

INCIDENCE AND CONTRIBUTION OF CODED-WIRE TAGGED CHINOOK SALMON TO
KODIAK MANAGEMENT AREA COMMERCIAL CATCHES
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By

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EXECUTIVE SUMMARY

A coded wire tag (CWT) pilot sampling program was initiated on commercial chinook salmon catches within the Kodiak Management Area (KMA) during 1994. The impetus for this effort centered around conservation concerns for several Cook Inlet chinook stocks, a record 1993 Kodiak area commercial chinook catch of 42,000 fish, coupled with a paucity of stock specific production data for Kodiak chinook systems.

Commercial catch CWT screening was completed for three areas spanning 9 June through 6 August. The commercial chinook catch for these areas during this time period was 16,783 fish, of which 1,806 (10.8%) were inspected for missing adipose fins. A total of 66 fish missing adipose fins were recovered: 41 CWT recoveries were used in analyses; 12 tagged fish were from inordinately large area-catch mixtures (including Afognak, Northwest Kodiak, Southwest Kodiak, and Eastside Districts); nine fish had potentially lost or shed tags, and four fish heads were lost during transport. There were 31 CWT fish recovered from the Westside area and 10 from the Alitak Bay District; none were found from Eastside Kodiak District catches. Tagged fish of Cook Inlet origin were not found, four tag recoveries (9.7%) were of Southeast Alaska origin, 34 (83.0%) from British Columbia, two (4.9%) from Washington, and one (2.4%) from Oregon.

An estimated 5,090 chinook salmon (~ 80% CI 2,927 to 7,253) from marked cohorts were harvested in the catch areas sampled in 1994; 70% of this catch was from the Westside area and 30% from the Alitak Bay District. Several of the Westside area catch contribution estimates although appearing reasonable (1,748 fish 12-18 June, 911 fish 19-25 June, and 785 fish 3-9 July) suffer from low sampling fractions and few tag recoveries which prevent conducting statistical validation given current methods. Additionally, there were three contribution estimates that were larger than the total reported catch, and are obviously overestimates. In light of this being a pilot study and the inherent problems identified with the contribution estimates, caution should be used when citing estimates contained within this report.

INTRODUCTION

The chinook salmon *Oncorhynchus tshawytscha* spawned in waters of the central coast of Alaska owing to their distant ocean migrations are susceptible to fishing mortality from a host of commercial and marine recreational fisheries. These fisheries operate within coastal rivers and streams, marine waters within three miles of the coastline and out to 200 miles in waters under federal jurisdiction. The Central Gulf of Alaska is recognized as an area where wild and hatchery stocks from Alaska, British Columbia, Washington, and Oregon traverse during their ocean migrations (Healey 1991). Excluding inriver fishery harvests, quantitative stock specific production estimates are currently incomplete for Cook Inlet and Kodiak Island wild and hatchery chinook stocks.

Within the Cook Inlet area there are numerous stocks of wild and hatchery chinook salmon most of which are currently recognized as being fully utilized at existing effort levels (Nelson 1996; Figure 1). Spanning 1990-1994, harvests of Cook Inlet chinook salmon from both sport and commercial user groups have averaged 104,322 fish annually. The largest harvest is derived from the freshwater recreational fishery which averages 70,892 fish per year; marine sport fishers harvest 16,275 fish annually, while the commercial net fishery catch averages 17,155 fish (Table 1; Appendix A.1; Ruesch and Fox 1996). Indexed escapement for Cook Inlet stocks during this time frame has averaged 81,790 with total run indices ranging from 161,000 to 221,000 (Nelson 1996; Whitmore et al. 1996; Appendix A.2). Recent declines in escapement indices for several streams within the Susitna River drainage and lower Kenai Peninsula have prompted management restrictions and research programs to examine stock contribution of chinook harvests in marine waters of southcentral Alaska.

The Kodiak Island area has two wild chinook salmon stocks Karluk and Ayakulik Rivers, one introduced run the Dog Salmon R., and one hatchery stock which supports a "put-and-take" sport fishery (Figure 2). Converse to the Cook Inlet area, the Kodiak commercial salmon fishery is the largest harvester of chinook salmon with inriver and marine sport fishers harvesting a small component of the total catch. Commercial chinook salmon harvests occur incidentally to fisheries whose focus during June and July is harvesting surplus production of sockeye and pink salmon. During the recent five year period (1990-94) commercial fishery harvests have averaged 26,000 fish per year and sport users 2,796 fish; average annual escapements approach 23,000 chinook salmon (Schwarz 1996; Brennan et al. 1996).

The marine waters referenced as the Gulf of Alaska (National Marine Fisheries Service-NMFS statistical area designation) encompass among other areas both the Kodiak Archipelago and Cook Inlet. The fisheries that occur in these waters are federally managed for groundfish species with chinook salmon harvested as bycatch. Chinook salmon catch estimates for the entire Gulf of Alaska have averaged 21,293 fish during 1990-1994, ranging from 13,600 (1994) to 37,600 (1991). The Central Gulf component (Figure 3; NMFS areas 620 and 630) of this catch has averaged 19,160 fish ranging from 12,630 (1992) to 33,177 (1991; D. Ackley, ADF&G, Juneau, personal communication).

Temporal and spatial stock composition estimates for individual fisheries operating outside of terminal or inriver waters is information routinely sought by fisheries management agencies. These estimates on short and long time horizons are central to stock preservation, formulating biologically sound management plans, and a suite of other vital applications. The coded wire tag (CWT; Jefferts et al. 1963) came into vogue largely in the 1970's as a means for estimating stock specific contribution rates for hatchery operations, and soon thereafter was applied to wild salmon stocks (Geiger 1990; Shaul and Clark 1990).

Within Cook Inlet, the ADF&G Sport Fish Division during the late 1970's initiated several hatchery programs (Ship Cr. and Deception Cr.) where CWT marked chinook smolts were released. Subsequently, numerous other wild and hatchery stocks have been coded wire tagged as part of a comprehensive chinook salmon stock assessment program. During the early 1990's conservation concerns (realized escapements below established goals) have developed for several of these stocks.

The Kodiak Management Area experienced a record commercial harvest of about 42,000 chinook salmon in 1993 (~ 2x greater than the previous 5 yr. average). This increase in harvest operating in concert with scant knowledge of Kodiak chinook salmon stock specific production, prompted a pilot CWT commercial catch sampling program during 1994. The intent of this program was to determine the frequency of occurrence and origin of non-local chinook salmon caught in the KMA commercial salmon fishery. The following summarizes results of this effort.

METHODS

Kodiak Area and Commercial Fishery

The Kodiak commercial salmon fishery management area spans the entire Kodiak Archipelago from Shuyak Island to the Trinity Islands (southern boundary) and includes the Alaska Peninsula from the northern boundary at Cape Douglas to Kilokak rocks in the south. This area is divided into seven districts and 52 sections, with five species of pacific salmon commercially harvested. During 1994, seven Alaska Board of Fishery (BOF) regulatory management plans were in effect which in essence dictate specifics of inseason management (ADF&G 1996). Generally, 9 June signifies the first fishery opening of the season for a portion of the management area with fisheries targeting early run sockeye salmon. Commercial fishing time is partially dictated by system specific early run sockeye salmon escapement goals; 6 July represents the initial opening date for an area wide pink salmon fishery with fishing time determined by the preseason pink salmon run forecast which varies from two and one half to four days per week (Brennan et al. 1996). Located within the area are 12 to 15 processing facilities that purchase salmon.

Commercial Catch Sampling

Age, length, and sex (ALS) composition sampling of the commercial sockeye salmon catch is accomplished annually from 9 June- 1 September by five field technicians; two stationed on the south end of Kodiak Island (Alitak Bay) and three operating within the City of Kodiak (Nelson and Swanton 1996). Sockeye salmon catches are sampled weekly, during or immediately following commercial fisheries, from four to five districts encompassing seven to nine management sections for the purpose of age composition estimation. Scanning of the commercial chinook salmon catch was an added assigned task for technicians at these locations during 1994.

The commercial fishing areas designated of primary importance for CWT sampling were: the Alitak Bay District combined with the Inner and Outer Ayakulik Sections of the Southwest Kodiak District; Eastside Kodiak District; Northwest Kodiak District; and the Afognak District (Figure 2). As this effort was deemed a pilot study, sample size was determined subjectively to be 300 fish scanned biweekly from each of the aforementioned commercial fishing areas during the period 9 June through 15 August. Sampling of these areas was completed opportunistically and considered of secondary importance to securing ALS samples from the sockeye catch.

Commercially caught chinook salmon delivered to processing facilities were first screened for harvest area by review of tender tally sheets and evaluation of individual harvest receipts (fish tickets). Treatment of fish harvested from several areas which were delivered by a single tender were designated as being of lower priority than those from a single area of interest. Due to the large numbers of management sections that comprise districts with a mixture of gear types (purse seine, set gillnet, and beach seine), gear specific catch sampling was ignored.

Chinook salmon from a harvest area were enumerated, and examined for missing adipose fins. If the desired sample size was not available, all fish were screened for missing fins. Fish identified with a missing adipose fin were set aside until the entire load of fish was screened; heads were removed by processing personnel and retained. For each head presumed to contain a CWT, a uniquely numbered cinch strap was affixed and the head placed into a clear plastic bag with cinch strap number visible. Sampling for CWT marked fish was assumed to be random due largely to the number of processors, tenders responsible for buying fish, and numerous delivery points. Recovered heads were placed in a freezer and shipped bimonthly to the ADF&G tag lab in Juneau. Attendant data forms were completed for each sample and recorded processor name, catch and delivery dates, total catch, number of fish screened, number of heads recovered and cinch strap number(s).

Actual commercial salmon catch numbers by area for the 1994 season were obtained from summary reports of individual harvest receipts (fish tickets). This database was edited for typographical errors, miss-reporting, and omissions by Kodiak area salmon management biologists prior to summary reports being generated. For chinook salmon escapements, daily hand tally counts are obtained via counting weirs on the Karluk, Ayakulik, and Dog Salmon Rivers and are treated as known without error (absolute numbers).

Data Analysis

Initially it was envisioned that estimates of both incidence and contribution by a CWT marked cohort to the commercial catch could be generated biweekly for each sampled area. However, when the program was initiated it was conceded that some *post hoc* combining of area and time strata was probable. In order to generate contribution estimates to the commercial catch (C) of chinook salmon by time period, area, and season, catch numbers derived from the fish ticket system were assumed known, without error. Tagging fractions for individual marked and released cohorts (maintained by the ADF&G tag lab) were also assumed known without error. Catch contributions for each tagged cohort, by area and week, were generated using a generalized form of an equation presented by Clark and Bernard (1987) and more recently by Bernard and Clark (1996) Following suit, let:

$$p_{jk} = C_{jk} \left(\frac{a_{1jk} m_{1jk}}{a_{2jk} m_{2jk} n_{1jk}} \right), \quad (1)$$

referenced as the fishery expansion, then

$$\hat{C}_{ijk} = m_c (p_{jk} \theta_i^{-1}); \quad (2)$$

where:¹

- \hat{C}_{ijk} = commercial chinook catch of cohort (i), from area(j) during week (k),
- θ_i = tagging fraction or proportion of a cohort (i) CWT marked and released,
- a_1 = number of sampled fish with adipose fin missing,
- a_2 = number of heads with fin clip received by tag lab,
- m_1 = number of heads with CWT recovered,
- m_2 = number of heads with CWT decoded,
- m_c = number of CWT marks, cohort specific, and
- n_1 = number of harvested fish examined for adipose fin clip.

Variance estimation was based upon a Poisson approximation tied to several presumed CWT sampling attributes specific to the Kodiak area: commercial catch CWT sampling being considered a random process; and occurrence of CWT marked fish in the fishery being uncommon (Geiger 1990). The formula used for catch contribution variance estimation was:

$$\hat{v}_{cijk} \approx m_c (p_{jk} \theta_i^{-1})^2. \quad (3)$$

For each cohort specific catch contribution estimate by area and time, variance and approximate 80% Confidence Intervals (CI's) were calculated. Confidence intervals were based upon the assumption of a normal distribution. Approximate variance estimates for each tag code by area

¹Estimates for variables encompassed by p_{jk} , θ_i , and cohort specific catches \hat{C}_{ijk} by time and area strata were provided by K. Crandall, ADF&G Commercial fisheries Management and Development Division, Juneau (personal communication).

and time were then summed over strata, and then between strata, to provide area and total variance estimates. Coefficients of variation were also generated (Zar 1984). For this study the covariance term as referenced in Bernard and Clark (1996) was assumed negligible and ignored. In order to address whether temporal and spatial sampling stratification was statistically valid, heterogeneity of CWT data on temporal, spatial, and region of origin levels were tested using a generalized linear model (GLM) with assumed Poisson error (Agresti 1990; Bishop et al. 1995). The GLM equation was of the form:

$$Y_{ijk} = \mu + \alpha_i + \beta_j + \gamma_k + (\alpha\beta)_{ij} + (\alpha\gamma)_{ik} + (\beta\gamma)_{jk} + \varepsilon_{ijl}, \quad (4)$$

where:

α_i = time (assumed continuous), and

β_j = areas (combined SW Afognak, NW and SW Kodiak), and

γ_k =region of origin (Alaska, British Columbia, Washington, Oregon).

A GLM was also used to test if there were differences between CWT marked fish contributions by region of origin or tag code (e.g. Alaska, British Columbia, Washington, and Oregon) for data collected from the KMA commercial salmon fishery and the NMFS groundfish trawl observer database with data extracted from Dahlberg et al. (1995).

RESULTS

Chinook salmon catch sampling summary

During the 1994 commercial fishing season a total of 22,575 chinook salmon were harvested in the KMA. The catch and percent of the total area harvest by district were: Afognak 5,806 fish (25.7%); Northwest Kodiak 6,552 (29.0%); Southwest Kodiak 5,549 (24.6%); Alitak Bay 1,945 (8.6%); Eastside Kodiak 1,130 (5.0%); Northeast Kodiak 308 (1.4%); and the Mainland District 1,285 (5.7%; Table 2; and Figures 4-5). The commercial fishing areas for which CWT sampling was performed represented 93.0% of the total KMA chinook salmon catch in 1994 .

Within the Afognak District the two highest weekly catches occurred during the weeks ending 18 and 25 June when 2,650 and 1,127 chinook salmon were harvested, respectively. These two weeks are well within the bounds of the Karluk and Ayakulik chinook salmon stocks annual run timing in this district (Appendix B.1). Peak weekly catches from the Northwest Kodiak and Southwest Kodiak Districts were also realized during these weeks. Plots relating percent of total escapement (Karluk and Ayakulik Rivers; Figure 2) to catch by day from both the NW and SW Kodiak Districts show that the bulk of the catch was within the peak run timing period (Appendix B.2-B.4); it appears to a degree that the realized catch mirrors local stock escapement timing. The Alitak Bay District peak catch occurred during the week ending 25 June (Appendix B.5), while a majority of the chinook catch within the Eastside Kodiak District was realized after

6 July (Appendix B.6). The number of days that commercial fishing was permitted in each of these areas varied from as few as 10 days to upwards of 21 days during June-July (Brennan et al 1996; Appendix B.1-B.8).

