Fishery Data Series No. 11-74

Migratory Timing and Abundance Estimates of Sockeye Salmon into Upper Cook Inlet, Alaska, 2010

by

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and

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December 2011

Alaska Department of Fish and Game Divisions of Sport Fish and Commercial Fisheries

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Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	*e*
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	*E*
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	log_2, etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

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December 2011

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This document should be cited as:
Shields, P. and T. M. Willette. 2011. Migratory timing and abundance estimates of sockeye salmon into Upper Cook Inlet, Alaska, 2010. Alaska Department of Fish and Game, Fishery Data Series No. 11-74, Anchorage.

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ABSTRACT

In 2010 the Alaska Department of Fish and Game conducted an offshore test fishery during the Upper Cook Inlet (UCI) commercial salmon fishing season. The test fishery is designed to estimate the inseason abundance and run timing of sockeye salmon *Oncorhynchus nerka* stocks entering the UCI management area. The test fishery was conducted from 1 July through 29 July and captured 3,058 sockeye salmon , representing 2,055 catch per unit of effort (CPUE) index points. The midpoint of the 2010 sockeye salmon run occurred on 14 July, which was 1 day early relative to the historical mean date of 15 July. Two formal estimates of the size and timing of the 2010 sockeye salmon run were made during the commercial fishing season, with the first best-fit estimator forecasting a total run to UCI of 4.69 and 4.55 million sockeye salmon. These estimates deviated from the actual total run of 5.26 million by -11% and -14%, respectively. Two estimates of the total Kenai River sockeye salmon run were also made using 5 best fit models. Based on data through 22 July, the total Kenai River run was projected to range between 2.46 and 7.81 million fish. The second estimate, made using data through 26 July, predicted the total Kenai River run would range between 2.63 and 3.24 million fish. The first best fit Kenai River total run estimate from each analysis (22 July: 2.82 million; 26 July: 2.62 million) differed from the preliminary postseason Kenai River total run estimate of 3.26 million fish by -13% and -19%, respectively. In summary, 7 of the 10 Kenai River inseason run projections were within 20% of the actual run size. The final test fish passage rate was approximately 2,272 sockeye salmon per CPUE point. Genetic stock identification of samples collected during the test fishery showed similar results to previous years, that is, during the third and fourth weeks in July, Kenai River sockeye salmon were the dominant stock entering Cook Inlet, whereas during the first part of the month, Kasilof River sockeye salmon stocks were equally or more abundant than Kenai River stocks.

Key words: Upper Cook Inlet, Alaska, Pacific salmon, *Oncorhynchus* spp., test fishery, migratory behavior, GSI.

INTRODUCTION

In 1979, the Alaska Department of Fish and Game (ADF&G) began an offshore test fishery (OTF) project near the southern boundary of the Upper Cook Inlet (UCI) salmon management area (Figure 1). The project was designed to estimate the total sockeye salmon *Oncorhynchus nerka* run (including run timing) returning to UCI during the commercial salmon fishing season. These data have become extremely important to ADF&G staff, helping to adjust commercial fishing times and areas to most efficiently harvest surplus sockeye salmon or restrict fisheries that may overharvest specific stocks. In recent years, the Alaska Board of Fisheries (BOF) has assembled various management plans requiring inseason abundance estimates of the annual sockeye salmon run to implement specific plan provisions. The OTF project has increasingly become one of the most important tools fishery managers utilize to make inseason fishery management decisions that comply with BOF management directives.

Test fishing results have been reported annually since 1979 (Waltemyer 1983, 1984, 1986a-b; Hilsinger and Waltemyer 1987; Hilsinger 1988; Tarbox and Waltemyer 1989; Tarbox 1990–1991, 1994–1998a-b, 1999; Tarbox and King 1992; Shields 2000, 2001, 2003; Shields and Willette 2004, 2005, 2007, 2008, 2009a-b, 2010). This report presents the results of the 2010 test fishing project.

OBJECTIVES

The objectives of the project were to:

1. Make an inseason estimate of the 2010 UCI sockeye salmon total run (including run timing), and
2. Estimate the 2010 Kenai River sockeye salmon run size.

METHODS

TEST FISHING

Sockeye salmon returning to UCI were sampled by fishing 6 geographically fixed stations between Anchor Point and the Red River Delta (Figure 1). These stations have been fished since 1992 (Tarbox 1994) and were established based on analyses that showed they provided the most reliable estimates of inseason run size and timing. Stations were numbered consecutively from east to west, with station locations (latitude and longitude) determined with global positioning system technology. A chartered test fishing vessel, *FV Americanus*, sampled all 6 stations (numbered 4, 5, 6, 6.5, 7 and 8) daily, traveling east to west on odd-numbered days and west to east on even-numbered days. Sampling started on 1 July and continued through 29 July. The vessel fished 366 m (1,200 ft or 200 fathoms) of multi-filament drift gillnet with a mesh size of 13 cm (5 1/8 inches). The net was 45 meshes deep and constructed of double knot Super Crystal[1] shade number 1, with filament size 53/S6F.

Catch and catch per unit of effort (CPUE) data for missed stations were interpolated by averaging catches from the day before and the day after for each station not fished. However, for stations where 3 or more consecutive days were missed, a different interpolation method was needed. This method used the proportion of the catch and CPUE for each station from all days fished previous to the missing values in order to estimate these parameters for any station where 3 or more consecutive days of fishing were missed.

The following physical and chemical readings were taken at the start of each set: air temperature, water temperature, salinity (all at 1 m below the surface), wind velocity and direction, tide stage, water depth, and water clarity. Air and water temperatures (°C) and salinity (ppt) were measured using an YSI salinity/temperature meter. Wind speed was measured in knots and direction was recorded as 0 (no wind), 1 (north), 2 (northeast), 3 (east), 4 (southeast), 5 (south), 6 (southwest), 7 (west), or 8 (northwest) using a Kestrel 4000 pocket weather tracker. Tide stage was classified as 1 (high slack), 2 (low slack), 3 (flooding), or 4 (ebbing) by observing the movement of the vessel while drifting with the gill net. Water depth was measured in fathoms (fm) using a Simrad echo sounder, and water clarity was measured in meters (m) using a 17.5 cm secchi disk, following methods described by Koenings et al. (1987).

All salmon captured in the drift gillnet were identified by species and enumerated. Sockeye salmon (n<50 at each station) were measured for fork length (mideye to fork of tail) to the nearest mm and also had an axillary process removed for genetic analysis (as described by Habicht et al. 2007).

The number of fish captured at each station (s) on each day (i) was expressed as a CPUE statistic, or index point, and standardized to the number of fish caught in 100 fathoms of gear in one hour of fishing time:

$$CPUE_{s,i} = \frac{100\,fm \;\; x \;\; 60\min \;\; x \;\; number\ of\ fish}{fm\ of\ gear \;\; x \;\; MFT} \,. \tag{1}$$

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[1] Product names used in this report are included for scientific completeness, but do not constitute a product endorsement.

Mean fishing time (*MFT*) was:

$$MFT = (C - B) + \frac{(\mathrm{B} - \mathrm{A}) + (\mathrm{D} - \mathrm{C})}{2} \ , \tag{2}$$

where: A = time net deployment started,

B = time net fully deployed,

C = time net retrieval started, and

D = time net fully retrieved.

