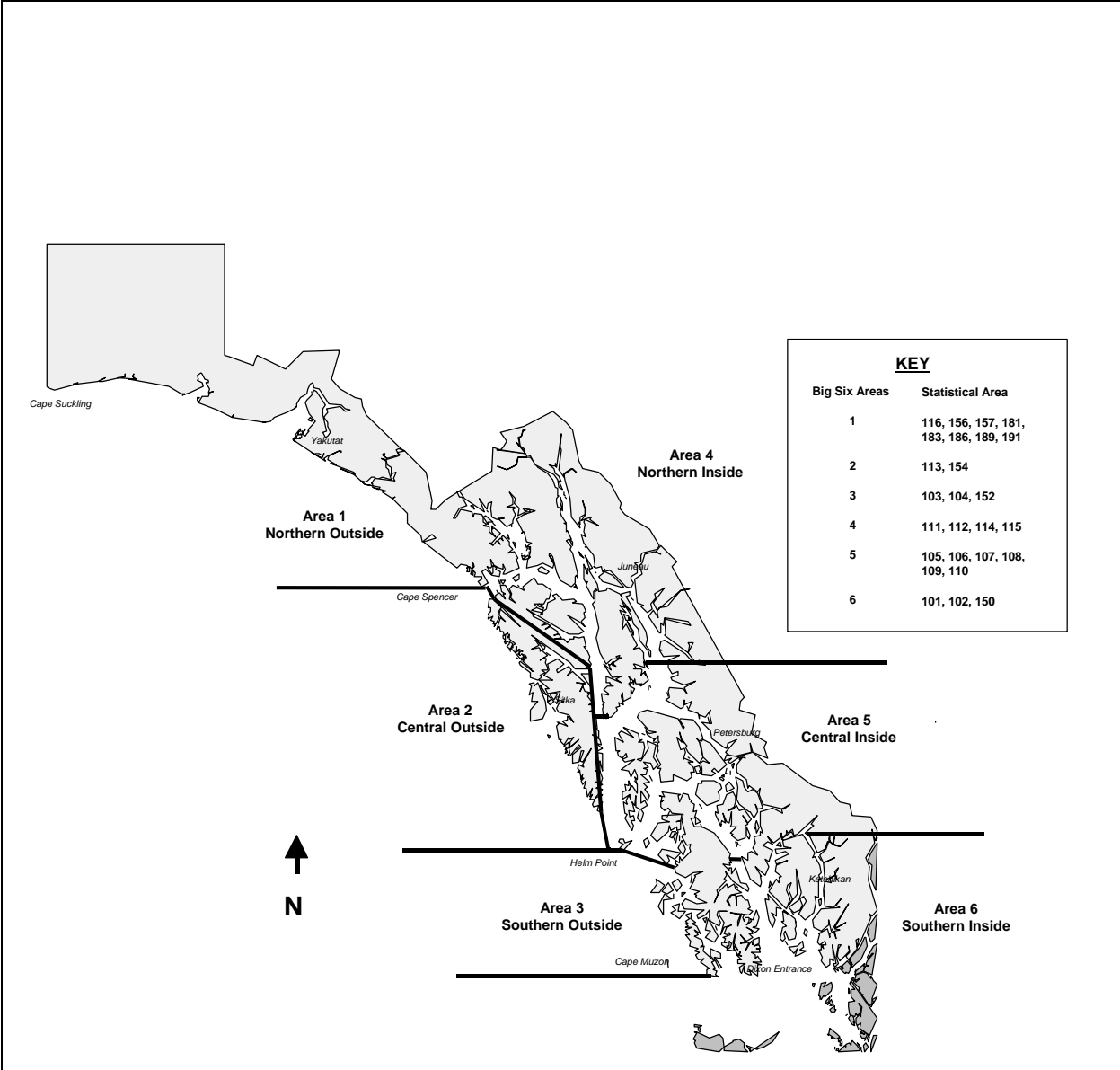


Figure 1. Map showing big-six areas in Southeast Alaska.