Owing to area mixtures of fish from tender deliveries to processing plants located in Kodiak and Larson Bay, the Southwest Afognak Section, and the Northwest Kodiak and Southwest Kodiak Districts were treated as one large sampling area (referred to as Westside Kodiak; Figure 6). This is converse to the areas initially identified as being targeted for sampling. Commercial catches were sampled over seven weeks beginning on 10 June and ending on 6 August, however two weekly catches were not sampled (weeks of 26 June-2 July and 10-16 July). The total catch during this time frame was 17,273 chinook salmon, however CWT sampling was conducted during the period when 14,196 fish were caught (Table 3). A total of 1,330 fish were scanned for coded wire tags which represents a sampling fraction of 9.1% (range 1.4% to 12.9%); 50 coded wire tags were recovered of which 37 (74.0%) were secured during the weeks 12-18 and 19-25 June.

In the Alitak Bay District during 9 June through 6 August, 1,865 chinook salmon were caught. Sampling was conducted during six weekly periods representing 82% (1,524 fish) of the 9 June-6 August harvest (Table 2). There were 433 fish inspected for CWT marks and 16 tagged fish recovered, of which 11 were from catches which occurred during 19-25 June and 3-9 July. The overall sampling fraction for this area was 37.3% (range from 0.3% to 64.4%; Table 3).

Within the Eastside Kodiak District, 9 June- 6 August, only three weekly periods were sampled: 3-9 July, 10-16 July, and 31 July-6 August. The total catch realized from 9 June-6 August was 1,060 fish of which 640 fish (60.4%) were captured during the three weeks sampled. There were 43 fish sampled for CWT marks which equates to a sampling fraction of 6.7%. No CWT marked chinook salmon were recovered from this area.

There were 66 fish missing adipose fins (presumed CWT marked fish) that were recovered from all areas during 9 June through 6 August, however there were only 41 CWT recoveries employed for catch contribution estimation (Table 4). There were 12 tagged fish deemed to be from catch mixtures of limited utility; 9 fish that had potentially lost or shed tags prior to sampling or were naturally missing a fin, and an additional four presumed tagged fish whose heads were lost during transport of which one was previously unreported (Appendix C).

The GLM analyses of the CWT recoveries showed that tag origin (Alaska, British Columbia, Washington, Oregon) of marked fish recovered was highly significant ($\Delta dev=20.99871$, $df=24$, $P<0.0001$; Table 5) and can likely be attributed to the dominance of British Columbia fish. The test conducted on time (when treated as a continuous random variable) based solely on numbers of CWT fish recovered was also significant ($\Delta dev=16.15706$, $df=23$, $P=0.02778$) which eludes to the obvious, that the number of recoveries decreased over time, regardless of area. Recoveries of marked fish regardless of origin, obtained from the Westside Kodiak area versus recoveries from the Alitak Bay District were also different from one another ($\Delta dev=12.46394$, $df=22$, $P=0.054637$). Tests of the interaction between tag origin and time was marginally significant ($\Delta dev=6.30493$, $df=19$, $P=0.104125$), whereas interactions between origin-area, and time-area

were not statistically significant ($\Delta dev=3.64804, df=16, P=0.447604$ and $\Delta dev=3.48706, df=15, P=0.688250$ respectively). These analyses infer that although harvest area, and time when the sample was collected, will influence the number of CWT fish encountered, the relative proportions between the two areas do not change significantly with time or area.

A test (GLM) performed on the combined numbers of CWT marked fish by origin from the commercial salmon fishery and from the NMFS trawl fishery (Appendix D) varied little and were not statistically different from one another ($\Delta dev=7.30737, df=4, P<0.0001$) Additional tests (Pearson's χ^2 , and Fisher's exact test) support this result ($P=0.8640, P=0.8553, \text{ and } P=0.8770$ for each test), suggesting that the mixture of stocks contributing to both the Kodiak commercial salmon fishery as well as the NMFS trawl fishery are similar.

CWT Marked Cohort Catch Contribution Estimates

From the Kodiak areas where CWT sampling occurred an estimated 5,089 fish (approximate 80% CI 2,927 to 7,253) were from marked cohorts, representing 32.5% of the sampled harvest (Tables 3-4). There were four tag recoveries of Southeast Alaska origin (9.7%), 34 from British Columbia (83.0%), two from Washington (4.9%), and one (2.4%) from Oregon (Table 4; Appendix D). The usable tag recoveries by commercial fishing area were 31 from the Westside Kodiak area and 10 from the Alitak Bay District. As mentioned previously no tagged fish were recovered from the Eastside Kodiak District.

For the Westside Kodiak area a majority of the marked fish recovered were of British Columbia origin. Marked cohorts from Alaska, Washington, and Oregon were present during the week of 12-18 June, however by 3-9 July, only British Columbia and Alaska marked cohorts were estimated as present (Figure 7). Catch contributions from CWT recoveries during 12-18 June were 1,748 fish (approximate 80% CI 264 to 3,232) representing 30.4% of the overall chinook catch. During 19-25 June an estimated 910 fish from marked cohorts (80% CI 386 to 1,435) were harvested representing 20.4% of the total catch; additionally 785, 76, and 1,134 fish were estimated for the weeks 3-9 July, 17-23 July, and 24-30 July (Table 4; Figure 8). The total marked cohort contribution estimate for this area was 4,655 (approximate 80% CI 2,517 to 6,793) from a total catch of 14,619 fish or 31.8%. The coefficients of variation for each weekly estimate ranged from 44% to 95% with the area total CV being 36% (Table 4).

In the Alitak Bay District marked fish recoveries were all of British Columbia origin. The estimated contribution of CWT marked chinook salmon to the commercial catch was 435 fish (80% CI 109 to 761) over the three weeks from which samples were secured (Figure 9). The catch during this time period was 640 of which the estimated marked fish contribution was 68%. The coefficients of variation for this areas contribution estimates were 63%, 83%, and for the area total 58%.

DISCUSSION

The adjustments made regarding sampling frequency (weekly versus biweekly) and combining catch areas for estimation merely reflect the complex structure of the Kodiak salmon fishery. The ability of samplers to obtain unmixed samples in most cases was largely dependent upon which commercial fishing areas were open and whether catches became mixed by the time they were available for sampling. Tender schedules and area specific catch magnitudes were both influential and would likely continue to be, given similar fishing effort, time, and run sizes. It is apparent from this pilot study that the larger the area strata or how proximate the area is to a processing facility (e.g. the Alitak Bay or Eastside Kodiak Districts) largely dictated success of obtaining area specific samples. Sampling was terminated prior to 15 August because of the low catch rates (approximately less than 200 fish per area) for most areas.

The assumption of the catch numbers being known without error has not been addressed for chinook salmon within the Kodiak area but has been assessed for sockeye. Vining and Barrett (1994) evaluated the accuracy of individual harvest receipts (fish tickets) considering both area and time and found negligible error in average weight and numbers of fish reported. Therefore this assumption is realistic but untested for chinook.

The incidence and origin of CWT marked fish in the KMA commercial salmon fishery and from the Gulf of Alaska groundfish trawl fishery should not be surprising given the geographical location of these fisheries relative to the known ocean distributions of these stocks (Healey 1991). The vulnerability of these stocks to harvest within the Kodiak salmon fishery in 1994 could be an artifact of prevailing ocean conditions that have since dissipated or continue to persist. This contention is partially supported by the test comparing region of origin of CWT marked fish from the salmon and trawl fisheries suggesting that these fisheries were operating on the same stock mixtures. There is mounting evidence relating large scale climatic change to existing ocean production and hence salmonid distribution (Francis 1993; Welch et al 1995; and Bottom et al. 1996). Additional data need to be collected to address this question. There were no CWT marked fish of Cook Inlet origin recovered from the Kodiak salmon fishery during 1994 even though sufficiently large (similar to some British Columbia hatchery tagging fractions) numbers of marked fish were available.

The contribution estimates are questionable both numerically and in terms of the confidence bounds. There was one temporal strata from the Westside Kodiak area and two from the Alitak Bay District where the estimated contributions of marked cohorts were greater than the assumed total number of fish caught. For the Westside Kodiak area, period 24-30 July the actual catch was 711 fish, whereas the estimated contribution from CWT marked cohorts was 1,134 fish or 1.59 times greater than the assumed known harvest. In the two instances where this occurred within the Alitak Bay District (3-5 July and 31 July-6 August), the estimates were 1.33 times and 1.47 times the actual catches. Additionally, the realized coefficients of variation were all well above 20-25%; the only estimate approximating this subjective threshold level was the overall total at 33%. Shaul and Clark (1990) using Monte Carlo simulations found significant positive bias (overestimation) and high variability for sampling fractions that were 25% to 50% and for a

minimum of 10 tag recoveries for an individual stock. Additionally, the approximate confidence intervals reported herein were generated assuming that the contribution estimates are normally distributed. However, Shaul and Clark (1990) and Geiger (1990) both suggest that confidence intervals generated in this fashion are typically unrealistically small when faced with small sampling fractions and low numbers of tag recoveries. At present, no acceptable statistical approach exists with which to adequately address contribution estimates nor confidence bounds with the data limitations of this study. The estimates reported herein supersede all previously circulated preliminary contribution estimates generated with this data; existing catch contribution estimates should be cited cautiously.

As mentioned previously, the complex nature of the commercial salmon fishery within Kodiak waters precludes attempting to generate estimates of CWT contributions on any finer scale than a district level. Future numerical estimates could benefit greatly from increasing the sampling fraction to a minimum of 20% for each area and time strata, if not higher. It would also be desirable to have enough tag recoveries so that statistical validation using Monte Carlo simulation or the like would be possible.

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Table 1. Chinook salmon harvest and escapement indices from the Cook Inlet area, 1990-1994.

Year	Sport Harvest ^a		Total	Commercial ^b Harvest	Escapement Indices ^c	Harvest plus
	Marine	Freshwater				Escapement Indices ^d
1990	11,474	46,301	57,775	16,105	88,000	161,880
1991	10,823	56,169	66,992	13,535	81,215	161,742
1992	14,679	73,196	87,875	17,158	66,565	171,598
1993	23,970	101,996	125,966	18,719	77,248	221,933
1994	20,430	76,796	97,226	20,260	95,921	213,407
Average	16,275	70,892	87,167	17,155	81,790	186,112

^a Numbers were extracted from the statewide sport fisheries angler survey (see Howe et al. 1995).

^b Numbers derived from Ruesch and Fox 1996.

^c Escapement indices were extracted from (Hammarstrom 1996a, 1996b; Whitmore et al. 1996; and Nelson 1994). During 1990-94 escapement indices derived from aerial surveys conducted on the Susitna River Drainage were 53,389, 41,588, 34,681, 31,241, and 21,325, respectively. Aerial survey escapement indices represent some unknown fraction of the total annual escapement and are therefore considered in most cases to be minimum values (Cousens et al. 1982; Pahlke 1995, 1996).

^d These values do not represent total run (catch plus escapement) as the harvest contains chinook salmon of hatchery origin while escapements are indices not estimated total escapement. These values represent minimum numbers of fish estimated as present in Cook Inlet and also includes fish harvested in marine waters that are not of Cook Inlet origin.

Table 2. Commercial catch and average weight of chinook salmon harvested by district and week, Kodiak Management Area, 1994

Statistical Week	Week Ending Date	Commercial Fishing District													
		Afognak		Northwest Kodiak		Southwest Kodiak		Allitak Bay		Eastside Kodiak		Northeast Kodiak		Mainland	
		Commercial Catch	Average Weight	Commercial Catch	Average Weight	Commercial Catch	Average Weight	Commercial Catch	Average Weight	Commercial Catch	Average Weight	Commercial Catch	Average Weight	Commercial Catch	Average Weight
24	11-Jun	7	15.9	416	12.5	0	0.0	261	14.3	0	0.0			0	0.0
25	18-Jun	2,650	10.8	1,812	12.5	1,283	13.7	202	19.2	77	13.1			0	0.0
26	25-Jun	1,127	10.4	1,012	14.8	2,313	14.8	558	17.1	81	12.8	8	10.7	276	17.5
27	2-Jul	481	10.5	585	14.7	730	15.5	390	19.7	135	14.1			205	15.1
28	9-Jul	636	6.2	737	14.4	735	13.3	212	18.3	503	12.7	277	5.9	325	13.0
29	16-Jul	172	12.1	633	15.8	53	19.6	101	19.2	75	15.5	19	8.5	228	16.2
30	23-Jul	112	13.8	430	16.7	103	17.3	37	24.7	23	24.9	0	0	190	14.0
31	30-Jul	218	12.7	262	18.2	231	16.9	43	21.6	104	18.5	1	3	57	18.4
32	6-Aug	185	16.3	309	17.8	41	16.8	61	24.3	62	17.9	3	16	0	0.0
33	13-Aug	88	10.7	95	15.0	45	13.7	0	0.0	0	0.0	0	0	0	0.0
34	20-Aug	84	5.4	77	15.6	0	0.0	32	19.0	69	19.0	0	0	0	0.0
35	27-Aug	19	18.8	95	19.0	3	19.3	17	23.6	1	18.0			0	0.0
36	3-Sep	225	16.5	36	18.8	10	11.9	20	18.8	0	0.0			4	15.8
37	10-Sep	0	0.0	0	0.0	4	18.3	11	20.1	0	0.0			0	0.0
38	17-Sep	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0			0	0.0
39	24-Sep	0	0.0	50	17.4	0	0.0	0	0.0					0	0.0
Totals		5,806	12.3	6,552	15.9	5,549	15.9	1,945	20.0	1,130	16.7	308	8.8	1,285	15.6

Table 3. Commercial catch areas sampled for coded wire tag marked chinook salmon within the Kodiak Management Area, 9 June through 6 August, 1994.

District/Area	Sample Date	Week Represented	Commercial Catch	No. Fish Sampled (Scanned)	Presumed CWT marked Recoveries	Sampling Fraction	Sampling Location
Southwest Afognak S.	10-Jun	5-11 June	423	6	0	1.4%	Kodiak& Larson Bay
Northwest Kodiak D.	16-17 Jun	12-18 June	5,745	614 ^a	24	10.7%	Kodiak& Larson Bay
Southwest Kodiak D.	24-Jun	19-25 June	4,452	348	13	7.8%	Kodiak & Larson Bay
		26 June-2 July	1,796	^b	^b		
	7-9 Jul	3-9 July	2,108	273	9	13.0%	Kodiak & Larson Bay
		10-16 July	858	^b	^b		
	21-22 Jul	17-23 July	645	44	2	6.8%	Larson Bay & Kodiak
	30-Jul	24-30 July	711	14	2	2.0%	Kodiak & Larson Bay
	4-6 August	31 July-6 August	535	31	0	5.8%	Kodiak
			17,273 ^c				
Area/District Subtotal			14,196 ^d	1,330	50	9.4%	
Alitak Bay		5-11 June	261	^b	^b		
	18-19 Jun	12-18 June	202	57	1	28.2%	Alitak Bay
	20-21 Jun	19-25 June	558	251	6	45.0%	Alitak Bay
	28-Jun	26 June-2 Jul	390	1	1	0.3%	Alitak Bay
	8-Jul	3-9 July	212	27	5	12.7%	Alitak Bay
	13-16 Jul	10-16 July	101	65	1	64.4%	Alitak Bay
		17-23 July	37	^b	^b		
		24-30 July	43	^b	^b		
	5-7 Aug	31 July-6 Aug	61	32	2	52.5%	Alitak Bay
			1,865 ^c				
Area/District Subtotal			831 ^d	433	16	37.3%	
Eastside Kodiak		5-11 June	0	^b	^b		
		12-18 June	77	^b	^b		
		19-25 June	81	^b	^b		
		26 June-2 Jul	135	^b	^b		

Table 3. (page 2 of 2)

District/Area	Sample Date	Week Represented	Commercial Catch	No. Fish Sampled (Scanned)	No. Tagged Fish Recovered	Sampling Fraction	Sampling Location
	9-Jul	3-9 July	503	18	0	3.6%	Alitak Bay
	15-Jul	10-16 July	75	14	0	18.7%	Alitak Bay
		17-23 July	23	^b	^b		
		24-30 July	104	^b	^b		
	6-8 Aug	31 July-6 Aug	62	11	0	17.7%	Alitak Bay
Area/District Subtotal			1,060^c	43	0	6.7%	
			18,333^c				
Total			15,667^d	1,806	66	11.5%	

^a There were 35 fish from the Eastside Kodiak District mixed with this sample, they were assumed to be of negligible influence, however catch contribution estimates were not generated for 12 of the 24 tag recoveries.