Once deployed at a station, the drift gillnet fished 30 minutes before retrieval started. However, the net was capable of capturing fish prior to being fully deployed, as it was during the time it was being retrieved. *MFT* was therefore adjusted by summing the total time it took to set and retrieve the net, then dividing this time in half, and adding it to the time when the entire net was deployed and fished.

Daily $CPUE_i$ data were summed for all *m* stations (typically 6) as follows:

$$CPUE_i = \sum_{s=1}^{m} CPUE_{s,i} \ . \tag{3}$$

Cumulative $CPUE_i$ ($CCPUE_d$) was given by:

$$CCPUE_d = \sum_{i=1}^{d} CPUE_i \ , \tag{4}$$

where: d = date of the estimate.

DESCRIBING THE SALMON MIGRATION AND PROJECTING TOTAL RUN

The sockeye salmon run was described for each of the previous years based on the respective test fishing data, as described in Mundy (1979):

$$Y_{yr,d} = 1 \big/ (1 + e^{-(\mathrm{a} + \mathrm{bd})}) \ , \tag{5}$$

where: $Y_{yr,d}$ = modeled cumulative proportion of $CCPUE_{yr,f}$ (f = final day of season) for year *yr* as of day *d*, and

a and *b* = model parameters.

Variables without the subscript *yr* indicating year refer to the current year's estimate. To determine which of the previous run timing curves most closely fit the current year's data, and to estimate total run for the entire season (TR_f), a projection of the current year's $CCPUE_d$ at the end of the season ($CCPUE_f$) was estimated as per Waltemyer (1983):

$$CCPUE_f = \frac{\sum_{d=0}^{D} CCPUE_d^{\ 2}}{\sum_{d=0}^{d} Y_{yr,d} \cdot CCPUE_d} . \quad (6)$$

This model assumes that the average day of return and its variance for previous year *yr* is the same as for the current year (Mundy 1979). To test this assumption, inseason Y_d was estimated as:

$$Y_d = \frac{CCPUE_d}{CCPUE_f} , \quad (7)$$

and mean squared error (*MSE*) between Y_d and $Y_{yr,d}$ was estimated as:

$$MSE = \frac{\sum_{d=0}^{D} \left(Y_{yr,d} - Y_d\right)^2}{d+1} . \quad (8)$$

Years were ranked from lowest *MSE* (best model) to highest (worst), and the best fit years were used to estimate $CCPUE_f$ for the current year. Catchability, or the fraction of the available population taken by a defined unit of fishing effort, was estimated as:

$$CPUE_{s,i} = \frac{100\, fm \;\; x \;\; 60\, \text{min} \;\; x \;\; number\ of\ fish}{fm\ of\ gear \;\; x \;\; MFT} , \quad (9)$$

where: q_d = estimated cumulative catchability as of day *d*, and

r_d = cumulative total run as of day *d*.

The cumulative total run on day *d* was the sum of all estimates for commercial, recreational, and personal use harvests to date, total escapement to date, and the number of residual (i.e., residing) sockeye salmon in the district. Commercial harvest data was estimated inseason from catch reports called or faxed into the ADF&G office. All commercially harvested salmon in UCI, whether sold or kept for personal use, are required to be reported to the Soldotna ADF&G office by the fishermen or processors within 12 hours of the close of a fishing period. Personal use and recreational harvests were estimated inseason by examining catch statistics from previous years' fisheries on similar sized runs. Total escapement to date included estimated escapements into all monitored systems (Crescent, Susitna, Kenai and Kasilof rivers, and Fish Creek) and unmonitored systems, which are assumed to be 15% of the escapement into monitored systems (Tobias and Willette 2003). The number of residual fish in the district was estimated by assuming exploitation rates of 70% in set net fisheries, 35–40% in districtwide drift net fisheries (based on the number of boats that fished), and 25% in reduced district drift net fisheries (Mundy et al. 1993). For example, if the drift gillnet fleet harvested 500 thousand sockeye salmon on an inletwide fishing period, the number of sockeye salmon originally in the district would be 1,250 (500/0.40=1,250) where the number remaining, or the residual, is 750,000 (1,250–500=750).

Passage rate, as of day d, the expansion factor used to convert CPUE into estimated numbers of salmon passing the test fishing transect line into UCI, was

$$PR_d = 1/q_d \ . \tag{10}$$

Total run at the end of the season (TR_f) was

$$TR = PR_d \cdot CCPUE_f. \tag{11}$$

The midpoint of the run, the day that approximately 50% of the total run has passed the OTF transect, was

$$M = a/b \,, \tag{12}$$

where: M = midpoint date of run, and

a and b = model parameters.

Because the test fishery does not encompass the entire sockeye salmon run, the total $CCPUE_f$ for the test fishery is estimated postseason using 2 methods (Equations 13 and 14):

$$CCPUE_f^h = CCPUE_f \cdot \frac{H_t}{H_L} \ , \tag{13}$$

where: $CCPUE_f^h$ = total estimated $CCPUE_f$ for the season, based on harvest,

H_t = total commercial harvest for the season,

H_L = total commercial harvest through final day of test fishery (f+2), and

L = number of days (lag time) it took salmon to travel from test fishery to commercial harvest areas (2 days).

$$CCPUE_t^r = CCPUE_f \cdot \frac{E_t + H_t}{E_L + H_L}, \tag{14}$$

where: $CCPUE_t^r$ = total estimated $CCPUE_f$ for the season, based upon total run,

E_t = total escapement for the season,

H_t = total commercial harvest for the season,

E_L = total UCI escapement through the final day of the test fishery, summed from 6 different streams,

H_L = total UCI commercial harvest through the final day of the test fishery, and

L = number of days (lag time) it took salmon to travel from the test fishery to spawning streams or commercial harvest areas.

The total run adjustment to $CCPUE_f$ (Equation 14) has replaced adjustments based on harvest alone (Equation 13), primarily due to changes to commercial fishing management plans made by the board. Management plans now provide much less fishing time in August than in the past; therefore, adjustments based on harvest alone would not have accurately reflected the additional fish that entered the district after the test fishery ceased. The total run to date on the last day of the test fishery was the sum of all commercial harvest data and escapement. Escapements estimates were derived by summing passage from 3 sockeye salmon sonar enumeration sites (Kenai, Kasilof, and Crescent rivers) and adding to that an expansion of the cumulative weir counts at Chelatna, Judd, and Larson lakes to reflect the total Susitna River sockeye salmon escapement, plus the weir count at Fish Creek, and an estimate of escapement to all unmonitored systems through day *d*. An estimate of escapement to all non-monitored systems in UCI is considered to be 15% of the monitored runs. Lag times are the approximate time for fish to migrate from the test fish transect to a particular destination. As suggested by Mundy et al. (1993), lag times must be considered when estimating the total run passing the test fish transect on day *d*. A lag time of up to 2 days was assumed for fish harvested in the commercial fishery. We estimated lag times between the test fishery and escapement projects as follows: Crescent River, 1 day; Kasilof and Kenai rivers, 4 days; Fish Creek, 7 days (Mundy et al. 1993); and Susitna River weirs, 14 days. The number of sockeye salmon harvested in sport and personal use fisheries after test fishing has ceased that have not been estimated in the escapement are assumed to be insignificant, and therefore are not utilized in the $CCPUE_f$ posttest fishery adjustment.