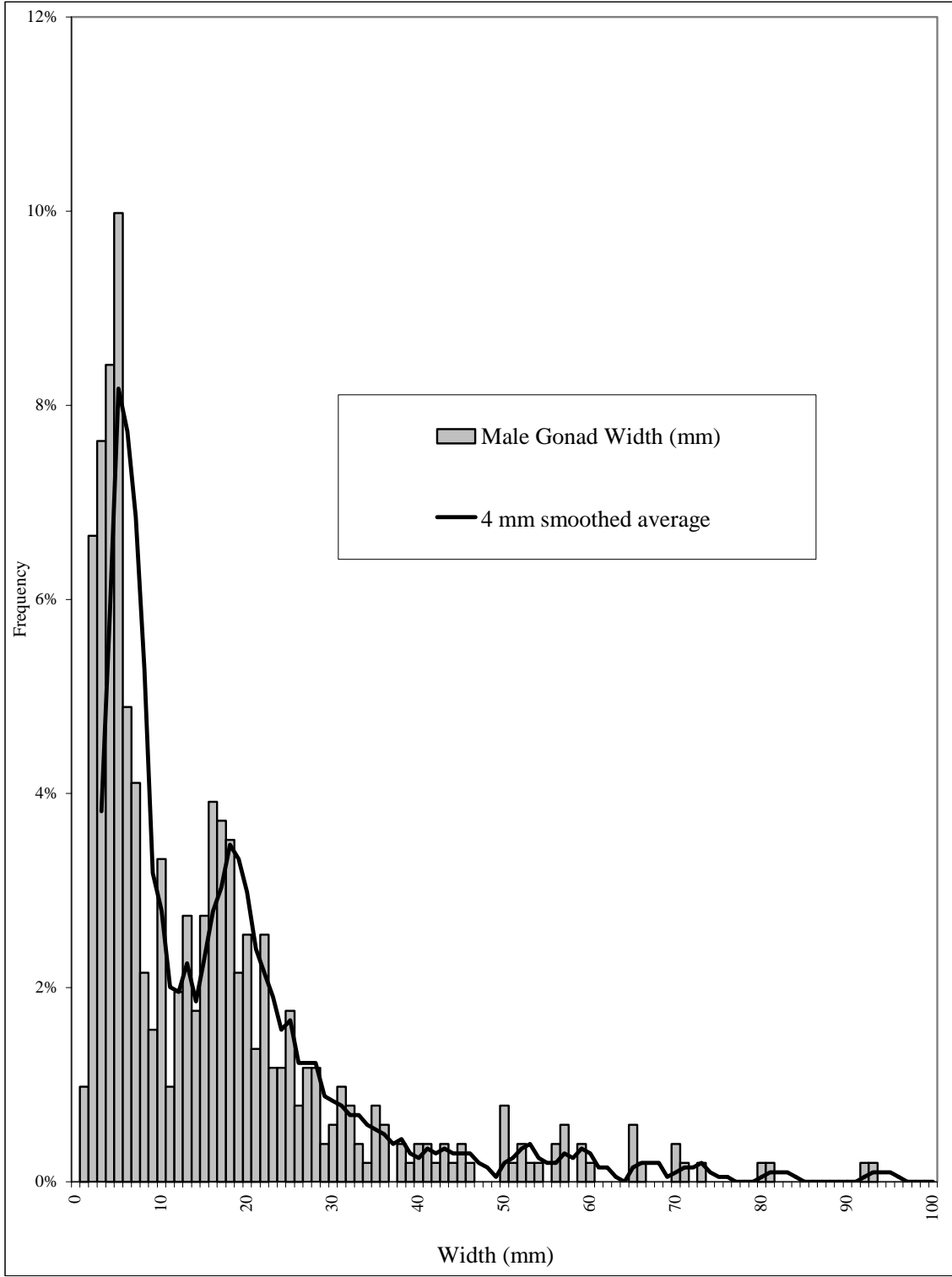


Figure 2. Frequency distribution of milt sac measurements from 511 male chinook salmon sampled during the 1999 troll observer program.