^b Sampling for cwt marked fish was not conducted.

^c These numbers represent both sampled and unsampled catches by area for the time periods referenced.

^d Values reflect sampled catches that were used for contribution estimates and those where no CWT tagged fish recovered.

Table 4. Contribution estimates of coded wire tagged marked cohorts to the commercial catch of areas sampled within the KMA, 1994.

Commercial Catch Area	Statistical Week	Date	Tag Code	Coded Wire Tag Origin	State or Province	Number of Tags Recovered	Commercial Catch	Number Examined	Sampling Fraction	Expansions			Coefficient of Variation	Poisson Variance	Approximate 80% Confidence Intervals	
										Fishery	Tagging	Total			Lower	Upper
Southwest Afognak S.	25	12-18 June	21048	Marble River PIP	British Columbia	1	5,745	614	0.106875544	16.44	3.75	62	100	3,800.72	-17.36	140.66
Northwest Kodiak Dst.	25	12-18 June	180837	Snootli Creek	British Columbia	1	5,745	614	0.106875544	16.44	1.17	19	100	369.98	-5.42	43.89
Southwest Kodiak Dst.	25	12-18 June	634527	W. Hanford Reach	Washington	1	5,745	614	0.106875544	16.44	1.01	17	100	275.71	-4.67	37.88
	25	12-18 June	20516	Masset CDP	British Columbia	1	5,745	614	0.106875544	16.44	1.00	16	100	270.27	-4.63	37.51
	25	12-18 June	43625	Medvejje	Alaska	1	5,745	614	0.106875544	16.44	10.53	173	100	29,968.18	-48.74	394.97
	25	12-18 June	180354	Snootli Creek	British Columbia	1	5,745	614	0.106875544	16.44	12.93	213	100	45,185.66	-59.85	484.99
	25	12-18 June	180248	Clayoquot CDP	British Columbia	1	5,745	614	0.106875544	16.44	4.88	80	100	6,436.40	-22.59	183.04
	25	12-18 June	75626	Dexter Ponds Hat.	Oregon	1	5,745	614	0.106875544	16.44	3.02	50	100	2,465.00	-13.98	113.28
	25	12-18 June	21208	Robertson Cr.	British Columbia	1	5,745	614	0.106875544	16.44	68.06	1,119	100	1,251,951.53	-315.03	2552.84
Subtotal						9	5,745	614				1,748	68	1,340,723	264	3,232
Southwest Afognak S.	26	19-25 June	180805	Robertson Cr.	British Columbia	1	4,452	348	0.078167116	12.05	25.18	303	100	92,063.09	-85.43	692.27
Northwest Kodiak Dst.	26	19-25 June	180826	Snootli Creek	British Columbia	1	4,452	348	0.078167116	12.05	4.41	53	100	2,823.91	-14.96	121.24
Southwest Kodiak Dst.	26	19-25 June	21546	Conuma R.	British Columbia	1	4,452	348	0.078167116	12.05	11.24	135	100	18,344.54	-38.13	309.02
	26	19-25 June	180827	Snootli Creek	British Columbia	1	4,452	348	0.078167116	12.05	8.35	101	100	10,123.88	-28.33	229.56
	26	19-25 June	180229	Robertson Cr.	British Columbia	1	4,452	348	0.078167116	12.05	1.01	12	100	148.12	-3.43	27.77
	26	19-25 June	634117	Humtulpis Hat.	Washington	1	4,452	348	0.078167116	12.05	1.02	12	100	151.07	-3.46	28.04
	26	19-25 June	43604	Crystal Lake	Alaska	1	4,452	348	0.078167116	12.05	7.90	95	100	9,062.09	-26.80	217.19
	26	19-25 June	21428	Snootli Creek	British Columbia	1	4,452	348	0.078167116	12.05	15.44	186	100	34,615.35	-52.38	424.49
	26	19-25 June	32209	Little Port Walter	Alaska	1	4,452	348	0.078167116	12.05	1.02	12	100	151.07	-3.46	28.04
Subtotal						9	4,452	348				911	45	167,483	386	1,435
Southwest Afognak S.	28	3-9 July	180458	Nitinat River	British Columbia	1	2,108	273	0.129506641	6.74	37.53	253	100	63,984.82	-71.22	577.12
Northwest Kodiak Dst.	28	3-9 July	180248	Clayoquot CDP	British Columbia	1	2,108	273	0.129506641	6.74	4.88	33	100	1,081.83	-9.26	75.04
Southwest Kodiak Dst.	28	3-9 July	180443	Conuma River	British Columbia	1	2,108	273	0.129506641	6.74	9.09	61	100	3,753.60	-17.25	139.78
	28	3-9 July	21545	Conuma River	British Columbia	1	2,108	273	0.129506641	6.74	9.16	62	100	3,811.63	-17.38	140.86
	28	3-9 July	20517	Masset CDP	British Columbia	1	2,108	273	0.129506641	6.74	1.00	7	100	45.43	-1.90	15.38
	28	3-9 July	180837	Snootli Creek	British Columbia	1	2,108	273	0.129506641	6.74	1.17	8	100	62.19	-2.22	17.99
	28	3-9 July	43647	Medvejje	Alaska	1	2,108	273	0.129506641	6.74	14.30	96	100	9,289.49	-27.14	219.90
	28	3-9 July	180354	Snootli Creek	British Columbia	1	2,108	273	0.129506641	6.74	12.93	87	100	7,594.81	-24.54	198.83
	28	3-9 July	21319	Conuma River	British Columbia	1	2,108	273	0.129506641	6.74	26.43	178	100	31,733.22	-50.15	406.43
Subtotal						9	2,108	273				785	44	121,357	339	1,232
Southwest Afognak S.	30	17-23 July	180201	Gold River PIP	British Columbia	1	645	44	0.068217054	11.54	1.02	12	100	138.55	-3.31	26.86
Northwest Kodiak Dst.	30	17-23 July	24940	Gold River PIP	British Columbia	1	645	44	0.068217054	11.54	5.61	65	100	4,191.19	-18.23	147.71
Southwest Kodiak Dst.																
Subtotal						2	645	44				77	66	4,330	-6	161
Southwest Afognak S.	31	24-30 July	180203	Gold River PIP	British Columbia	1	711	14	0.019690577	38.79	1.65	64	100	4,096.45	-18.02	146.03
Northwest Kodiak Dst.	31	24-30 July	180327	Nitinat River	British Columbia	1	711	14	0.019690577	38.79	27.59	1,070	100	1,145,362.50	-301.32	2,441.75
Southwest Kodiak Dst.																
Subtotal						2	711	14				1,134	95	1,149,459	-240	2,508

-Continued-

Table 4. (page 2 of 2)

Commercial Catch Area	Statistical Week	Date	Tag Code	Coded Wire Tag Origin	State or Province	Number of Tags Recovered	Commercial Catch	Number Examined	Sampling Fraction	Expansions			Coefficient of Variation	Poisson Variance	Approximate 80% Confidence Intervals	
										Fishery	Tagging	Total			Lower	Upper
Alitak Bay	26	19-25 June	20130	Clayoquot CDP	British Columbia	1	558	251	0.449820789	1.03	1.93	2	100	3.95	-0.56	4.54
Alitak Bay	26	19-25 June	21533	Kilimat River	British Columbia	1	558	251	0.449820789	1.03	12.07	12	100	154.56	-3.50	28.36
Alitak Bay	26	19-25 June	21553	Robertson Creek	British Columbia	1	558	251	0.449820789	1.03	33.16	34	100	1,166.55	-9.62	77.93
Alitak Bay	26	19-25 June	20249	Snootli Creek	British Columbia	1	558	251	0.449820789	1.03	13.05	13	100	180.67	-3.78	30.67
Subtotal						4	558	251				62	63	1,506	12	112
Alitak Bay	28	3-9 July	21549	Robertson Creek	British Columbia	1	212	27	0.127358491	9.19	25.48	234	100.00	54,831.47	-65.93	534.25
Alitak Bay	28	3-9 July	20128	Clayoquot CDP	British Columbia	1	212	27	0.127358491	9.19	1.93	18	100.00	314.59	-4.99	40.47
Alitak Bay	28	3-9 July	20129	Clayoquot CDP	British Columbia	1	212	27	0.127358491	9.19	1.92	18	100.00	311.34	-4.97	40.26
Alitak Bay	28	3-9 July	82853	Nitinat River	British Columbia	1	212	27	0.127358491	9.19	1.48	14	100.00	184.99	-3.83	31.03
Subtotal						4	212	27				289	83.31	55,842	-19	585
Alitak Bay	32	31 July-6 Au	21553	Robertson Creek	British Columbia	1	61	32	0.524590164	2.63	33.16	87	100.00	7605.72	83.81	90.61
Alitak Bay	32	32 July-6 Au	20614	Sooke River PIP	British Columbia	1	61	32	0.524590164	2.63	1.01	3	100.00	7.06	2.66	2.66
Subtotal						2	61	32				90	97.09	7,613	-22	202
GRAND TOTAL						41	15,667^a	1,603				5,090	33.16	2,848,113	2,927	7,253

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^a This value reflects all catches where contribution estimates were generated and sampled catches where no tagged fish were found.

Table 5. Statistics generated from hypothesis tests conducted on CWT data collected during 1994 from the Kodiak commercial salmon fishery and the NMFS groundfish trawl fishery using the generalized linear model.

Model	Change in Deviance (Δ dev)	df	Pr (χ^2)
Kodiak CWT			
Null (μ)	83.8174	27	
Tag Origin (γ)	20.9987	24	0.0000
Time-Stat.wk (α)	16.1571	23	0.0278
Harvest Area (β)	12.4639	22	0.0546
Origin:Time ($\gamma:\alpha$)	6.3049	19	0.1041
Origin:Area ($\gamma:\beta$)	3.6480	16	0.4476
Time:Area ($\alpha:\beta$)	3.4871	15	0.6882
NMFS CWT			
Null (μ)	94.0096	7	
Tag Origin (γ)	7.3089	4	0.0000
Harvest Area (β)	0.7389	3	0.0104
Origin:Area($\gamma:\beta$)	0.0000	0	0.8640

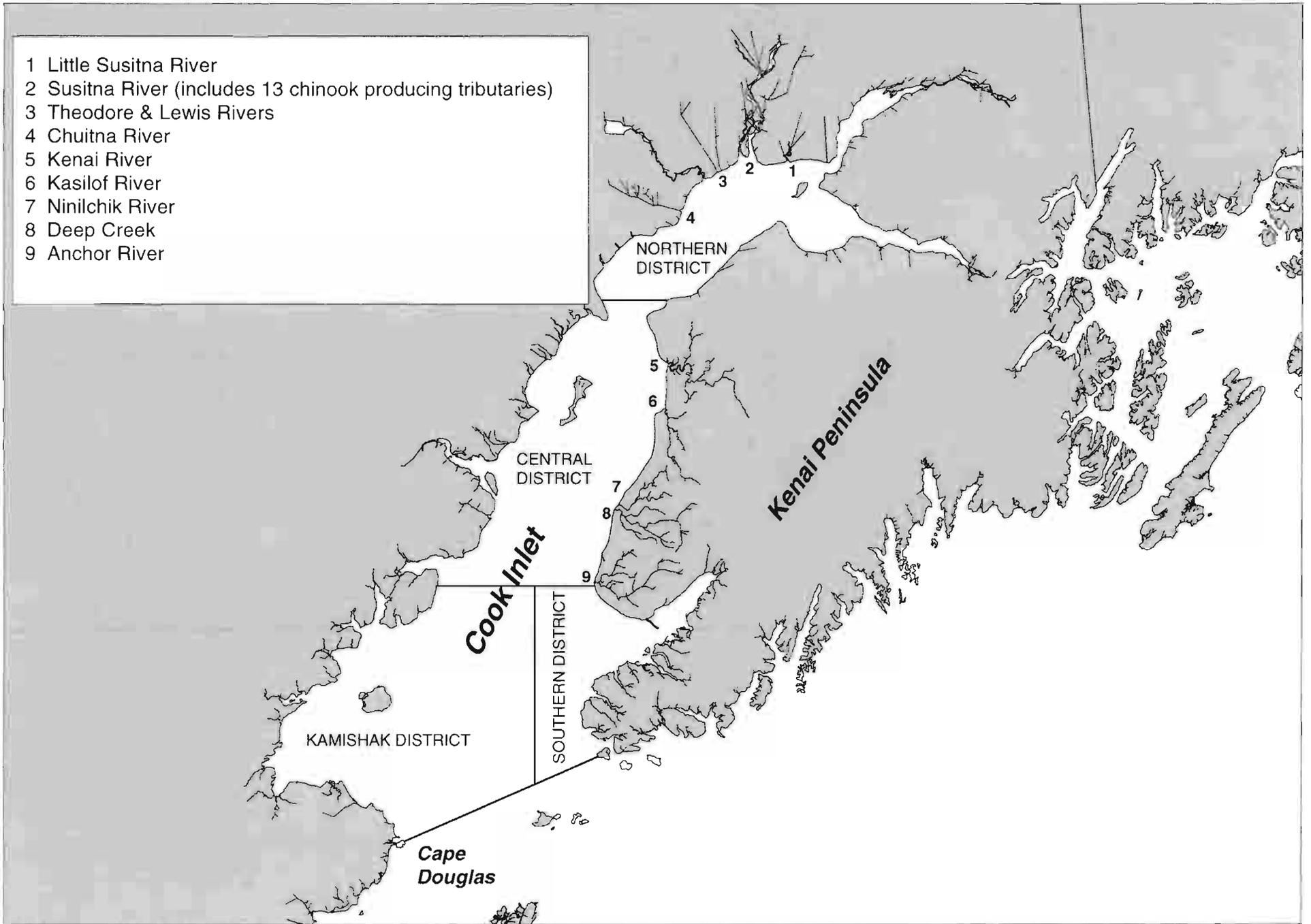


Figure 1. Map of the Cook Inlet area showing location of chinook salmon systems.