Adjusted estimates of $CCPUE_f$ ($CCPUE_t^h$ and $CCPUE_t^r$) were used for postseason estimates of TR_f.

RESULTS AND DISCUSSION

In 2010, rough seas prevented the test boat from fishing some to all of the stations on 10, 15, 16, 17, 18, 21 and 23 July (Table 1). Catch and CPUE data for missed stations were interpolated. As described earlier, when fishing occurred the day before and the day after a station was missed, a simple average was used to interpolate the missed data. However, for stations where 3 or more consecutive days were missed, a different method was used. This method used the proportion of the catch and CPUE for each station from 1 to 14 July to estimate these parameters for any station where 3 or more consecutive days of fishing were missed. For example, on 15 July, stations 6, 6.5 and 7 were not fished, but had been fished the day before and the day after, so the simple average method was used, resulting in catch estimates of 51, 27, and 9, respectively. From 1 to 14 July, stations 6, 6.5 and 7 had accounted for approximately 74.1% of the daily catch, which meant that the estimated cumulative catch on 15 July for stations 4, 5, and 8, which made up 25.9% of the daily catch from 1 to 14 July, would have been 29. The 1–14 July proportion for each station was then applied to the total catch of 29 to estimate the catch for stations 4, 5, and 8. The same method was used to estimate missing CPUE values (Tables 2 and 3).

After interpolating the data for the missed stations, a total of 3,058 sockeye salmon were estimated to have been captured during the 2010 test fishery, as well as 266 pink salmon *O. gorbuscha*, 1,155 chum salmon *O. keta*, 700 coho salmon *O. kisutch*, and 3 Chinook salmon *O. tshawytscha* (Tables 1–2, Appendices A1–A12). Sockeye salmon daily catches ranged from 11 on 8 July to 306 fish on 11 July. The total sockeye salmon $CCPUE_f$ for the 2010 project was

2,055 with daily CPUE values ranging from 9 to 206. The $CCPUE_f$ of 2,055 represented the fifth highest unadjusted $CCPUE_f$ since 1992 (Tables 3 and 4), which is when the number of stations sampled by the test fish boat was standardized to the current configuration (Tarbox 1994). The 1992–2010 annual test fish unadjusted $CCPUE_f$ and the total annual run of sockeye salmon to UCI (Figure 2) were not significantly (α=0.05) correlated (P=0.084 and R^2=0.17), with 83% of the variation unexplained, indicating that the $CCPUE_f$ statistic alone is not a reliable predictor of the total annual sockeye salmon run.

As expected, the distribution of sockeye salmon catches along the test fish transect was similar to the distribution of CPUE values (Tables 2 and 3), since fishing occurs at fixed intervals at each station.

INSEASON ABUNDANCE ESTIMATES

Tarbox and Waltemyer (1989) provided detail about the assumptions used in the curve fitting procedures to estimate the $CCPUE_f$ statistic during the season. One of the major assumptions is that 24 June represents the first day of the sockeye salmon run to UCI. Variability in actual runs can therefore result in an average or early run being misclassified as late, especially during the first couple weeks of the test fish program. For this reason, 20 July was chosen as the earliest date that inseason formal estimates of each year's total run size and run timing should be made. By then, there are enough data points in the current year's run timing curve to provide a more accurate estimate of the $CCPUE_f$. In addition, Tarbox and King (1992) and later OTF annual reports demonstrated that the initial first choice (best fit) estimate of the $CCPUE_f$ statistic and total run made around mid-July was often not the best fit estimate later in July. Therefore, when making formal inseason estimates of the total run, the top 5 or 6 best fits are evaluated. Careful consideration is given to years whose fits reveal the least day to day change in the predicted $CCPUE_f$. These years are identified as potentially being the final best fit at the end of the season, especially if the *MSE* (Equation 8), also referred to as the mean sum of squares, statistic is also improving. Salmon run timing from other areas of the state is also considered to help predict UCI run timing.

The first formal abundance estimate of the 2010 UCI sockeye salmon run occurred on 23 July, using commercial, sport and personal use harvests, escapement, and test fishery data through 22 July (Table 5). The 2010 test fish *CCPUE* curve was mathematically compared to run curves from 1979 through 2009, with the estimates ranked from best to worst based on *MSE*. The passage rate was estimated to be 2,555 based on a run of 4.01 million fish through 22 July (includes residual fish abundance in the district). The 2010 test fish *CCPUE* curve most closely tracked the 1984 run, estimating a $CCPUE_f$ of 1,836 index points. Given a passage rate of 2,555, the total run estimate was 4.69 million fish. As cautioned earlier, the first best fit (lowest *MSE*) on approximately 20 July often turns out not to be the best fit at the end of July, so the top 5 fits were considered, which included run timing curves from 2006, 2005, 1989, and 1979 (in order of best fit). Using these data, total run estimates ranged from 4.19 to 11.83 million sockeye salmon. Unfortunately, the best fits included runs from 4 days early to 9 days late, raising concerns about which run timing curve to use. Because many sockeye salmon runs in other areas of the state were characterized as early or on time, fits from on time and early-run curves were given more credence.

The second formal estimate of the total run of sockeye salmon to UCI in 2010 followed the 25 July inletwide commercial fishing period (Table 5). At that time, the run to date was estimated at 4.50 million fish, with a *CCPUE* of 1,839. The passage rate was therefore estimated to be 2,448 fish per CPUE point. The current *CCPUE* curve again most closely tracked the 1984 run, and projected a $CCPUE_f$ of 1,858 and a total run of 4.55 million fish. The top 5 best fits now all tracked runs that were either on time or early and projected a total run to UCI ranging from 4.55 to 5.58 million fish.

The total sockeye salmon run to UCI in 2010 (postseason data) was estimated at approximately 5.26 million fish, including commercial, sport, and personal use harvests, as well as escapement to all systems (this run estimate utilized Bendix-equivalent sockeye salmon escapement data from the Kenai and Kasilof rivers, as these were the data used inseason). Therefore, the first best fit total run estimates from the 2 formal inseason projections of the 2010 run were approximately 11% and 14% lower, respectively, than the actual run size. However, because the top 5 best fits from each analysis were given careful consideration inseason, the range in error from these projections are highlighted here. Based on data through 22 July, the difference between the projected total run to UCI and the actual value ranged from -20% to +125%. Using the test fish data through 25 July, the error ranged from -14% to +6%, with 3 of the top 5 best fits projecting a total run that was within 6% of the actual value.

KENAI RIVER RUN ESTIMATE

In addition to making inseason estimates of the total size of the annual UCI sockeye salmon run, commercial fishery management plans compel ADF&G to make an inseason estimate of the number of Kenai River sockeye salmon in the run. Various management actions in both sport and commercial fisheries are tied to the total abundance of Kenai River sockeye salmon, which is characterized by 3 different size ranges: less than 2 million fish, between 2 and 4 million fish, and greater than 4 million fish (Shields 2010). As previously described, the *CCPUE* curves from the top 5 best fits of previous year's test fish data were used to project the $CCPUE_f$ for 2010, which was then used to estimate the UCI total run. The Kenai River component of the run was determined in part from a weighted age-composition allocation method to estimate the stock composition of the commercial harvest (Tobias and Tarbox 1999). This method (Bernard 1983) allocates the commercial harvest to various stocks by comparing the age composition of the escapement in the major river systems of UCI to the age composition of sockeye salmon harvested commercially (Tobias and Willette 2004). Three important assumptions of the weighted age-composition method are that: (1) the age compositions of fish escaping into the various river systems are representative of the age composition in the commercial harvest, (2) the commercial harvest in specific areas is composed of nearby stocks, and (3) exploitation rates are equal among stocks within age classes. The Kenai River run to date is estimated by summing: (1) the commercial harvest of Kenai River stocks, (2) the estimated sonar passage in the Kenai River, and (3) an estimate of sport and personal use harvest below the river mile 19 sonar site. Finally, the remainder of the run that will be Kenai River origin is projected by subtracting the run to date from the total run estimate, and then applying an estimate of the proportion of the run remaining that will be Kenai River by reviewing previous years' data for runs of similar timing.