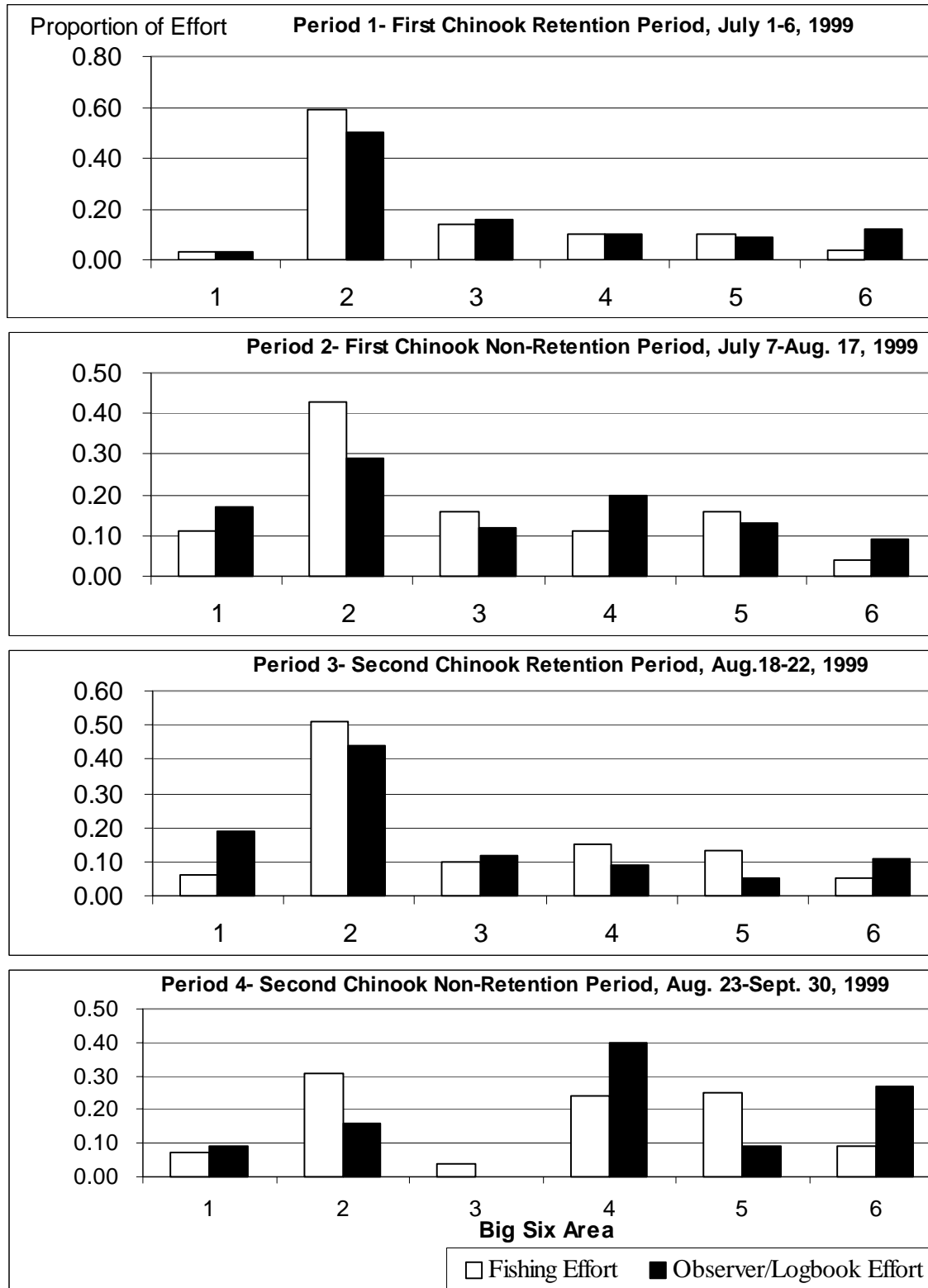


Figure 3. Proportion of fishing effort based on dock side interviews (Fishing Effort) and proportion of effort sampled during the observer program, by area and period, 1999.