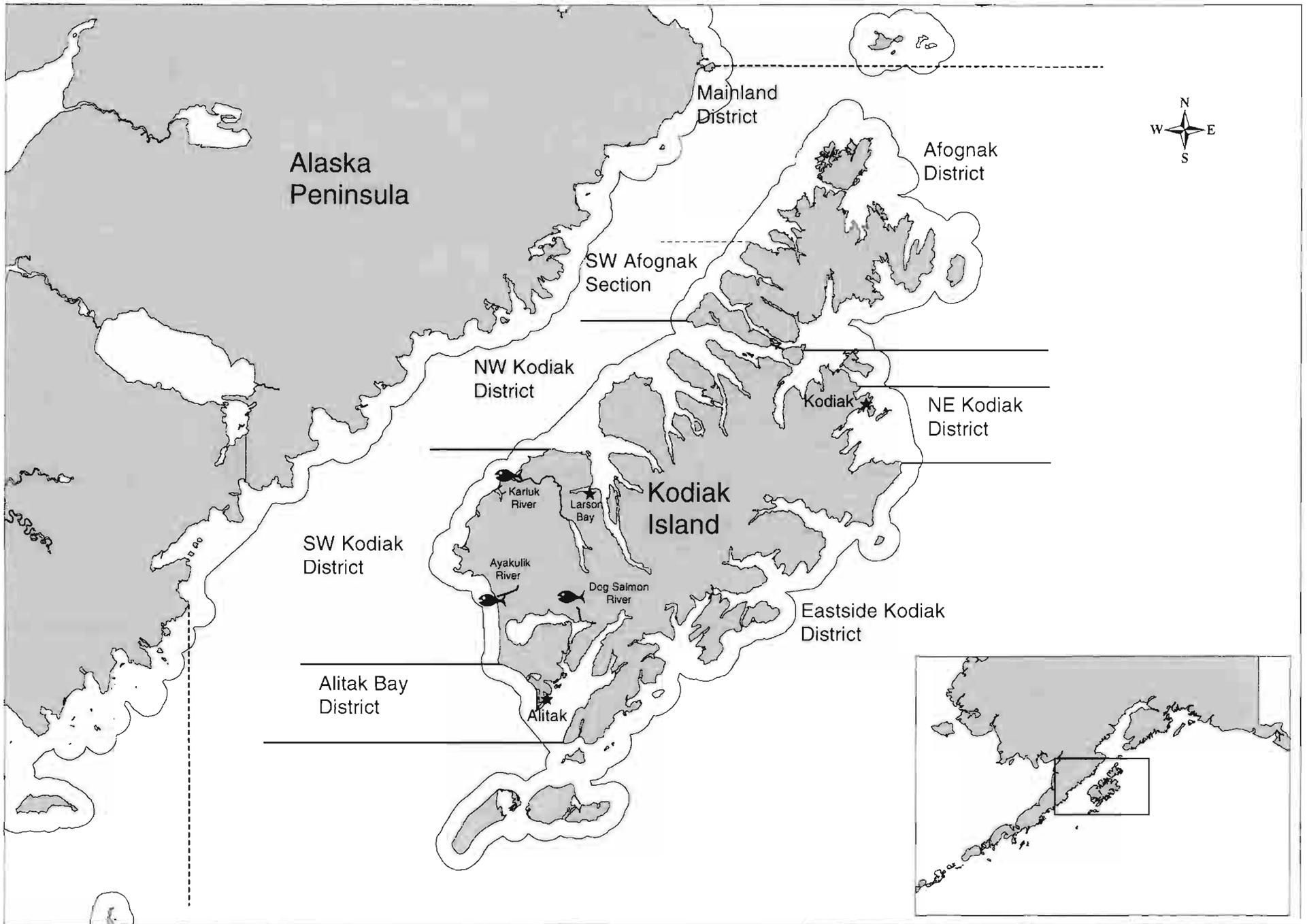


Figure 2. Map of the Kodiak Management Area depicting commercial fishing districts, processing facility locations, and chinook salmon spawning streams.

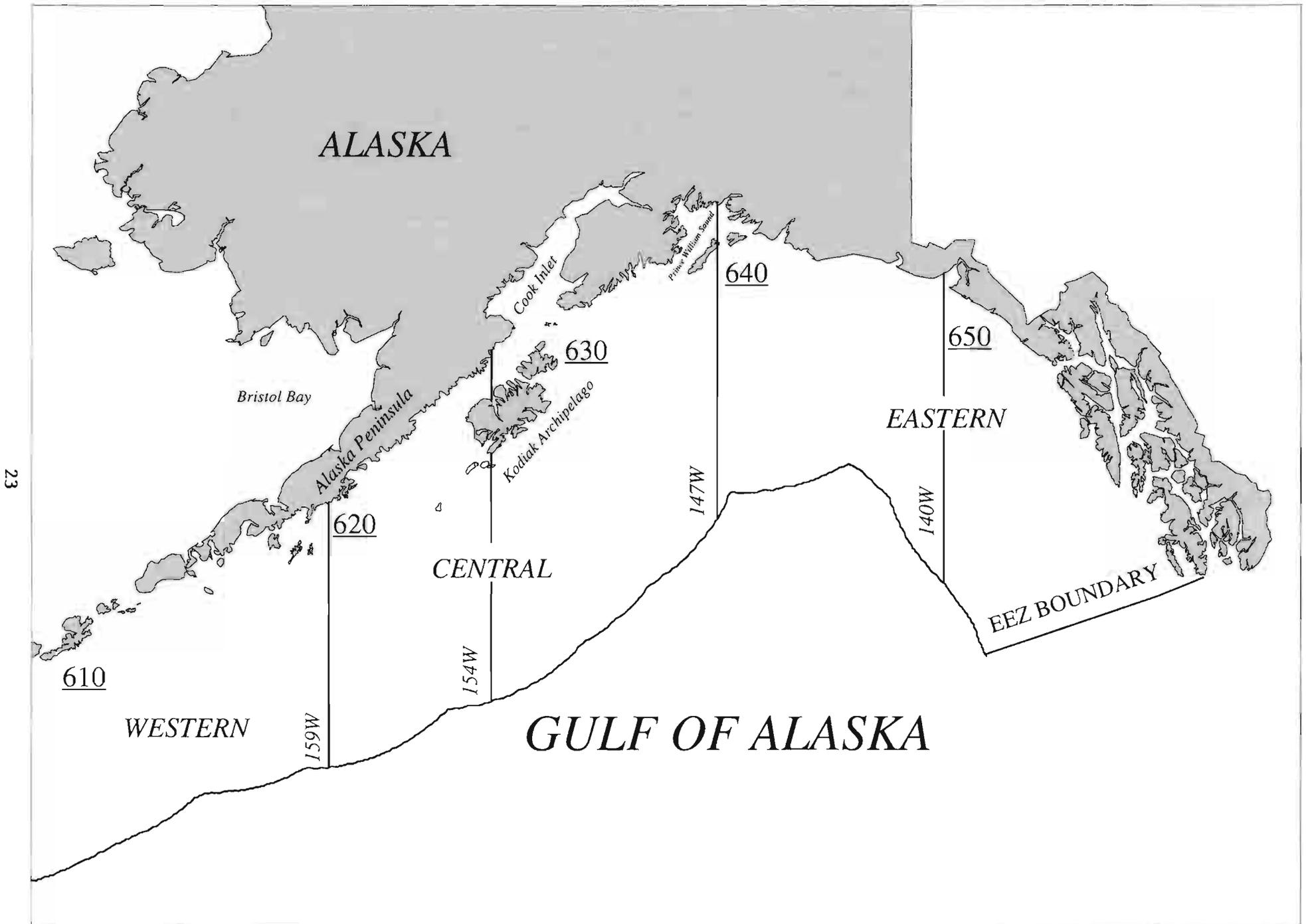


Figure 3. Map showing the Gulf of Alaska and National Marine Fisheries Service area designations.

Kodiak Management Area Average Chinook Catch by District (1988, 1990-93)

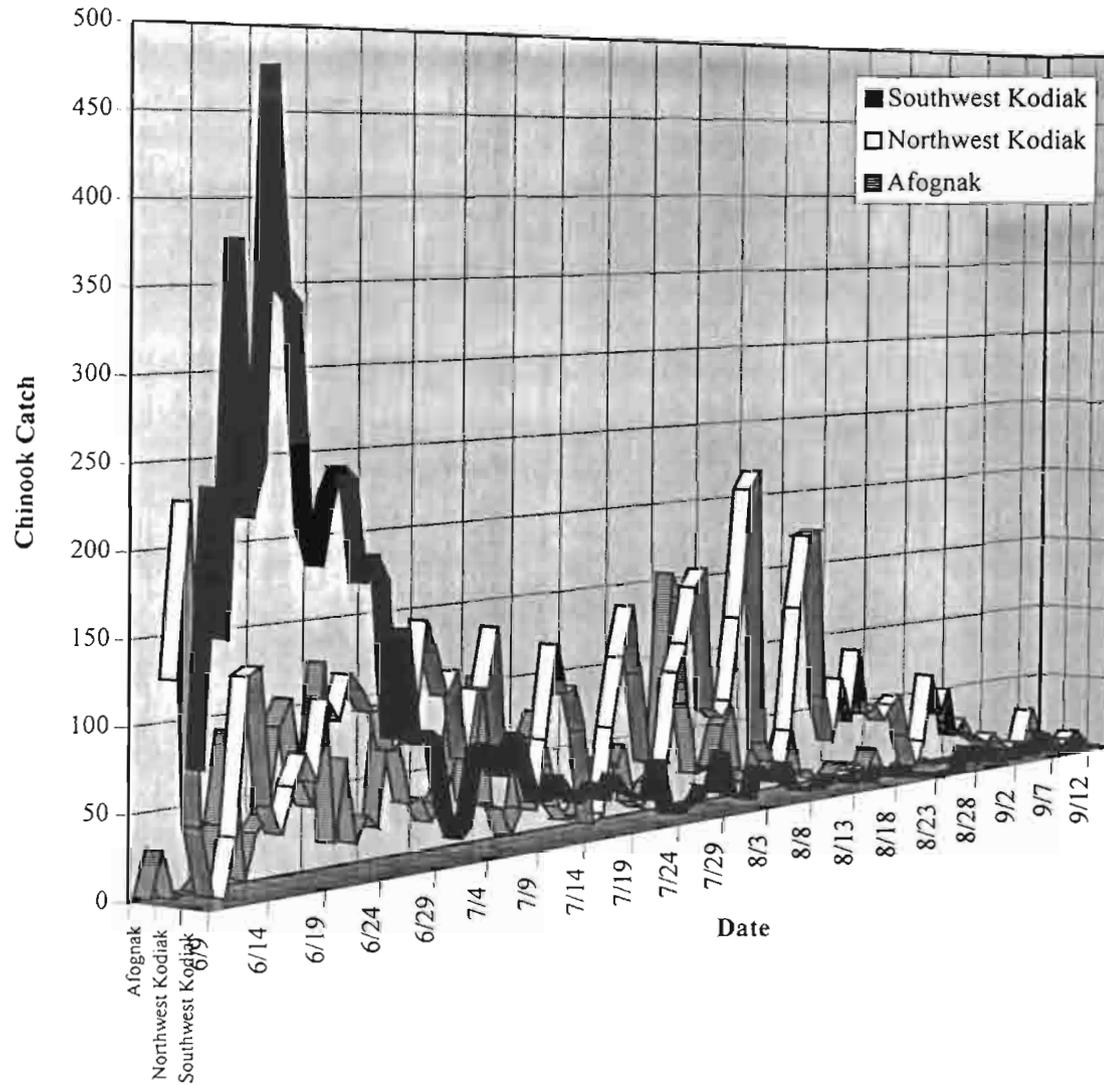


Figure 4. Average chinook salmon commercial catch by day within the Afognak, Northwest Kodiak, and Southwest Kodiak Districts, 1988, 1990-1993.

Kodiak Management Area Average Chinook Catch by District (1988, 1990-93)

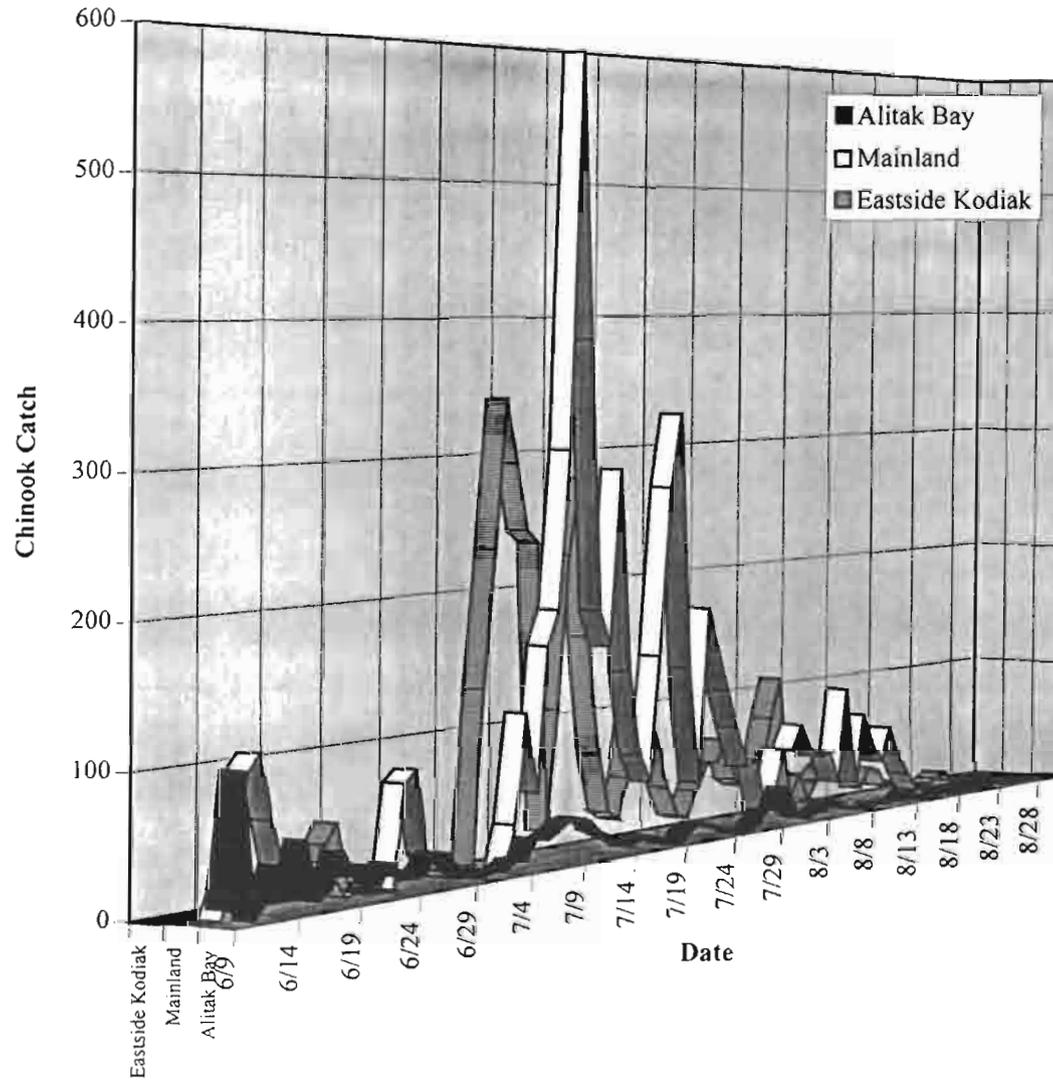


Figure 5. Average chinook salmon commercial catch by day within the Eastside Kodiak, Mainland, and Alitak Bay Districts, 1988, 1990-1993.