Using the 22 July total UCI run estimate, the total Kenai River sockeye salmon run was projected to range between 2.46 and 7.81 million fish (Table 6). Assuming 2.15 million Kenai River sockeye salmon had returned to date, that meant 0.31 to 5.66 million fish remained in the run, which was somewhat problematic. The preseason forecast for Kenai River had projected a total run of 3.06 million fish, requiring commercial fisheries management to follow guidelines for a run of 2 to 4 million sockeye salmon. However, 2 of the top 5 best fit estimators from the

23 July assessment were projecting a Kenai River run slightly less than 2 million fish, while 2 others estimated the run at slightly greater than 2 million fish, and one predicted a final run greater than 5 million. The significant variation in forecast ranges alerted staff to a precautionary commercial fishery management approach. A few days later (on 27 July), the Kenai River run assessment was updated. As mentioned earlier, the top 5 best fits now all tracked early or on time runs. The total Kenai River run was projected to range between 2.63 and 3.24 million fish (Table 6). Approximately 2.48 million sockeye salmon had been accounted for in the run to date, which left 0.15 to 0.77 million Kenai River fish remaining in the 2010 run (assuming 60% of the run remaining would be Kenai River stock). With all 5 run projections estimating the total Kenai River run ranging between 2 and 4 million fish, these inseason projections suggested that staff follow the guidelines for a Kenai River run of 2 to 4 million fish.

Preliminary postseason data showed the 2010 Kenai River sockeye salmon run to be approximately 3.26 million fish. The total run estimate, however, included sport, personal use, and educational fishery annual harvest estimates; these data will not be available until later in 2011. The inseason estimates of the Kenai River total run deviated from the actual run by -13% to +140% using data through 23 July, and by -0.3% to -19% using data through 26 July. The first best fit estimators from each time frame projected a total Kenai River run that was 13% and 19% less than the actual run, respectively. In summary, 7 of the 10 estimates of Kenai River total run size from the 22 July and 25 July analyses were within 20% of the actual estimated final run. Once again, test fish projections were a critical tool that managers relied on in making difficult inseason decisions.

OTF ERROR

The absolute percent error (APE) between actual total run and CCPUE-predicted total run in the 20 July estimate (or shortly thereafter) has been >30% only for runs 1 or more days early (Table 7, Figure 3). For all early runs, the mean APE is 38% (median=25%), while for runs on time or late, the 20 July mean APE is only 9% (median=7%). As stated earlier, the 20 July first best fit estimator has proven over time to not always be the best fit of the data just a few days later, but that was not the case in 2010. Using data through 22 July, the first best fit estimator most closely tracked the 1984 run, which was a 3 day early run, and projected a total return that was approximately 11% less than the actual run. Just a few days later the first best fit estimator had not changed, still tracking the 1984 run, and projected a total run approximately 14% less than the actual run.

RUN TIMING

The last day of test fishing typically occurs on 30 July each year, which means the "tail-end" of the sockeye salmon run is not assessed by the project. In 2010, the test fish project ended on 29 July, but escapement monitoring continued through 5 August in the Crescent River, 15 August in the Kasilof River, 19 August in the Kenai River, 5 September at Fish Creek and into the first week of September at Judd, Chelatna, and Larson lakes. Meanwhile, commercial fishing also continued into September. Therefore, to estimate the proportion of the run that occurred after the test fishery ceased, 2 methods were used to adjust the *CCPUE* statistic to reflect what it would have been had the project continued through the end of the sockeye salmon run.

The first method used the number of fish harvested commercially after the test fishery ended (Equation 13), while the second method enumerated both escapement and commercial catch (total run) after the test fishery terminated (Equation 14). The sport and personal use harvest of sockeye salmon occurring after the test fishery was assumed to be minimal, and therefore was not considered. Although differences between annual inseason and postseason (adjusted by either harvest or total run) $CCPUE_f$ statistics were often relatively minor, they affected calculations of the *a* and *b* coefficients in the equations used to describe historical run timing curves, which in turn had an effect on estimates of subsequent $CCPUE_f$ values (Table 4). Beginning in 2002, the total run method was used to make postseason adjustments to all previous years' $CCPUE_f$ statistics (Shields 2003). For the 2010 season, the test fish $CCPUE_f$ of 2,055 was adjusted to 2,266 based on the number of fish that were commercially harvested and escaped after the test fishery ceased (Table 4). Therefore, this method estimated that approximately 10% of the sockeye salmon run occurred after the test fishery terminated. Historical *a* and *b* coefficients calculated using total run-adjusted $CCPUE_f$ values are now used for all inseason run projections. Using the total run-adjusted values, the relationship between total run (logged) and test fishery $CCPUE_f$ was significantly (α=0.05) correlated (P=0.047 and R^2=0.21), yet 79% of the variation remains unexplained. Therefore, like the unadjusted $CCPUE_f$ statistic, using the total run-adjusted $CCPUE_f$ statistic by itself may not be a reliable predictor of the total annual sockeye salmon run.

A nonlinear mathematical model (Mundy 1979) was fit to the *CCPUE* proportions of the 2010 sockeye salmon run to UCI. Using the total run-adjusted $CCPUE_f$, this analysis suggested that 12.3% of the run had passed the OTF transect line prior to the start of test fishing on 1 July, and that the run was 89.3% complete at project termination on 29 July (Figure 4 and Appendix A13). Therefore, the mathematical modes suggest the 2010 test fishery covered approximately 77.0% of the run. The test fish passage rate for the season can be calculated by dividing the total number available to capture by the test fishery by the unadjusted $CCPUE_f$. In 2010, the estimated final passage rate was 2,272.

The midpoint of the 2010 UCI sockeye salmon run, or the day on which approximately 50% of the total run had entered UCI at the test fish transect, occurred on day 21.49, or 14 July, which was 1 day early compared to the historical mean date of 15 July (Table 8).