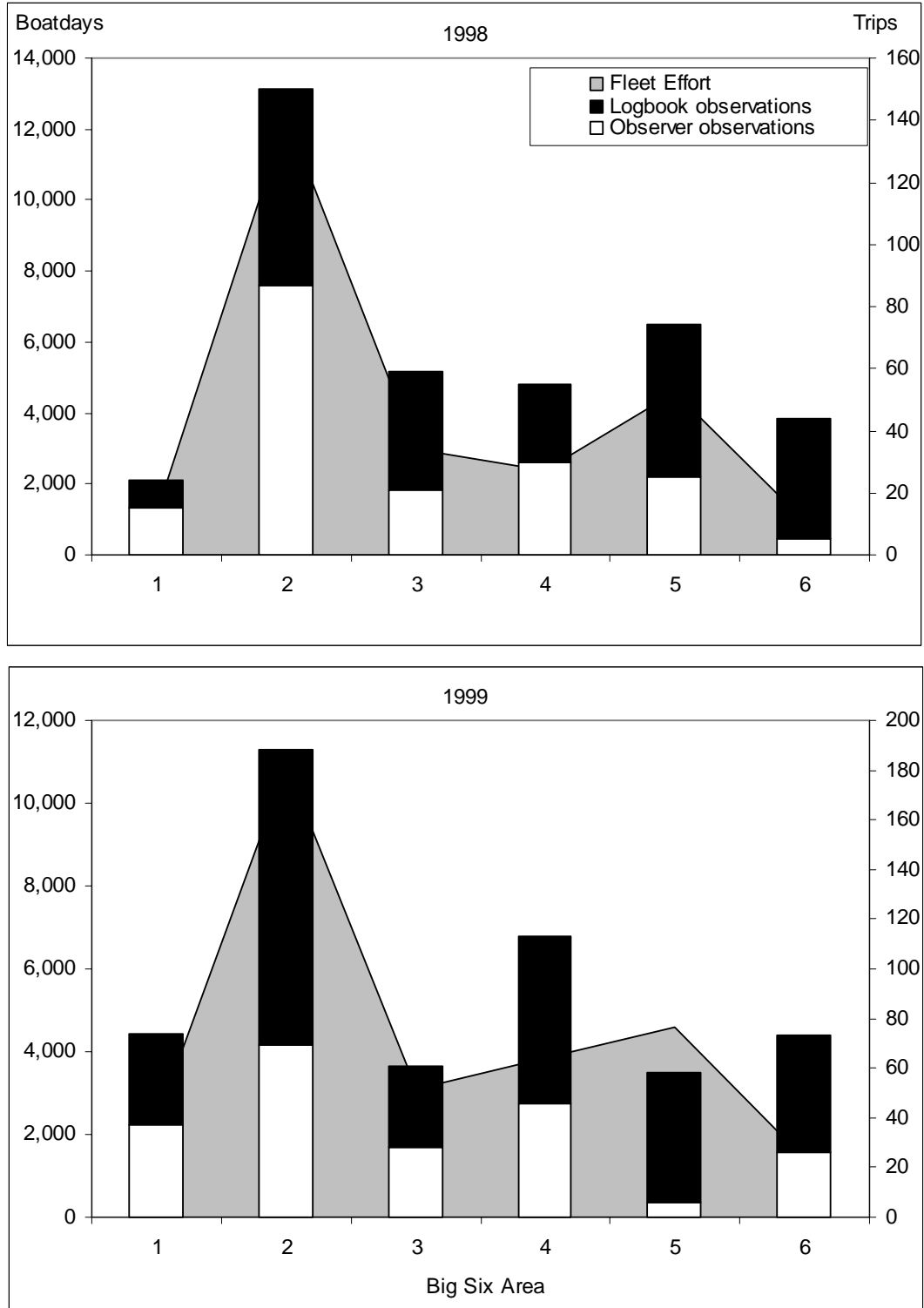


Figure 4. Observer and logbook number of trips (stacked column) and boatdays of fleet effort (gray area) during the 1998 and 1999 Southeast Alaska summer troll seasons.

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