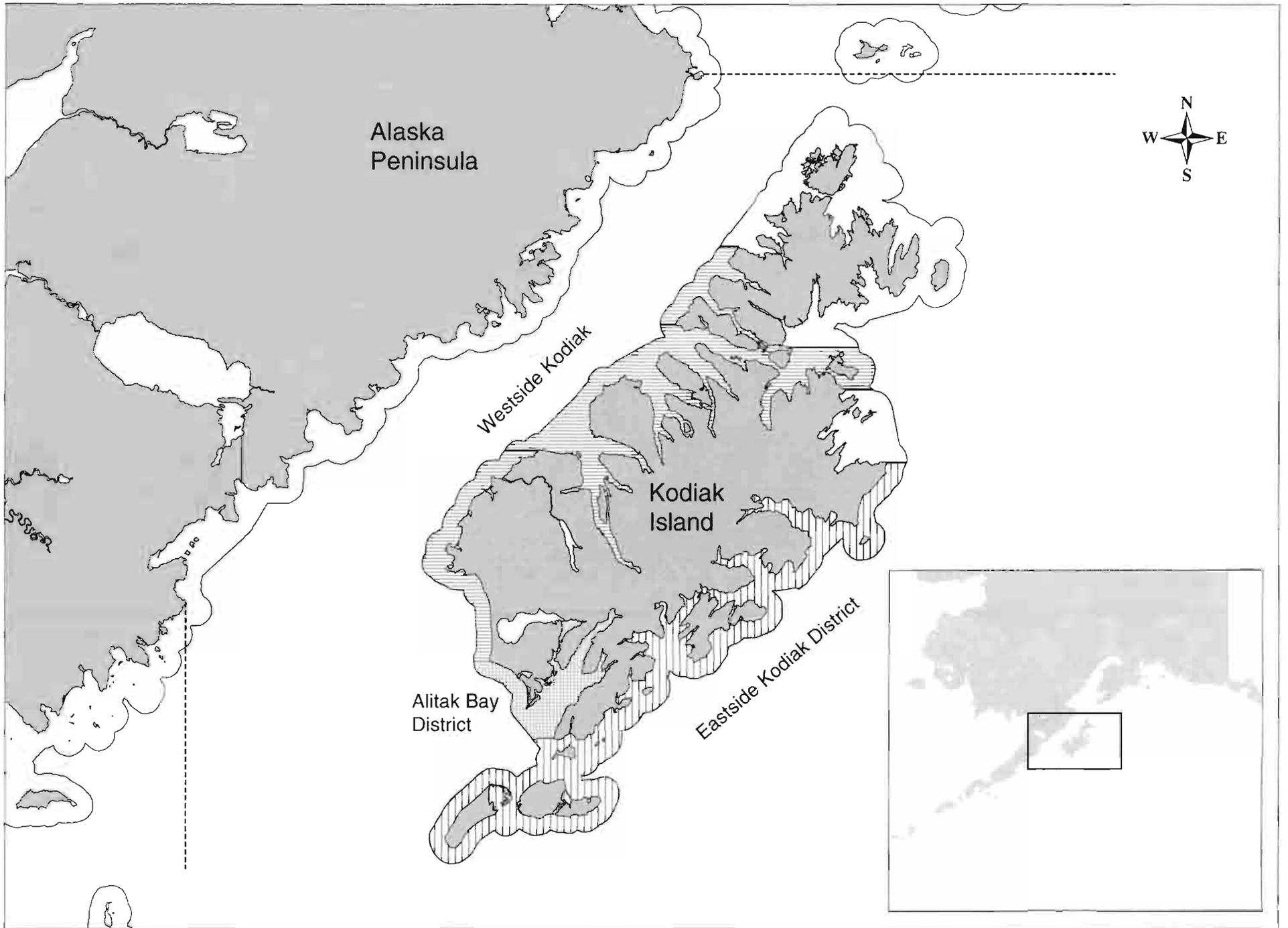


Figure 6. Commercial fishing areas sampled for CWT marked chinook salmon during 9 June - 6 August, 1994.

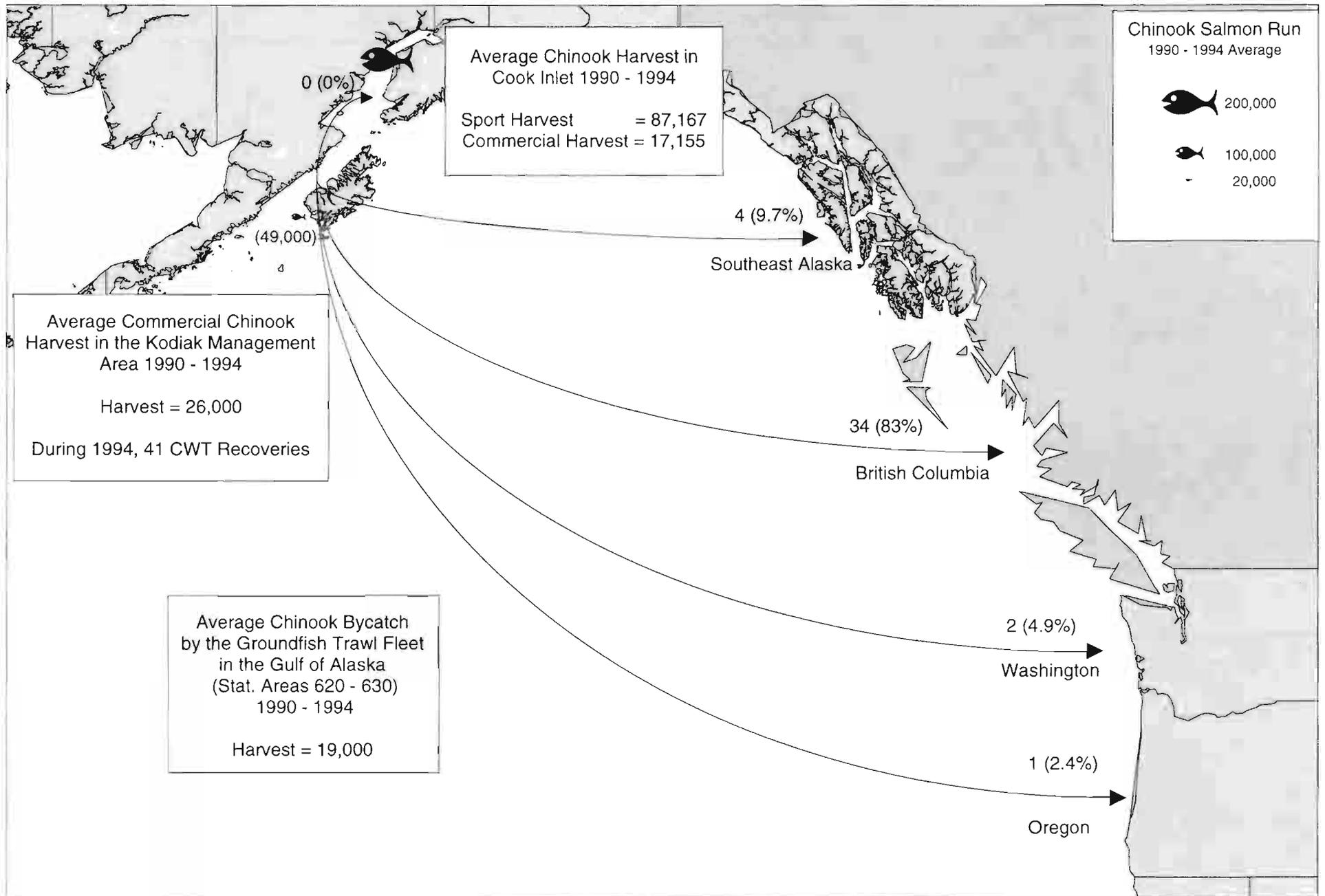


Figure 7. Map showing 1990-1994 average harvests and approximate run sizes for chinook salmon within the Cook Inlet and Kodiak areas, the Gulf of Alaska groundfish trawl survey average chinook salmon bycatch, and origin of CWT recoveries from the 1994 Kodiak commercial salmon fishery.

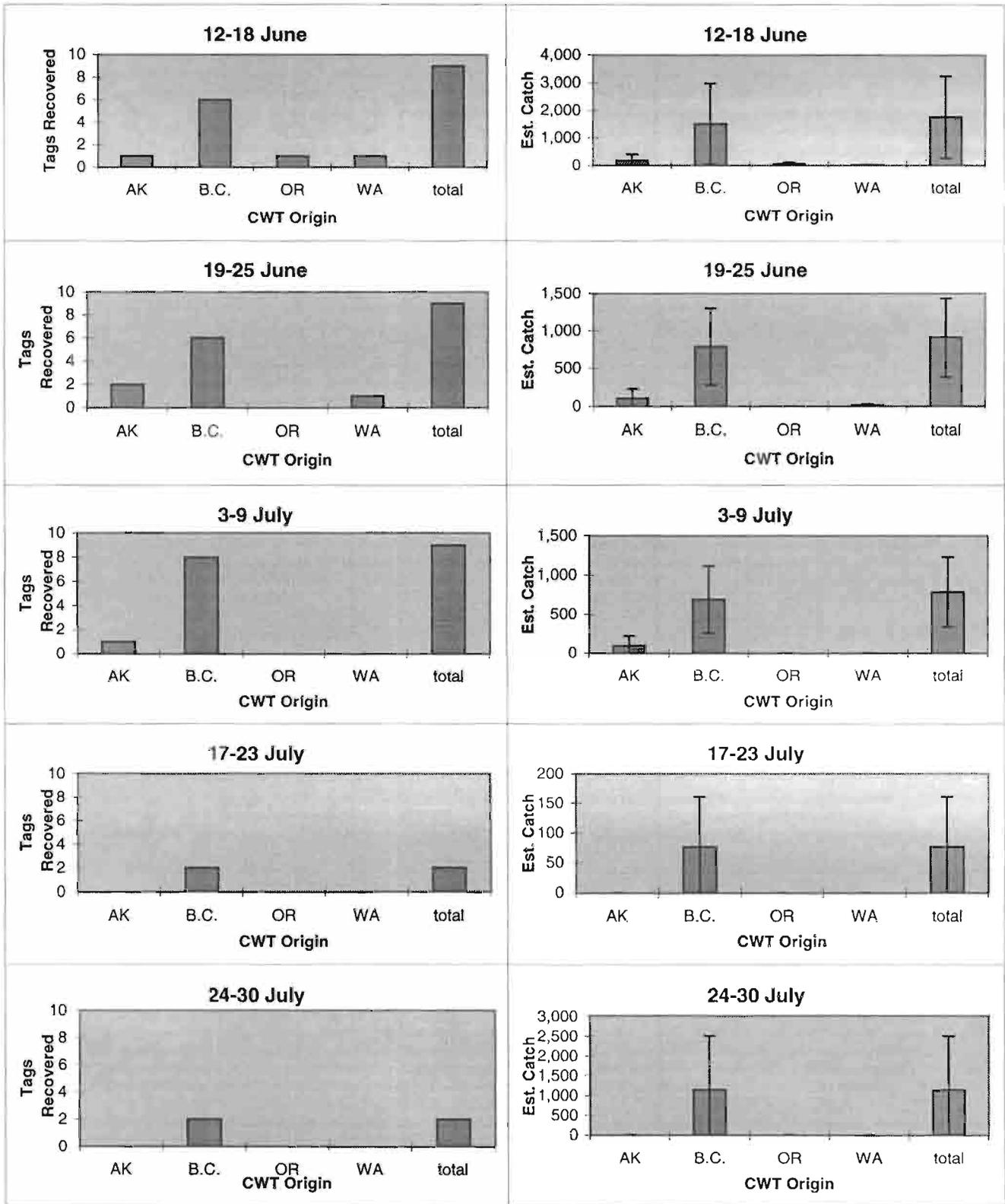


Figure 8. Tag recoveries and estimated catch contributions by week and CWT origin within the Westside Area of the KMA during 1994. Error bounds represent approximate 80% confidence intervals (truncated at 0).

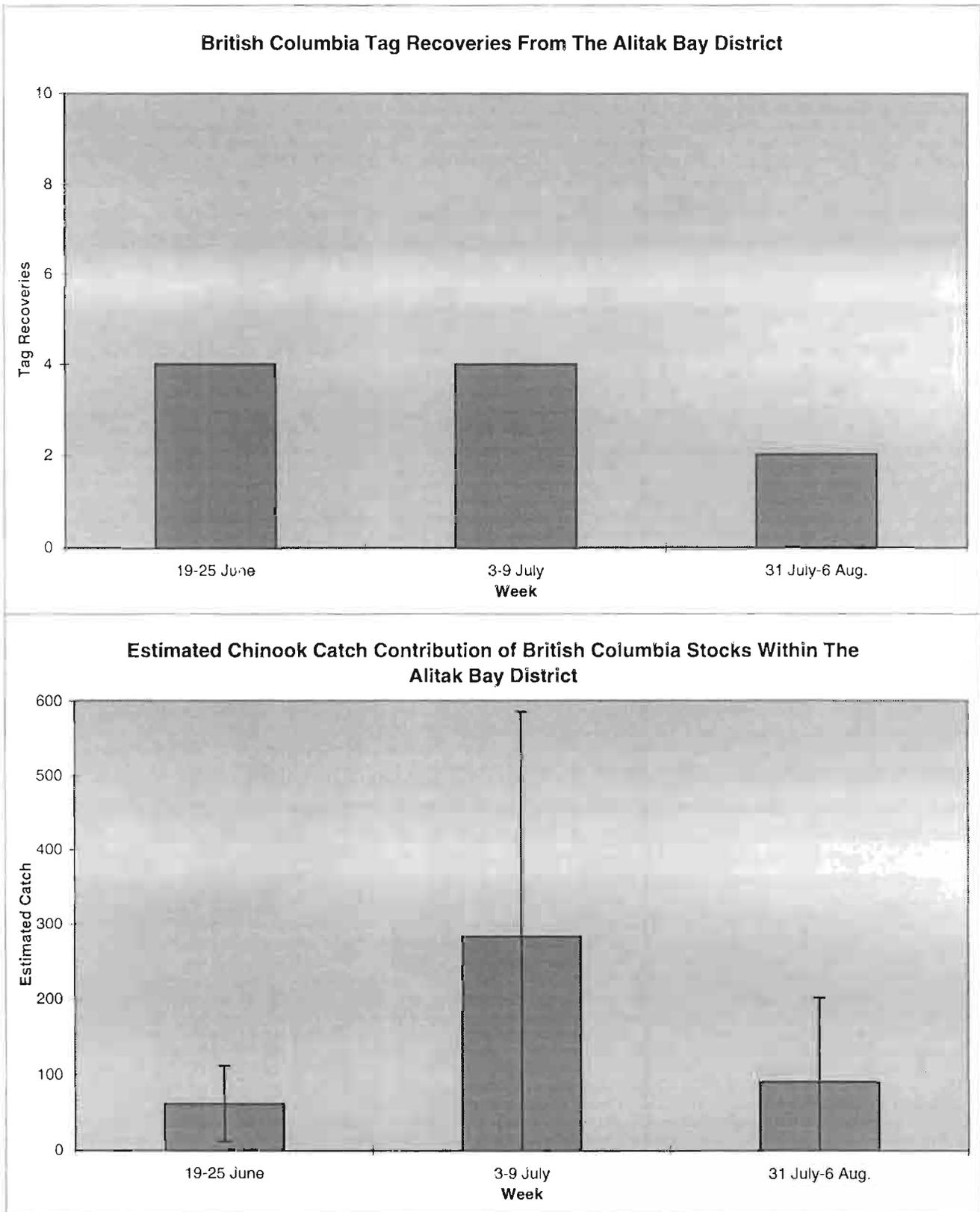


Figure 9. Tag recoveries and estimated contributions by week of British Columbia stocks within the Alitak Bay District of the KMA during 1994. Error bounds represent approximate 80% confidence intervals (truncated at 0).

APPENDIX

Appendix A.1 Marine and freshwater estimated sport harvests of chinook salmon within specific areas of Cook Inlet, 1990-94.