ENVIRONMENTAL VARIABLES

Surface water temperatures measured along the test fish transect ranged from 8.5°C to 12.1°C and averaged 9.9°C for the year (Appendices A14 and A15). These water temperature data were very similar to the 1992–2009 average surface water temperature of 10.3°C (Appendix A16). Water temperatures are believed by many to play a significant role in the timing of salmon runs (Burgner 1980), so these data have been closely monitored. In general, warmer water temperatures are thought to result in early runs, while cooler temperatures produce later runs. For example, in Bristol Bay, Burgner (1980) reported that the arrival dates of sockeye salmon were early during years when water temperatures were warmer than average. In a later Bristol Bay study, Ruggerone (1997) found that the change in temperature from winter to spring was a better predictor of run timing than water temperature alone. However, water temperature data alone may or may not be an accurate predictive tool for gauging the run timing of UCI salmon stocks. The 2005 UCI sockeye salmon run was the second latest run ever observed, yet surface water temperatures along the test fish transect were the warmest ever measured. Conversely, the 2008 run was 4 days early, yet surface water temperatures were much cooler than average. Therefore, it appears that factors other than just water temperature likely play a role in determining salmon run timing in UCI. Pearcy (1992) summarized some of the factors that affect the coastal migration of returning adult salmon. He reviewed the orientation mechanisms used by salmon in coastal waters and concluded that prior to entering estuaries adult salmon probably rely on cues that are different from those used in the open ocean phases of their migration. Salinity, temperature, currents, and bathymetry were all thought to play a role in migration. Another dynamic to consider that could affect run timing is the age composition of the run, which relates to fish size; larger fish swim faster than smaller fish (Flynn and Hilborn 2004). Finally, it should be noted that when classifying total sockeye salmon run timing in UCI, the magnitude of the Kenai River run should be considered. Kenai River sockeye salmon return to UCI later than any other numerically significant stock, and because the Kenai River run is the largest in UCI, runs classified as late in general tend to be large Kenai River runs. For example, from 1979 to 2010, the average Kenai River annual run for years where the UCI return was classified as early (n=12), was 2.3 million fish, yet for UCI runs classified as on time or late (n=20), the Kenai River run averaged 3.7 million fish. Thus, a combination of these factors (water temperature, salinity, currents, bathymetry, fish size, and stock composition of the run) likely affects fish migration and ultimately classifying the run timing as early or late.

In an attempt to better understand and predict sockeye salmon migrations into UCI, ADF&G conducted a companion study on the test fish vessel from 2002 to 2005. Using side-looking sonar, fish distribution in the water column was measured in relation to various oceanographic data, such as water temperature, salinity, tide stage, and water clarity. These data have not been published yet, but one of the objectives of the study was to determine whether or not the OTF inseason run forecasting model could be improved using this additional information.

A summary of the physical data that has been collected at each of the 6 test fish stations can be found in Appendices A14–A16. In 2010, air temperatures along the test fish transect ranged from 8° to 14°C and averaged 11.2°C, or the seventh coldest average air temperature since the test fishery began in 1979. Wind velocity averaged 5.8 knots for the month, which was the third calmest year in the past 20 years and the fifth least windy year since 1979. Wind direction was variable, but in general, winds originated out of the south, the predominate wind orientation in UCI during July. The 2010 seasonal average salinity of 30.1 ppt was slightly higher than the 1992–2009 average of 29.4 ppt. Koenings et al. (1987) describe a secchi disk as a black and white circular plate that is used to easily estimate the degree of visibility in natural waters. Secchi disk readings in 2010 were similar to the averages from all previous years. In general, water clarity along the test fish transect decreases as you travel from east to west (from 2001 to 2010, the average secchi disk depth was 7.9 m at station 4 (Figure 1) and decreased to 3.0 m at station 8) as a result of numerous glacial watersheds draining into the west side of Cook Inlet. Finally, station 4 was the shallowest station, averaging 23.8 fathoms (144 feet) in depth. It should be noted, though, that changes in depth are a result of different stages of tide as well as minor differences in set location from day to day.

GSI ANALYSIS

ADF&G has developed and refined sockeye salmon genetic stock identification techniques (GSI) since the early 1990s (Seeb et al. 1997; Seeb et al. 2000; Habicht et al. 2007; Barclay et al. 2010a-b). Beginning in 2006, fish captured in the test fishery that were previously measured to estimate mean lengths were also sampled for GSI analysis. Approximately 7,500 samples collected from 2006 to 2009 were successfully genotyped (Tables 9 and 10). Samples were pooled into discrete time periods to meet sample size goals (*n*=400), resulting in 4 periods in 2006 and 2008, 5 periods in 2007, and 6 periods in 2009. The data from these 4 years revealed similar findings, i.e., during the third and fourth weeks in July, Kenai River sockeye salmon were the dominant stock entering Cook Inlet, whereas during the first part of the month, Kasilof River sockeye salmon stocks were equally or more abundant than Kenai River stocks. The GSI analyses also showed that Susitna River sockeye salmon stocks (labeled as JCL and SusYen) comprised 11% of all fish captured in 2006, 12% in 2007, 13% in 2008, and 9% in 2009 (unweighted average). The 2010 test fish samples had not been analyzed at the time this report was prepared.

The efficacy of using GSI analyses in combination with the test fishery for inseason management of the UCI commercial fishery remains unclear. While it could be useful to know when specific stocks are entering the Central District, inter and intra-annual variability in migration routes through the district would make adjusting commercial fishing periods to increase or decrease stock-specific exploitation problematic. Nonetheless, GSI data will undoubtedly serve as the foundation for future research projects aimed at more clearly understanding stock-specific run timing and migration through UCI.

The UCI test fishery continues to provide fishery managers with very important data about sockeye salmon abundance and timing. Since commercial, sport, and personal use fishery management plans depend on inseason sockeye salmon run estimates, the UCI test fishery project remains one of the most essential tools available for their management.

ACKNOWLEDGEMENTS

The authors would like to thank Roland Maw, captain of the *F/V Americanus*, and the test fishery crew members for conducting safe and efficient maritime activities.

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TABLES AND FIGURES

Table 1.–Summary of sockeye salmon fishing effort, daily and cumulative catch and CPUE, and fish length, Upper Cook Inlet offshore test fish project, 2010.

Date	Number of Stations	Mean Fishing Time (min)	CATCH Daily	CATCH Cum	CPUE Daily	CPUE Cum	Mean Length (mm)
7/1	6	228.0	90	90	66	66	556
7/2	6	238.5	154	244	95	161	541
7/3	6	223.5	86	330	67	228	553
7/4	6	255.5	206	536	132	360	543
7/5	6	248.0	219	755	150	509	554
7/6	6	242.5	166	921	110	619	553
7/7	6	227.0	20	941	15	634	535
7/8	6	217.0	11	952	9	644	553
7/9	6	235.5	116	1,068	84	728	569
7/10	5[a]	196.5	39	1,107	28	756	558
7/11	6	244.5	306	1,413	206	962	564
7/12	6	225.5	60	1,473	46	1,008	553
7/13	6	228.5	44	1,517	34	1,043	559
7/14	6	226.0	65	1,582	51	1,093	555
7/15	0[a]	0.0	117	1,699	74	1,167	na
7/16	3[a]	149.0	188	1,887	113	1,280	564
7/17	2[a]	89.5	132	2,019	91	1,371	572
7/18	5[a]	191.0	66	2,085	51	1,421	563
7/19	6	235.0	103	2,188	76	1,497	564
7/20	6	227.5	82	2,270	57	1,554	554
7/21	0[a]	0.0	59	2,329	40	1,594	na
7/22	6	232.0	33	2,362	23	1,617	556
7/23	3[a]	113.5	126	2,488	72	1,690	560
7/24	6	246.5	121	2,609	74	1,764	559
7/25	6	220.5	21	2,630	16	1,780	551
7/26	6	235.5	148	2,778	104	1,885	561
7/27	6	271.5	228	3,006	130	2,015	564
7/28	6	220.0	14	3,020	11	2,027	554
7/29	6	222.5	38	3,058	28	2,055	553

[a] Not all stations fished because of rough weather; the data for missing stations were interpolated.

Table 2.–Estimated sockeye salmon catch by date and station, Upper Cook Inlet offshore test fish project, 2010.

	Station Number						
Date	4	5	6	6.5	7	8	Total
7/1	8	71	8	0	3	0	90
7/2	4	19	3	3	124	1	154
7/3	27	14	45	0	0	0	86
7/4	23	19	68	89	1	6	206
7/5	6	2	99	46	54	12	219
7/6	0	4	13	87	5	57	166
7/7	0	1	5	0	6	8	20
7/8	2	0	1	2	5	1	11
7/9	0	8	19	49	29	11	116
7/10[a]	2	1	25	2	1	8	39
7/11	6	2	87	88	119	4	306
7/12	1	26	17	2	14	0	60
7/13	1	16	4	6	10	7	44
7/14	3	16	31	2	0	13	65
7/15[a]	6	15	51	27	9	9	117
7/16[a]	10	24	71	51	17	15	188
7/17[a]	17	24	35	34	11	11	132
7/18[a]	25	24	6	2	4	5	66
7/19	42	4	39	9	2	7	103
7/20	59	12	4	6	1	0	82
7/21[a]	31	6	3	18	1	0	59
7/22	2	0	1	30	0	0	33
7/23[a]	6	1	11	1	106	1	126
7/24	10	1	21	80	8	1	121
7/25	0	0	2	16	3	0	21
7/26	10	20	5	19	31	63	148
7/27	0	150	1	43	33	1	228
7/28	0	9	2	2	0	1	14
7/29	0	3	0	6	29	0	38
Total	301	492	677	720	626	242	3,058
%	10%	16%	22%	24%	20%	8%	100%

[a] Not all stations fished because of rough weather; the data for missing stations was interpolated.

Table 3.–Estimated sockeye salmon CPUE by date and station, Upper Cook Inlet offshore test fish project, 2010.

	Station Number						
Date	4	5	6	6.5	7	8	Total
7/1	6.2	50.4	6.5	0.0	2.4	0.0	66
7/2	3.2	14.6	2.4	2.5	71.9	0.8	95
7/3	20.8	11.6	34.2	0.0	0.0	0.0	67
7/4	16.3	13.5	40.8	56.1	0.8	4.8	132
7/5	4.6	1.5	62.4	32.2	39.4	9.4	150
7/6	0.0	3.3	9.9	54.8	4.0	37.6	110
7/7	0.0	0.8	3.9	0.0	4.6	6.2	15
7/8	1.6	0.0	0.8	1.7	4.2	0.8	9
7/9	0.0	6.5	14.4	32.8	21.8	8.7	84
7/10[a]	1.5	0.8	17.8	1.6	0.8	5.9	28
7/11	4.7	1.7	61.8	59.8	75.0	3.2	206
7/12	0.8	19.5	13.1	1.6	11.1	0.0	46
7/13	0.8	11.8	3.2	4.8	7.9	5.7	34
7/14	2.3	12.3	23.3	1.6	0.0	11.1	51
7/15[a]	4.2	10.0	31.2	16.4	5.7	6.4	74
7/16[a]	6.5	15.3	39.1	31.1	11.4	9.7	113
7/17[a]	12.4	16.8	23.1	23.1	7.3	7.8	91
7/18[a]	18.3	18.2	4.9	1.6	3.2	4.4	51
7/19	29.3	3.0	28.9	7.1	1.6	5.7	76
7/20	38.4	9.5	3.2	4.8	1.0	0.0	57
7/21[a]	19.9	4.7	2.0	13.1	0.5	0.0	40
7/22	1.4	0.0	0.8	21.3	0.0	0.0	23
7/23[a]	4.5	0.4	7.9	1.5	57.2	0.8	72
7/24	7.7	0.8	14.9	44.0	6.2	0.9	74
7/25	0.0	0.0	1.6	12.2	2.5	0.0	16
7/26	7.9	15.2	3.9	14.4	20.8	42.2	104
7/27	0.0	77.6	0.8	28.0	23.4	0.6	130
7/28	0.0	7.3	1.6	1.6	0.0	0.8	11
7/29	0.0	2.5	0.0	4.9	20.6	0.0	28
TOTAL	213	330	458	475	405	173	2,055
%	10%	16%	22%	23%	20%	8%	100%

[a] Not all stations fished because of weather; the data for missing stations was interpolated.

Table 4.–A comparison of models used to make postseason adjustments to the offshore test fish final CPUE.

	Final	Postseason OTF CPUE Adjustment		Harvest Adjusted		Total Run Adjusted	
Year	OTF CPUE	Harvest-adjusted	Total Run-adjusted	*a*	*b*	*a*	*b*
1979	602	651	664	-3.2451	0.1876	-3.3380	0.2004
1980	740	770	777	-2.2537	0.1640	-2.2403	0.1612
1981	364	383	387	-2.5459	0.1856	-2.5243	0.1819
1982	651	775	786	-3.6839	0.1522	-3.7156	0.1633
1983	2,464	2,472	2,474	-4.2719	0.1883	-4.2732	0.1884
1984	1,331	1,334	1,341	-3.4257	0.1855	-3.4018	0.1834
1985	1,422	1,575	1,563	-3.4581	0.1523	-3.5633	0.1626
1986	1,653	1,731	1,714	-3.7671	0.1633	-3.8642	0.1719
1987	1,404	1,422	1,428	-4.3442	0.1689	-4.6385	0.1785
1988	1,131	1,145	1,169	-3.3682	0.1639	-3.5655	0.1662
1989	619	682	692	-2.7114	0.1258	-2.7031	0.1238
1990	1,358	1,404	1,426	-5.7913	0.2259	-5.7085	0.2211
1991	1,574	1,759	1,740	-4.5806	0.1885	-4.6331	0.1919
1992	2,021	2,186	2,195	-5.4366	0.2235	-5.4043	0.2217
1993	1,815	1,882	1,913	-4.0776	0.1906	-3.9018	0.1797
1994	1,012	1,145	1,199	-4.0770	0.1553	-3.9757	0.1453
1995	1,712	1,828	1,850	-4.7036	0.2131	-4.6219	0.2078
1996	1,723	1,765	1,796	-4.6328	0.2266	-4.4605	0.2144
1997	1,656	1,705	1,826	-3.8265	0.1621	-3.7000	0.1496
1998	1,158	1,355	1,313	-3.6700	0.1473	-3.7142	0.1515
1999	2,226	2,475	2,419	-5.3100	0.2175	-5.1500	0.2081
2000	1,520	1,532	1,565	-5.1094	0.2614	-4.9141	0.2480
2001	1,586	1,594	1,630	-3.9323	0.2002	-3.9823	0.2041
2002	1,736	1,749	1,825	-4.3694	0.2292	-4.0642	0.2068
2003	1,787	1,824	1,848	-4.5091	0.2117	-4.4402	0.2068
2004	2,028	2,220	2,345	-4.6374	0.1903	-4.6374	0.1903
2005	2,643	3,032	3,191	-3.7460	0.1354	-3.7152	0.1302
2006	1,507	1,756	1,969	-4.2031	0.1438	-4.0762	0.1308
2007	2,584	2,774	2,924	-4.9217	0.1962	-4.6427	0.1793
2008	1,594	1,612	1,675	-2.9601	0.1665	-2.8021	0.1521
2009	2,487	2,559	2,616	-4.5578	0.2275	-4.4130	0.2173
2010	2,055	2,184	2,266	-3.3795	0.1702	-3.1347	0.1459

Table 5.–Total run estimates for sockeye salmon to Upper Cook Inlet, Alaska, made during the 2010 season.