	1990		1991		1992		1993		1994	
	Marine	Fresh	Marine	Fresh	Marine	Fresh	Marine	Fresh	Marine	Fresh
Knik Arm	51	1,971	152	2,125	24	3,945	152	3,450	20	4,283
Anchorage	12	445	30	1,139	109	2,339	71	2,970	204	2,504
E. Susitna		9,423		9,083		21,307		22,688		14,970
W. Cook Inlet	157	19,537	157	22,605	182	19,853	193	23,161	377	11,854
Kenai River ^a		3,160		4,489		4,201		13,849		12,690
Kenai River ^b		5,019		5,345		5,913		16,463		15,018
Kenai Pen. ^c		6,746		11,383		15,638		19,415		15,477
Kenai Pen. ^d	11,385		10,484		14,364		23,559		19,351	
SubTotal	11,474	46,301	10,823	56,169	14,679	73,196	23,970	101,996	20,430	76,796
Total	58,779		68,534		90,800		131,092		99,304	

^a Non-guided sport fisher harvest

^b Guided sport fisher harvest

^c Freshwater sport harvest

^d Marine sport harvest excluding the Seward area from the kenai Peninsula marine total as reported in the statewide harvest survey (Howe et al. 1995).

Appendix A.2. Annual indexed and estimated total chinook salmon escapements within the Cook Inlet Area, 1990-94.

Year	West-side Susitna ^a (aerial survey)	East-side Susitna ^a (aerial survey)	Total Susitna	Kenai River ^b		Anchor R. Deep Cr. Niniichik	Total Unadjusted
				Early	Late (sonar)		
1990	28,042	25,347	53,389	8,745	21,086	4,780	88,000
1991	19,425	22,163	41,588	9,925	27,662	2,040	81,215
1992	18,899	15,782	34,681	8,558	23,326		66,565
1993	18,028	13,213	31,241	11,975	34,032	5,961	77,248
1994	9,421	11,904	21,325	18,514 ^c	53,281 ^d	2,801	95,921
Average	18,763	17,682	36,445	11,543	31,877	3,896	81,790

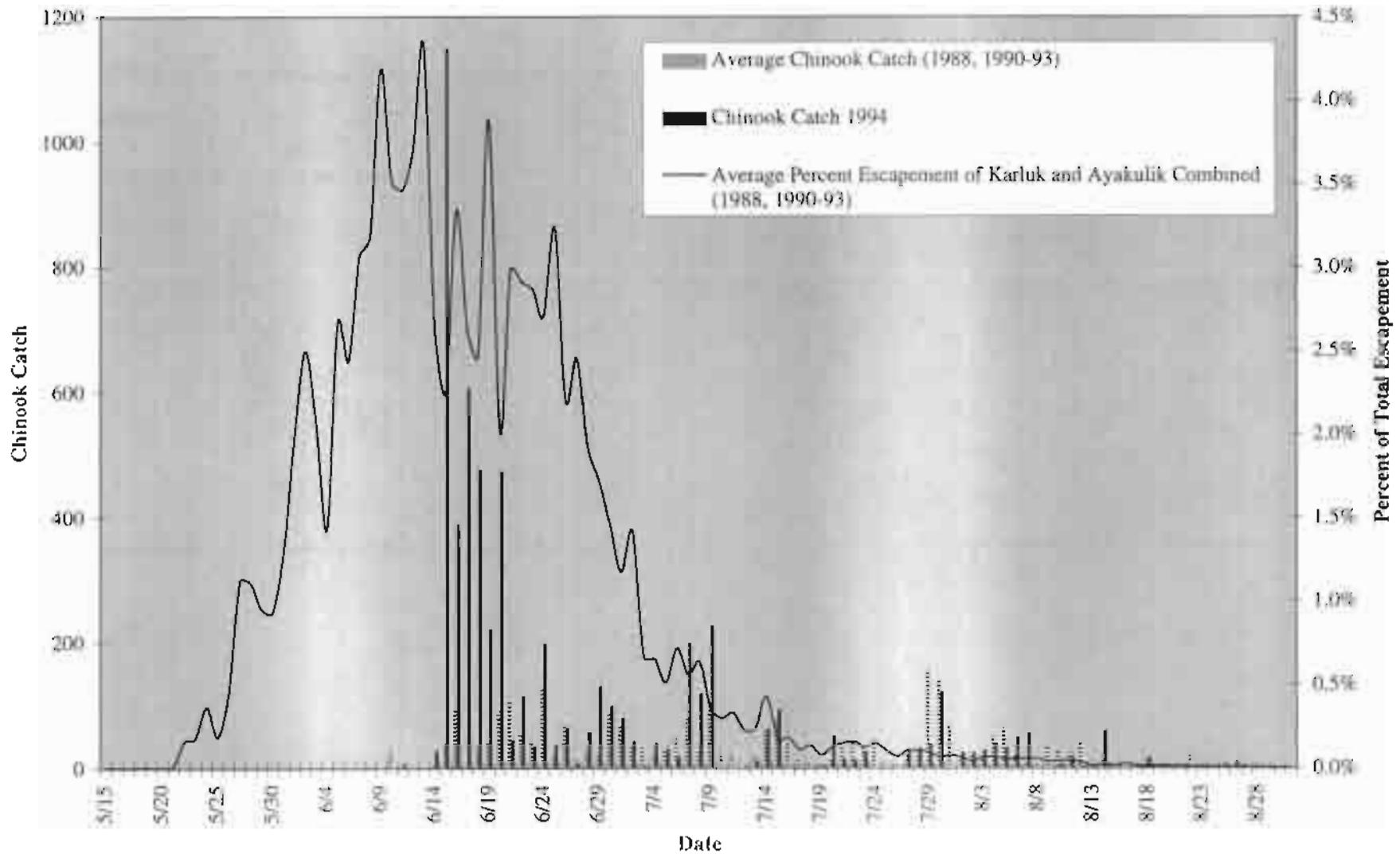
^a Escapement indicies extracted from Whitmore et al. (1996).

^b Escapement indicies derived from Nelson (1994).

^c Values extracted from Hammarstrom (1996a).

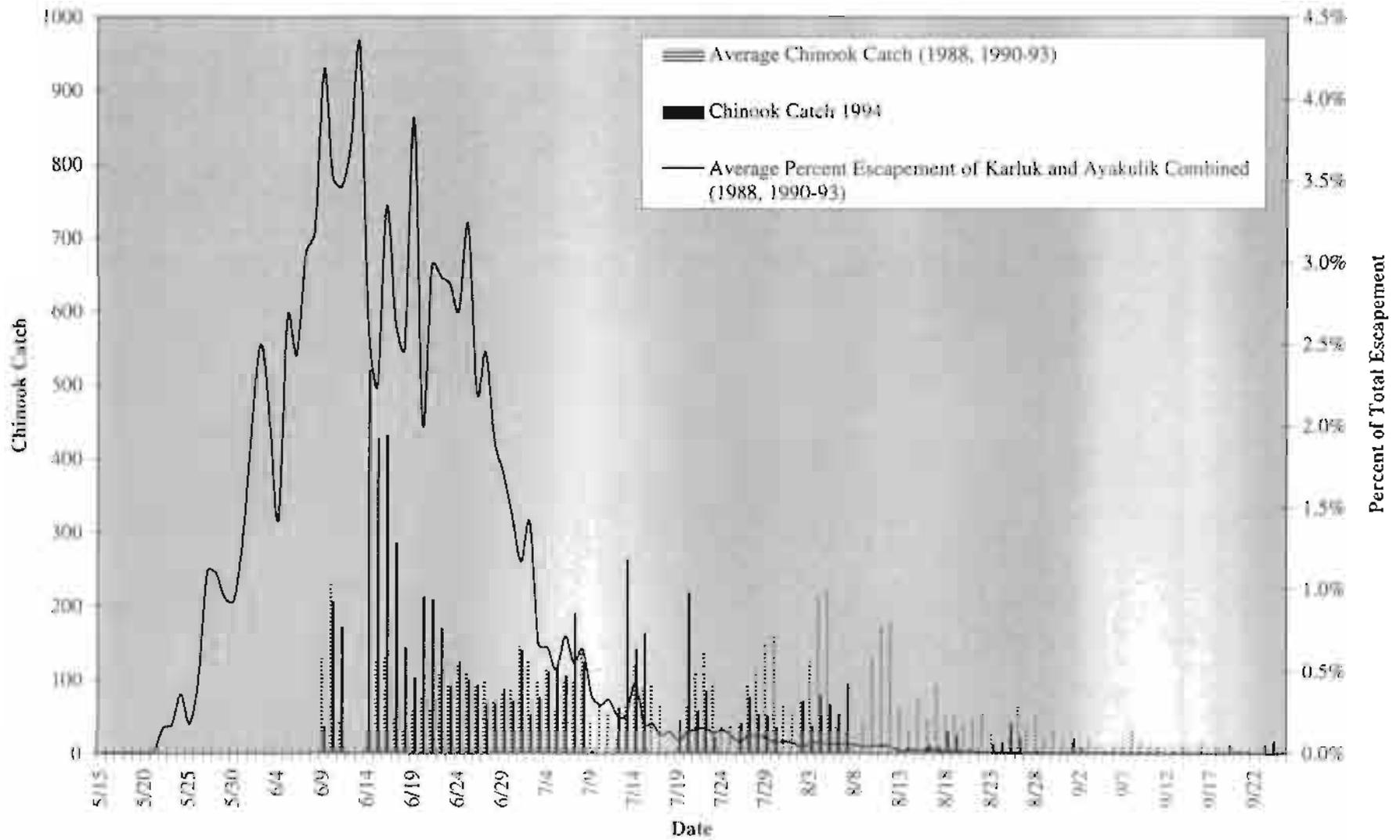
^d Values extracted from Hammarstrom (1996b).

Afognak District Chinook Catch



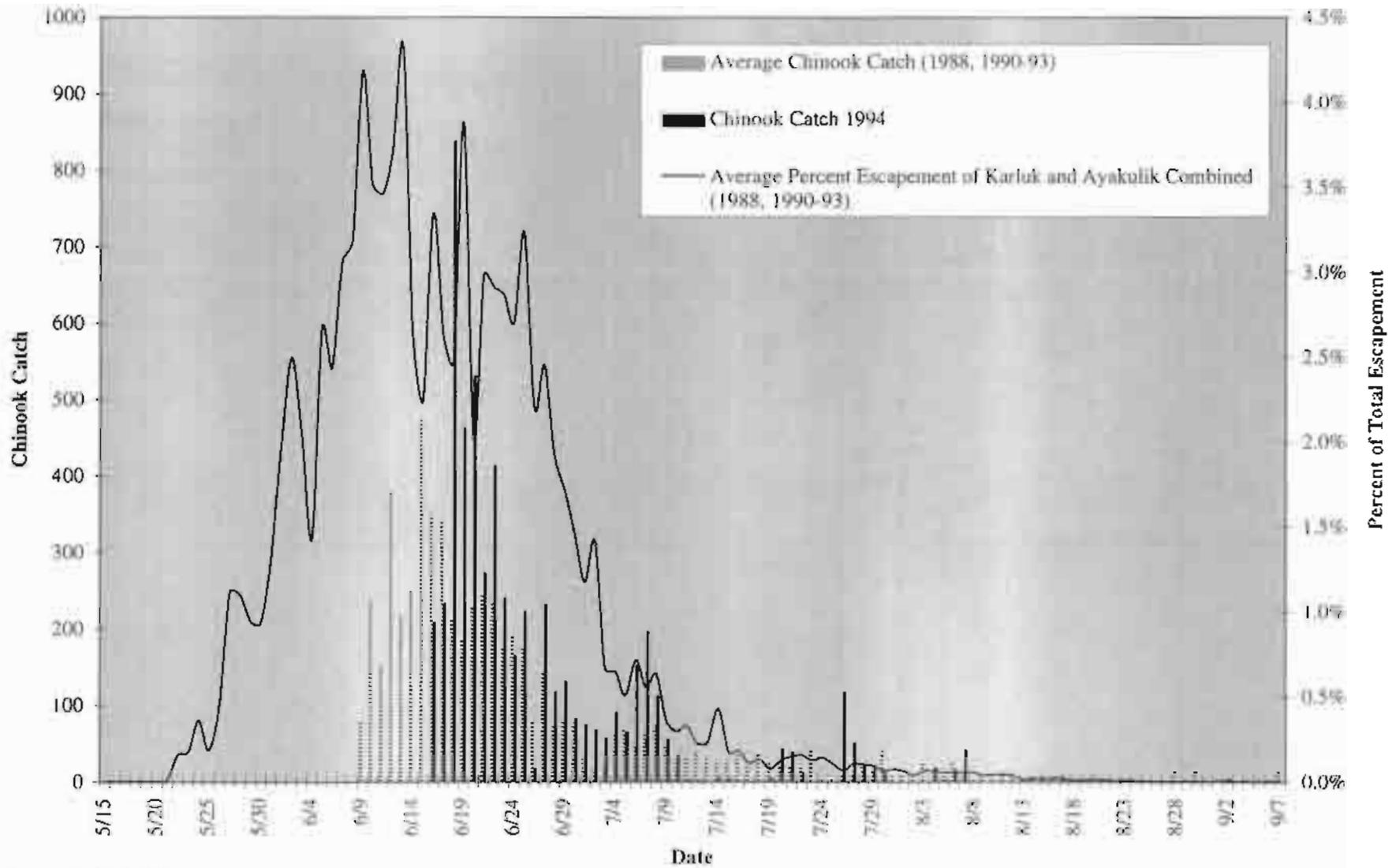
Appendix B.1. The average (1988, 1990-93; and 1994) chinook salmon commercial catch by day from the Afognak District compared to the average (unlagged weir counts) daily percent of chinook escapements to the Karluk and Ayakulik Rivers combined.