Based on data through 7/22/2010						
Escapement						1,287,160
Cumulative Catch (Commercial, Sport, & PU)						2,481,564
Residual in District						245,809
Total Run Through 7/22/2010 =						4,014,533
2010 Cumulative OTF CPUE through 7/22 =						1,571
Passage Rate (Total Run/Cumulative CPUE) through 7/22 =						2,555
Run Estimates Based on Model Results (Fit of Current Year to Past Years)						
	Mean Sum	Estimated Total CPUE				Estimated
Year	of Squares	Current	Previous Day	Difference	Timing	Total Run
1984	0.001310	1,836	1,840	-4	3 day early	4,690,444
2006	0.001469	4,629	4,783	-154	9 day late	11,826,320
2005	0.001516	3,671	3,763	-93	7 day late	9,378,998
1989	0.001819	2,288	2,297	-8	on time	5,847,189
1979	0.001878	1,639	1,631	8	5 day early	4,188,149
1988	0.001950	2,222	2,249	-27	1 day early	5,677,840
1985	0.001986	2,295	2,326	-31	on time	5,864,486
2008	0.002179	1,871	1,869	2	4 day early	4,780,944
1997	0.002224	2,813	2,872	-59	3 day late	7,187,410
1998	0.002297	2,771	2,829	-58	3 day late	7,080,303
1994	0.002351	3,474	3,577	-102	5 day late	8,877,085
1982	0.002448	2,438	2,480	-42	1 day late	6,229,423
2001	0.002600	1,920	1,936	-16	2 day early	4,906,499
2002	0.002942	1,935	1,953	-18	2 day early	4,944,952
1986	0.002953	2,392	2,435	-43	on time	6,110,741
1993	0.003031	2,258	2,295	-36	on time	5,770,052
1983	0.004703	2,434	2,491	-57	1 day late	6,219,893
2009	0.004757	2,015	2,043	-28	2 day early	5,148,614
1987	0.005150	3,263	3,390	-128	4 day late	8,336,183
2007	0.005226	3,237	3,363	-126	4 day late	8,269,726
1996	0.005259	2,092	2,127	-35	1 day early	5,345,710
2003	0.005410	2,207	2,250	-43	1 day early	5,637,828
2004	0.006070	2,825	2,921	-96	2 day late	7,219,195
1991	0.006153	2,769	2,861	-92	2 day late	7,075,934
1995	0.006515	2,349	2,407	-58	on time	6,001,488
2000	0.006894	1,920	1,945	-25	2 day early	4,905,834
1999	0.008422	2,972	3,099	-127	3 day late	7,592,793
1990	0.009937	3,389	3,581	-192	4 day late	8,657,761
1992	0.010114	2,884	3,012	-128	2 day late	7,368,793
1981	0.010774	1,486	1,466	20	8 day early	3,797,125
1980	0.012360	1,524	1,504	20	8 day early	3,893,348

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Table 5.–Page 2 of 2.

Based on data through 7/26/2010						
Escapement						1,523,606
Cumulative Catch (Commercial, Sport, & PU)						2,799,021
Residual in District						178,429
Total Run Through 7/26/2010 =						4,501,055
2010 Cumulative OTF CPUE through 7/26 =						1,839
Passage Rate (Total Run/Cumulative CPUE) through 7/26 =						2,448

Run Estimates Based on Model Results (Fit of Current Year to Past Years)

	Mean Sum	Estimated Total CPUE				Estimated
Year	of Squares	Current	Previous Day	Difference	Timing	Total Run
1984	0.001287	1,858	1,847	11	3 day early	4,547,363
1989	0.001561	2,280	2,277	2	on time	5,579,668
1988	0.002019	2,166	2,172	-6	1 day early	5,301,039
2008	0.002150	1,911	1,898	13	4 day early	4,677,475
1985	0.002167	2,226	2,235	-9	on time	5,447,500
2001	0.002289	1,910	1,905	5	2 day early	4,674,587
2002	0.002603	1,919	1,916	4	2 day early	4,697,985
2005	0.002823	3,369	3,433	-64	7 day late	8,244,665
1979	0.002916	1,700	1,680	20	5 day early	4,160,820
1982	0.002958	2,332	2,350	-17	1 day late	5,708,802
2006	0.003170	4,110	4,224	-114	9 day late	10,059,675
1997	0.003237	2,642	2,674	-32	3 day late	6,466,173
1993	0.003273	2,177	2,188	-11	on time	5,329,308
1998	0.003285	2,606	2,637	-31	3 day late	6,377,547
1986	0.003471	2,285	2,302	-17	on time	5,593,546
1994	0.004167	3,155	3,221	-66	5 day late	7,722,161
2009	0.004396	1,971	1,973	-2	2 day early	4,824,451
1996	0.005086	2,028	2,034	-6	1 day early	4,962,835
1983	0.005577	2,295	2,317	-23	1 day late	5,616,406
2003	0.005606	2,114	2,126	-12	1 day early	5,174,402
2000	0.006099	1,890	1,888	2	2 day early	4,626,297
1995	0.007269	2,213	2,234	-21	on time	5,416,123
1987	0.008206	2,896	2,967	-71	4 day late	7,087,510
2007	0.008261	2,876	2,946	-70	4 day late	7,038,045
1991	0.008315	2,525	2,569	-44	2 day late	6,179,834
2004	0.008380	2,566	2,614	-47	2 day late	6,281,627
1999	0.011872	2,633	2,695	-62	3 day late	6,445,614
1981	0.013648	1,584	1,557	28	8 day early	3,877,173
1992	0.013656	2,554	2,613	-59	2 day late	6,251,033
1980	0.014457	1,620	1,593	27	8 day early	3,965,922
1990	0.015453	2,876	2,971	-95	4 day late	7,038,608

Table 6.–Projected total Kenai River sockeye salmon run (millions) in 2010 estimated from total offshore test fish CPUE and age composition stock allocation data through 22 July and 26 July, 2010.