Northwest Kodiak District Chinook Catch



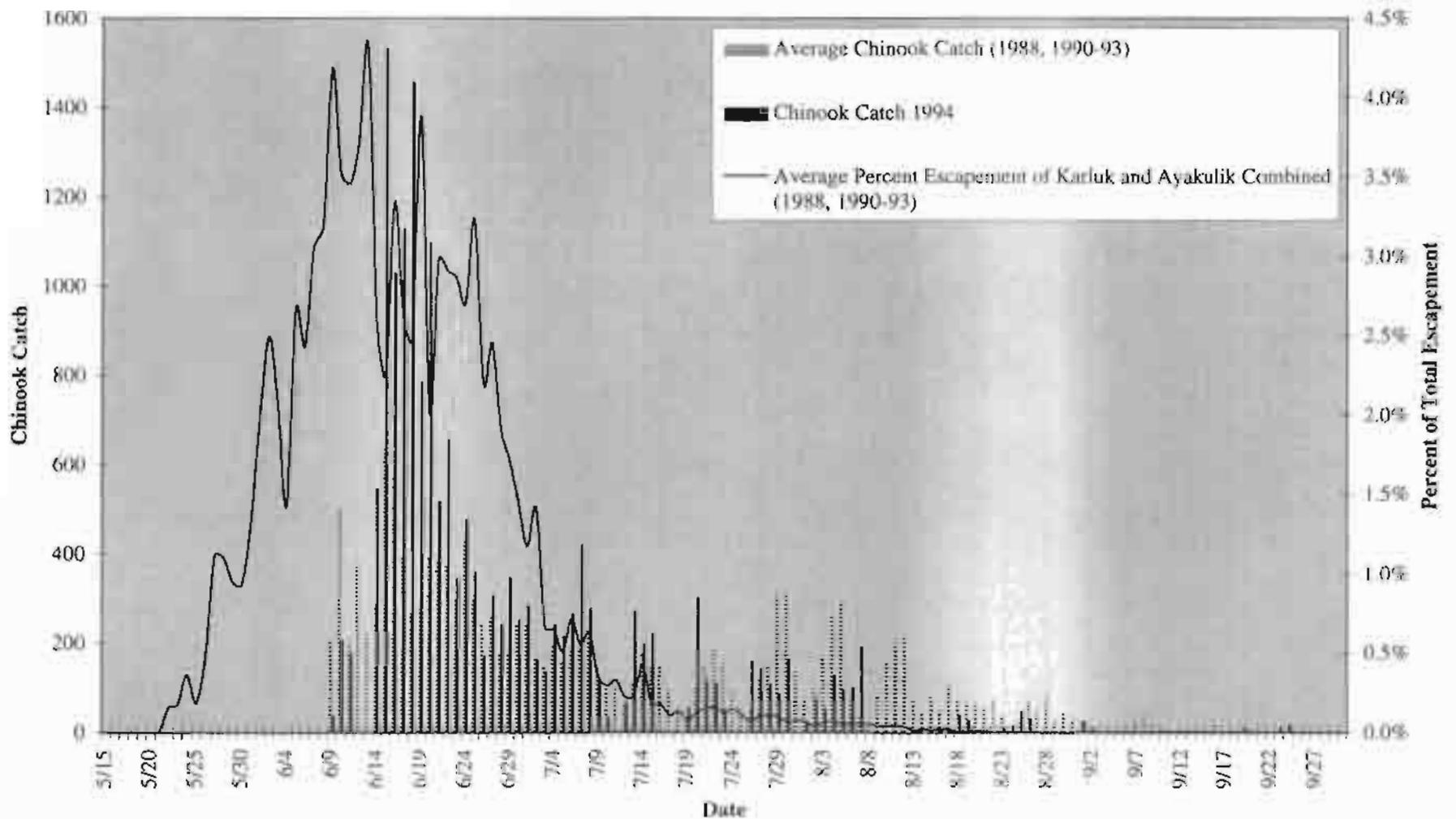
Appendix B.2. The average (1988, 1990-93; and 1994) chinook salmon commercial catch by day from the Northwest Kodiak District compared to the average (unlagged weir counts) daily percent of chinook escapements to the Karluk and Ayakulik Rivers combined.

Southwest Kodiak District Chinook Catch



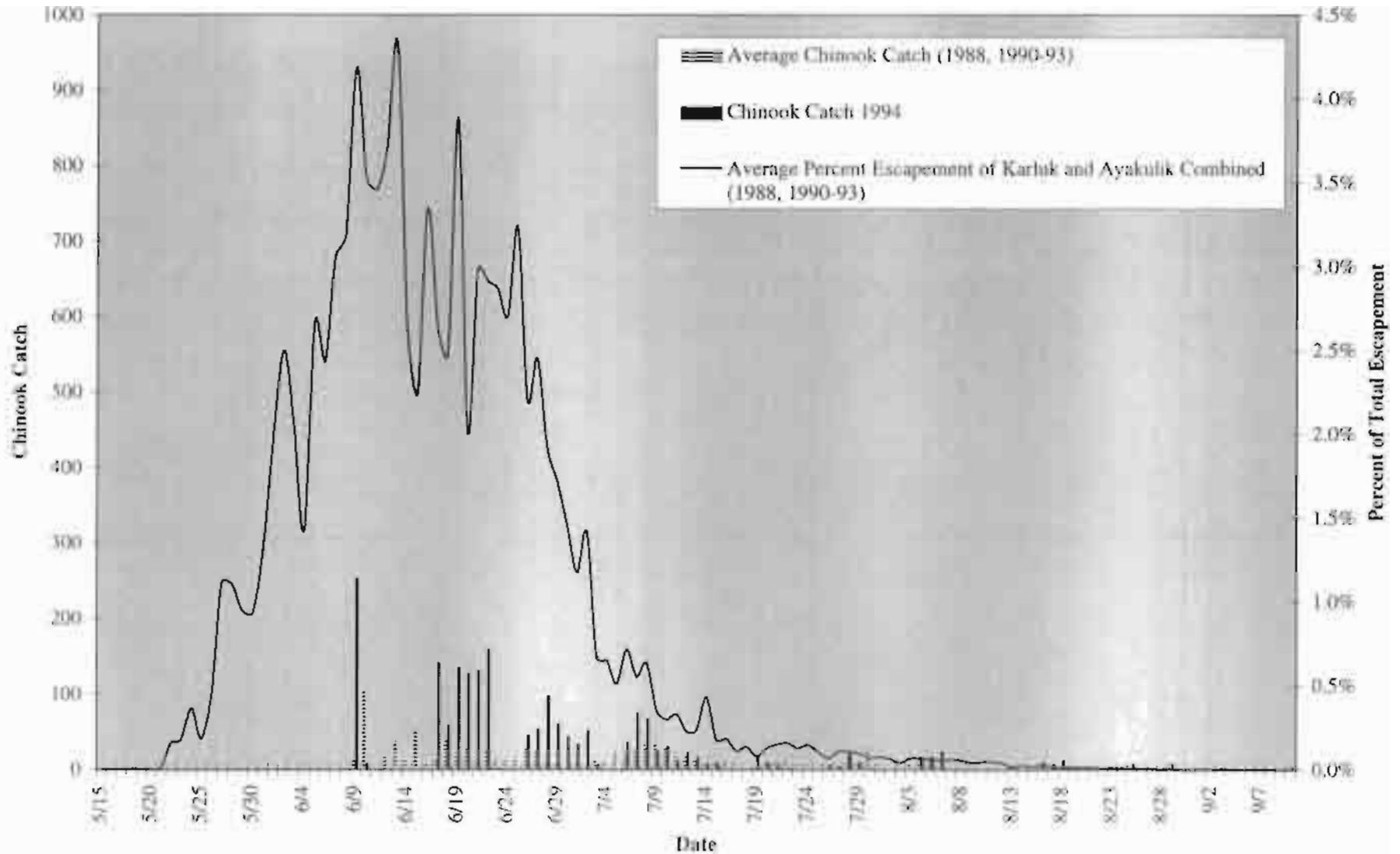
Appendix B.3. The average (1988, 1990-93; and 1994) chinook salmon commercial catch by day from the Southwest Kodiak District compared to the average (unlagged weir counts) daily percent of chinook escapements to the Karluk and Ayakulik Rivers combined.

Combined Chinook Catch in the Northwest Kodiak District, Southwest Kodiak District, and Southwest Afognak Section.



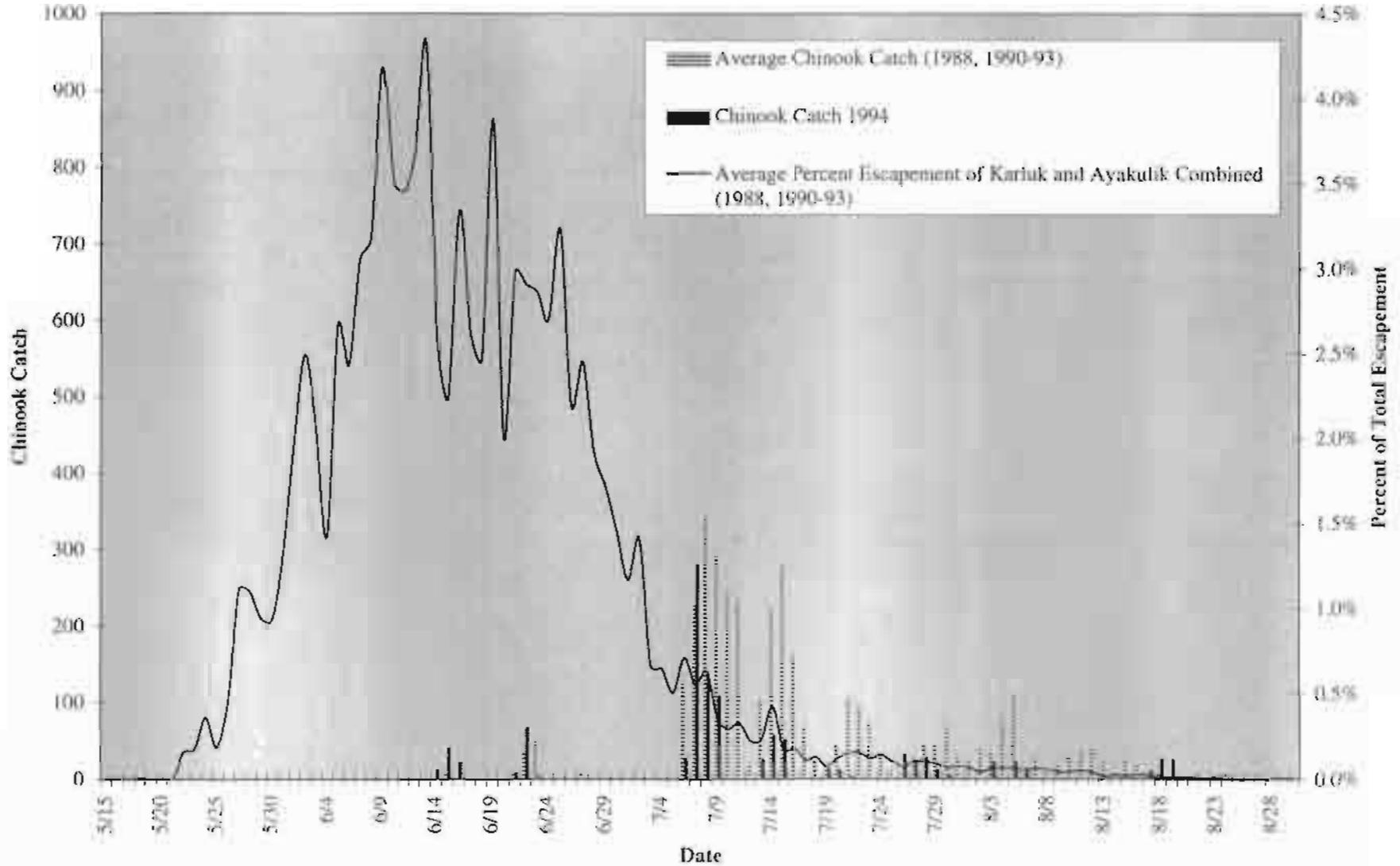
Appendix B.4. The average (1988, 1990-93; and 1994) chinook salmon commercial catch by day from the Northwest and Southwest Kodiak Districts and the Southwest Afognak Section compared to the average (unlagged weir counts) daily percent of chinook escapements to the Karluk and Ayakulik Rivers combined.

Alitak Bay District Chinook Catch



Appendix B.5. The average (1988, 1990-93; and 1994) chinook salmon commercial catch by day from the Alitak Bay District compared to the average (unlagged weir counts) daily percent of chinook escapements to the Karluk and Ayakulik Rivers combined.

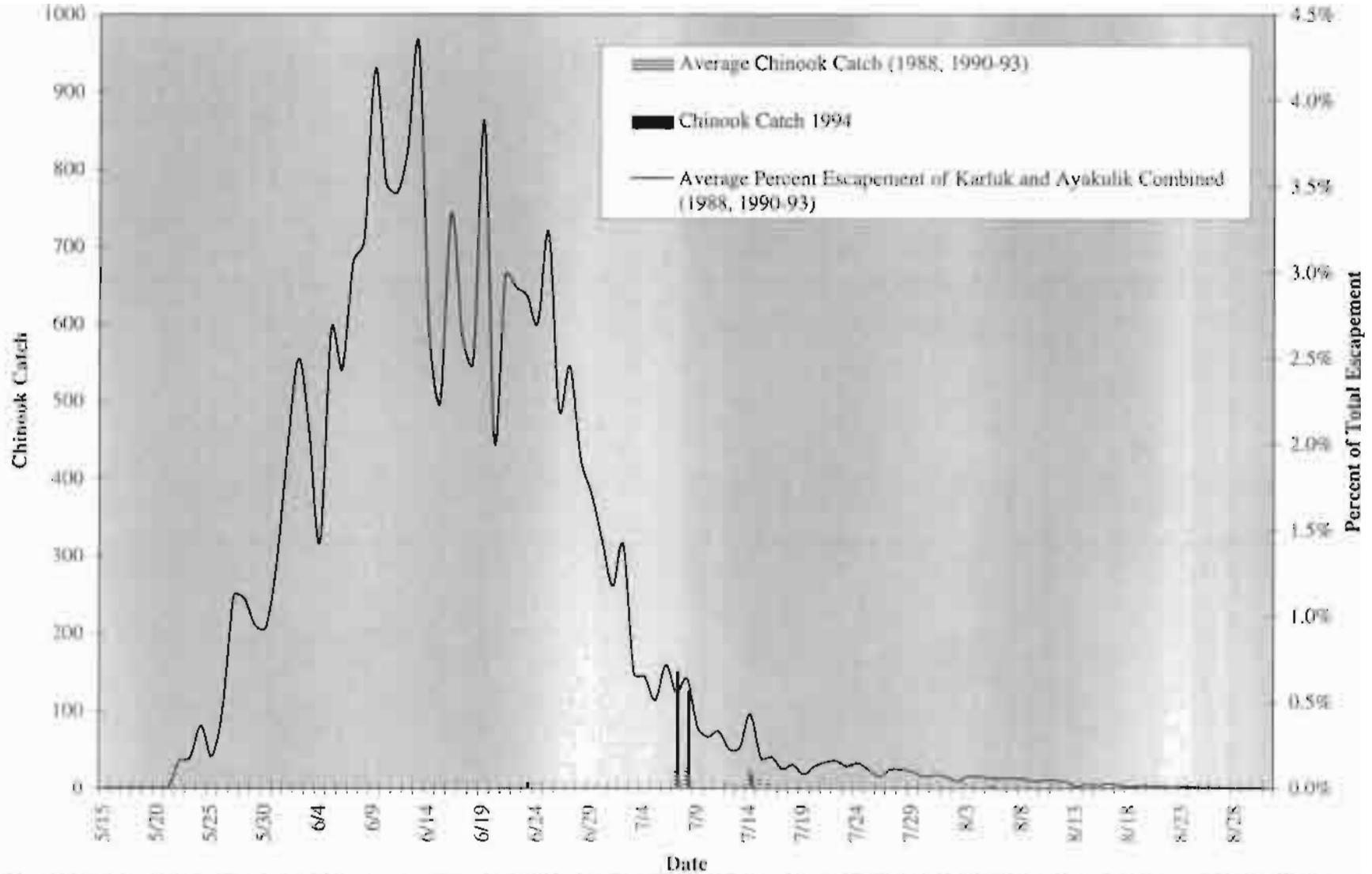
Eastside Kodiak District Chinook Catch



Appendix B.6. The average (1988, 1990-93; and 1994) chinook salmon commercial catch by day from the Eastside Kodiak District compared to the average (unlagged weir counts) daily percent of chinook escapements to the Karluk and Ayakulik Rivers combined.

Northeast Kodiak District Chinook Catch

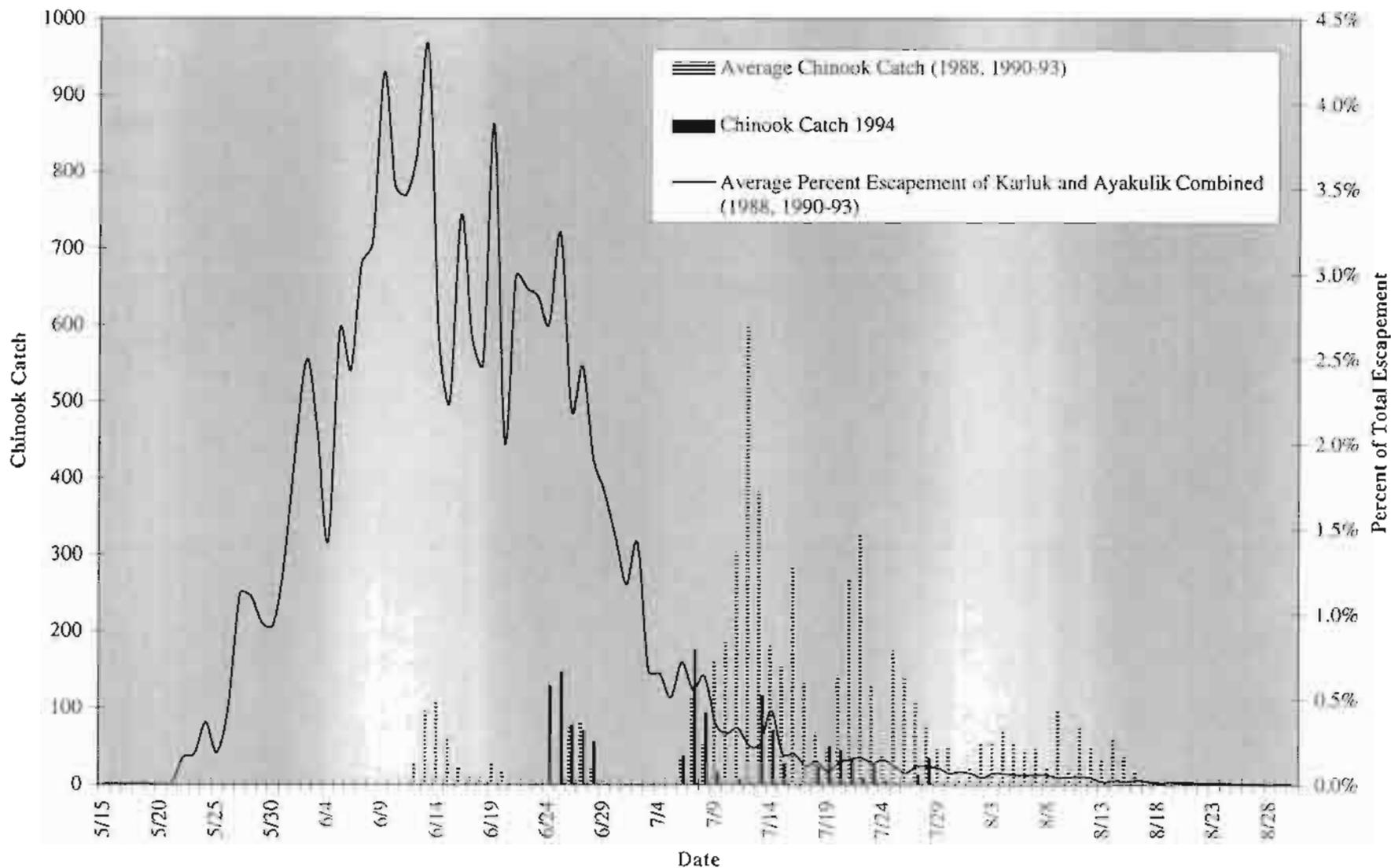
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Appendix B.7. The average (1988, 1990-93; and 1994) chinook salmon commercial catch by day from the Northeast Kodiak District compared to the average (unlagged weir counts) daily percent of chinook escapements to the Karluk and Ayakulik Rivers combined.

Mainland District Chinook Catch

04



Appendix B.8. The average (1988, 1990-93; and 1994) chinook salmon commercial catch by day from the Mainland District compared to the average (unlagged weir counts) daily percent of chinook escapements to the Karluk and Ayakulik Rivers combined.

Appendix C. Summary of the CWT marked chinook salmon commercially harvested and sampled within the Kodiak Management Area during 1994 as reported by the ADF&G tag lab.

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Stat.	All Districts in Sample	Combined Areas	Tag Code	Tag.. Status	BR Yr.	State Release	Wild or Hatchery stock	Theta ¹	Combined Area Expansion	Combined Area Contribution	All Kodiak Areas Expansion	All Kodiak Areas Contribution
26	257	Alitak Bay (257)	020130	1	89	BC	CLAYOQUOT CDP	1.93	1.03	1.98	9.47	18.23
26	257	Alitak Bay (257)	021533	1	90	BC	KITIMAT RIVER	12.07	1.03	12.43	9.47	114.26
26	257	Alitak Bay (257)	021553	1	90	BC	ROBERTSON CREEK	33.16	1.03	34.15	9.47	314.02
26	257	Alitak Bay (257)	020249	1	89	BC	SNOOTLI CREEK	13.05	1.03	13.44	9.47	123.58
28	257	Alitak Bay (257)	021549	1	90	BC	ROBERTSON CREEK	25.48	9.19	234.15	10.25	261.46
28	257	Alitak Bay (257)	020128	1	89	BC	CLAYOQUOT CDP	1.93	9.19	17.72	10.25	19.76
28	257	Alitak Bay (257)	020129	1	89	BC	CLAYOQUOT CDP	1.92	9.19	17.60	10.25	19.63
28	257	Alitak Bay (257)	082853	1	90	BC	NITINAT RIVER	1.48	9.19	13.58	10.25	15.15
32	257	Alitak Bay (257)	021553	1	90	BC	ROBERTSON CREEK	33.16	2.63	87.21	11.62	385.31
32	257	Alitak Bay (257)	020614	1	90	BC	SOOKE RIVER PIP	1.01	2.63	2.66	11.62	11.74
25	251 253 254	NW,SW,SW Afognak	021048	1	91	BC	MARBLE RIVER PIP	3.75	16.44	61.63	9.76	36.59
25	251 253 254	NW,SW,SW Afognak	180837	1	91	BC	SNOOTLI CREEK	1.17	16.44	19.27	9.76	11.44
25	251 253 254	NW,SW,SW Afognak	634527	1	91	WA	(W) HANFORD REACH ST	1.01	16.44	16.57	9.76	9.84
25	251 253 254	NW,SW,SW Afognak	020516	1	89	BC	MASSET CDP	1.00	16.44	16.44	9.76	9.76
25	251 253 254	NW,SW,SW Afognak	043625	1	89	AK	MEDVEJIE	10.53	16.44	173.11	9.76	102.77
25	251 253 254	NW,SW,SW Afognak	180354	1	91	BC	SNOOTLI CREEK	12.93	16.44	212.63	9.76	126.24
25	251 253 254	NW,SW,SW Afognak	180248	1	90	BC	CLAYOQUOT CDP	4.88	16.44	80.21	9.76	47.62
25	251 253 254	NW,SW,SW Afognak	075626	1	90	OR	DEXTER PONDS HATCHER	3.02	16.44	49.67	9.76	29.48
25	254 255	NW,SW,SW Afognak	021208	1	90	BC	ROBERTSON CREEK	68.06	16.44	1118.97	9.76	664.30
26	251 254	NW,SW,SW Afognak	180805	1	91	BC	ROBERTSON CREEK	25.18	12.05	303.42	9.47	238.45
26	251 254	NW,SW,SW Afognak	180826	1	91	BC	SNOOTLI CREEK	4.41	12.05	53.13	9.47	41.75
26	251 254	NW,SW,SW Afognak	021546	1	90	BC	CONUMA RIVER	11.24	12.05	135.39	9.47	106.40
26	251 254	NW,SW,SW Afognak	180827	1	91	BC	SNOOTLI CREEK	8.35	12.05	100.59	9.47	79.06
26	251 254	NW,SW,SW Afognak	180229	1	90	BC	ROBERTSON CREEK	1.01	12.05	12.17	9.47	9.56
26	251 254	NW,SW,SW Afognak	634117	1	90	WA	HUMPTULIPS HATCHERY	1.02	12.05	12.32	9.47	9.68
26	251 254	NW,SW,SW Afognak	043604	1	89	AK	CRYSTAL LK/EARL WEST	7.90	12.05	95.23	9.47	74.84
26	254 255	NW,SW,SW Afognak	021428	1	90	BC	SNOOTLI CREEK	15.44	12.05	186.05	9.47	146.22
26	254 255	NW,SW,SW Afognak	032209	1	89	AK	LITTLE PORT WALTER	1.02	12.05	12.33	9.47	9.69
28	251 253 254	NW,SW,SW Afognak	180458	1	91	BC	NITINAT RIVER	37.53	6.74	252.96	10.25	384.69
28	251 253 254	NW,SW,SW Afognak	180248	1	90	BC	CLAYOQUOT CDP	4.88	6.74	32.88	10.25	50.01
28	251 253 254	NW,SW,SW Afognak	180443	1	91	BC	CONUMA RIVER	9.09	6.74	61.29	10.25	93.21
28	254	NW,SW,SW Afognak	021545	1	90	BC	CONUMA RIVER	9.16	6.74	61.72	10.25	93.86
28	254	NW,SW,SW Afognak	020517	1	89	BC	MASSET CDP	1.00	6.74	6.74	10.25	10.25

-Continued-

Appendix C. (page 2 of 2)

Stat. Week	All Districts in Sample	Combined Areas	Tag Code	Tag.. Status	BR Yr.	State Release	Wild or Hatchery stock	Theta ¹	Combined Area Expansion	Combined Area Contribution	All Kodiak Areas Expansion	All Kodiak Areas Contribution
28	253 254 255	NW,SW,SW Afognak	180837	1	91	BC	SNOOTLI CREEK	1.17	6.74	7.90	10.25	12.01
28	253 254 255	NW,SW,SW Afognak	043647	1	90	AK	MEDVEJIE	14.30	6.74	96.41	10.25	146.62
28	253 254 255	NW,SW,SW Afognak	180354	1	91	BC	SNOOTLI CREEK	12.93	6.74	87.18	10.25	132.57
28	253 254 255	NW,SW,SW Afognak	021319	1	90	BC	CONUMA RIVER	26.43	6.74	178.11	10.25	270.87
30	254	NW,SW,SW Afognak	180201	1	90	BC	GOLD RIVER PIP	1.02	11.54	11.71	15.35	15.58
30	254	NW,SW,SW Afognak	024940	1	89	BC	GOLD RIVER PIP	5.61	11.54	64.73	15.35	86.10
31	251 253	NW,SW,SW Afognak	180203	1	90	BC	GOLD RIVER PIP	1.65	38.79	63.89	23.64	38.94
31	251 253	NW,SW,SW Afognak	180327	1	90	BC	NITINAT RIVER	27.59	38.79	1070.02	23.64	652.11
25	251 253 254 255 258	Mixed	043646	1	90	AK	MEDVEJIE	13.25	0.00	0.00	9.76	129.35
25	251 253 254 255 258	Mixed	021318	1	90	BC	CONUMA RIVER	26.43	0.00	0.00	9.76	257.92
25	251 253 254 255 258	Mixed	180444	1	91	BC	CONUMA RIVER	9.09	0.00	0.00	9.76	88.76
25	251 253 254 255 258	Mixed	180459	1	91	BC	NITINAT RIVER	48.86	0.00	0.00	9.76	476.85
25	251 253 254 255 258	Mixed	180802	1	91	BC	ROBERTSON CREEK	33.06	0.00	0.00	9.76	322.69
25	251 253 254 255 258	Mixed	043626	1	89	AK	MEDVEJIE	3.58	0.00	0.00	9.76	34.92
25	251 253 254 255 258	Mixed	180248	1	90	BC	CLAYOQUOT CDP	4.88	0.00	0.00	9.76	47.62
25	251 253 254 255 258	Mixed	021051	1	91	BC	MARBLE RIVER PIP	3.67	0.00	0.00	9.76	35.81
25	251 253 254 255 258	Mixed	021050	1	91	BC	MARBLE RIVER PIP	3.65	0.00	0.00	9.76	35.59
25	251 253 254 255 258	Mixed	180341	1	91	BC	SHUSWAP RIVER	4.77	0.00	0.00	9.76	46.52
25	251 253 254 255 258	Mixed	043705	1	90	AK	NEETS BAY	25.33	0.00	0.00	9.76	247.25
25	251 253 254 255 258	Mixed	180462	1	91	BC	NITINAT RIVER	19.43	0.00	0.00	9.76	189.65
26	257	Alitak Bay (257)		2					1.03	0.00	9.47	0.00
26	257	Alitak Bay (257)		2					1.03	0.00	9.47	0.00
28	257	Alitak Bay (257)		2					9.19	0.00	10.25	0.00
29	257	Alitak Bay (257)		2					0.00	0.00	0.00	0.00
25	251 253 254	NW,SW,SW Afognak		2					16.44	0.00	9.76	0.00
25	254 255	NW,SW,SW Afognak		2					16.44	0.00	9.76	0.00
26	251 254	NW,SW,SW Afognak		2					12.05	0.00	9.47	0.00
26	251 254	NW,SW,SW Afognak		2					12.05	0.00	9.47	0.00
26	251 254	NW,SW,SW Afognak		2					12.05	0.00	9.47	0.00
25	257	Alitak Bay (257)		8					0.00	0.00	9.76	0.00
25	251 253 254	NW,SW,SW Afognak		8					16.44	0.00	9.76	0.00
26	254 255	NW,SW,SW Afognak		8					12.05	0.00	9.47	0.00
										5089.60		6936.28

Appendix D. Summary of chinook salmon CWT recoveries reported from the NMFS groundfish trawl fishery observer database and identified as being harvested within marine waters proximate to the Kodiak Archipelago, 1994.

Tag Code	Brood Year	Release			Recovery		
		Coded Wire Tag Origin	State or Province	Date	Number of Tags	Fishery Area	Date
21049	91	Marble River	BC	Jun-92	1	Shelikof Strait	6/15/94
21319	90	Conuma River	BC	May-91	1	Shelikof Strait	6/15/94
21327	90	Dome Creek	BC	Apr-92	1	Shelikof Strait	3/1/94
43646	90	Bear Cove 113-41	AK	May-92	1	Shelikof Strait	6/15/94
43648	90	Bear Cove 113-41	AK	May-92	1	Southwest Afognak	6/20/94
75626	90	Santiam R. South Fk.	OR	Nov-91	1	Shelikof Strait	6/20/94
82849	90	Nitinat L.	BC	Jun-91	1	Shelikof Strait	6/1/94
180201	90	Gold River	BC	May-91	1	Shelikof Strait	6/1/94
180203	90	Gold River	BC	Jun-91	1	Shelikof Strait	6/15/94
180203	90	Gold River	BC	Jun-91	1	Southwest Afognak	6/20/94
180247	90	Kennedy	BC	Jun-91	1	Southwest Afognak	6/20/94
180354	90	Atnarko R. Up.	BC	Jun-92	1	Shelikof Strait	Jun-94
180354	90	Atnarko R. Up.	BC	Jun-92	1	Southwest Afognak	6/20/94
180529	91	Sooke R.	BC	Jun-92	1	Southwest Afognak	6/20/94
180530	91	Sooke R.	BC	Jun-92	1	Southwest Afognak	6/20/94
180804	91	Robertson Cr.	BC	May-92	1	Shelikof Strait	6/15/94
180826	91	Atnarko R. Lwr.	BC	May-92	1	Southwest Afognak	6/20/94
180827	91	Atnarko R. Lwr.	BC	Jun-92	1	Shelikof Strait	6/15/94
180837	91	Salloomt R.	BC	Jul-92	1	Shelikof Strait	6/15/94
211835	89	Salmon R.	WA	Sep-90	1	Southwest Afognak	6/20/94
212260	91	Salmon R. 21.0139	WA	Jul-92	1	Shelikof Strait	6/15/94

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