Data through 22 July

Year	MSS	Est. Total OTF CPUE Current	Est. Total OTF CPUE Prev. Day	Est. Total OTF CPUE Timing	Passage Rate	Estimated UCI Total run	Estimated UCI Run to Date[a]	Estimated UCI Run Remaining	Estimated Kenai Run to Date	Prop. Kenai	Estimated Kenai Run Remaining	Estimated Total Kenai Return
1984	0.00131	1,836	1,840	3 day early	2,555	4.69	3.74	0.95	2.15	70%	0.665	2.816
2006	0.00147	4,629	4,783	9 days late	2,555	11.83	3.74	8.09	2.15	70%	5.660	7.811
2005	0.00152	3,671	3,763	7 day late	2,555	9.38	3.74	5.64	2.15	70%	3.947	6.098
1989	0.00182	2,288	2,297	On Time	2,555	5.85	3.74	2.11	2.15	70%	1.475	3.626
1979	0.00188	1,639	1,631	5 day early	2,555	4.19	3.74	0.45	2.15	70%	0.314	2.465

Data through 26 July

Year	MSS	Est. Total OTF CPUE Current	Est. Total OTF CPUE Prev. Day	Est. Total OTF CPUE Timing	Passage Rate	Estimated UCI Total run	Estimated UCI Run to Date[a]	Estimated UCI Run Remaining	Estimated Kenai Run to Date	Prop. Kenai	Estimated Kenai Run Remaining	Estimated Total Kenai Return
1984	0.00129	1,858	1,847	3 day early	2,448	4.55	4.30	0.25	2.48	60%	0.150	2.625
1989	0.00156	2,280	2,277	on time	2,448	5.58	4.30	1.28	2.48	60%	0.769	3.245
1988	0.00202	2,166	2,172	1 day early	2,448	5.30	4.30	1.00	2.48	60%	0.602	3.077
2008	0.00215	1,911	1,898	4 day early	2,448	4.68	4.30	0.38	2.48	60%	0.228	2.703
1985	0.00217	2,226	2,235	on time	2,448	5.45	4.30	1.15	2.48	60%	0.690	3.165

Note: MSS is the mean sum of squares.

[a] Does not include residual fish resident in the Central District.

Table 7.–Absolute Percentage Error (APE) using the first best fit estimate of test fish data on or after July 20 to project the total annual UCI sockeye salmon run.

Year	Actual Run (millions)	July 20 estimate	APE	Run Timing
1988	8.52	11.30	32.6%	1 day early
1990	5.00	4.90	1.9%	4 day late
1991	3.66	3.90	6.5%	2 day late
1992	10.90	11.40	4.5%	2 day late
1993	6.48	6.40	1.2%	on time
1994	5.51	5.30	3.8%	5 day late
1995	4.51	4.50	0.2%	on time
1996	5.63	8.50	51.0%	1 day early
1997	6.41	6.00	6.4%	3 day late
1998	3.00	3.40	13.3%	3 day late
1999	4.57	5.20	13.7%	3 day late
2000	2.94	3.20	8.8%	2 day early
2001	3.53	6.20	75.4%	2 day early
2002	4.84	5.50	13.6%	2 day early
2003	6.29	6.79	8.0%	1 day early
2004	7.92	8.94	12.8%	2 day late
2005	7.92	9.17	15.8%	7 day late
2006	4.96	3.60	27.5%	9 day late
2007	5.44	4.65	14.6%	4 day late
2008	4.13	5.17	25.3%	4 day early
2009	4.29	9.11	112.5%	2 day early
2010[a]	5.26	4.69	10.8%	1 day early
			Average	Median
		All runs	21%	13%
		On time +	9%	7%
		All early	38%	25%

[a] Total run estimated by summing harvest and escapement throughout Upper Cook Inlet. In the Kenai and Kasilof rivers, escapements were converted to Bendix-equivalent units.

Table 8.–Midpoint dates of the sockeye salmon run across the Anchor Point test fish transect in Upper Cook Inlet, 1979–2010.

	Mean Date[a]	
Year	Coded	Calendar
1979	16.7	10 Jul
1980	13.9	7 Jul
1981	13.9	7 Jul
1982	22.8	16 Jul
1983	22.7	16 Jul
1984	18.5	12 Jul
1985	21.9	15 Jul
1986	22.5	15 Jul
1987	26.0	19 Jul
1988	21.5	14 Jul
1989	21.8	15 Jul
1990	25.8	19 Jul
1991	24.1	17 Jul
1992	24.4	17 Jul
1993	21.7	15 Jul
1994	27.4	20 Jul
1995	22.2	15 Jul
1996	20.8	14 Jul
1997	24.7	18 Jul
1998	24.5	18 Jul
1999	24.7	18 Jul
2000	19.8	13 Jul
2001	19.5	13 Jul
2002	19.7	13 Jul
2003	21.5	14 Jul
2004	24.4	17 Jul
2005	28.5	22 Jul
2006	31.2	24 Jul
2007	25.9	19 Jul
2008	18.4	11 Jul
2009	20.3	13 Jul
2010	21.8	14 Jul
Average	22.3	15 Jul

[a] Day 1 = 24 June.

Table 9.–Stock composition estimates, standard deviation (SD), 90% credibility interval (CI), sample size (n), and effective sample size (n_{eff}) for mixtures of sockeye salmon captured in the Upper Cook Inlet offshore test fishery in 2006–2009.

			Reporting Group[a]							
			Crescent	West	JCL	SusYen	Fish	KTNE	Kenai	Kasilof
					2006					
Start Date	07/01	Proportion	0.04	0.06	0.01	0.05	0.00	0.03	0.30	0.51
End Date	07/09	S.D.	0.01	0.02	0.01	0.02	0.00	0.01	0.04	0.04
n	325	Lower 90% CI	0.02	0.03	0.00	0.02	0.00	0.01	0.24	0.45
n_{eff}	325	Upper 90% CI	0.06	0.09	0.02	0.08	0.00	0.06	0.36	0.57
Start Date	07/10	Proportion	0.00	0.11	0.06	0.11	0.00	0.05	0.33	0.33
End Date	07/16	S.D.	0.00	0.04	0.02	0.04	0.00	0.02	0.04	0.04
n	266	Lower 90% CI	0.00	0.06	0.03	0.04	0.00	0.02	0.27	0.27
n_{eff}	263	Upper 90% CI	0.01	0.18	0.09	0.18	0.01	0.09	0.39	0.39
Start Date	07/17	Proportion	0.02	0.07	0.05	0.07	0.00	0.02	0.60	0.17
End Date	07/23	S.D.	0.01	0.02	0.02	0.02	0.00	0.01	0.03	0.03
n	401	Lower 90% CI	0.00	0.05	0.03	0.04	0.00	0.01	0.55	0.13
n_{eff}	397	Upper 90% CI	0.04	0.10	0.08	0.11	0.00	0.03	0.66	0.21
Start Date	07/24	Proportion	0.00	0.07	0.05	0.02	0.00	0.03	0.70	0.12
End Date	08/01	S.D.	0.00	0.02	0.01	0.02	0.00	0.02	0.03	0.02
n	393	Lower 90% CI	0.00	0.04	0.03	0.00	0.00	0.01	0.65	0.09
n_{eff}	391	Upper 90% CI	0.01	0.11	0.08	0.05	0.00	0.06	0.75	0.16

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Table 9.–Page 2 of 4.

			Reporting Group[a]							
			Crescent	West	JCL	SusYen	Fish	KTNE	Kenai	Kasilof
						2007				
Start Date	07/01	Proportion	0.08	0.16	0.03	0.03	0.02	0.05	0.39	0.23
End Date	07/09	S.D.	0.02	0.03	0.01	0.01	0.01	0.02	0.03	0.03
n	374	Lower 90% CI	0.05	0.11	0.02	0.01	0.00	0.02	0.34	0.19
n_{eff}	372	Upper 90% CI	0.12	0.22	0.05	0.05	0.03	0.09	0.45	0.28
Start Date	07/10	Proportion	0.03	0.08	0.05	0.10	0.01	0.03	0.53	0.17
End Date	07/13	S.D.	0.01	0.02	0.01	0.02	0.01	0.01	0.03	0.03
n	444	Lower 90% CI	0.02	0.04	0.03	0.07	0.00	0.01	0.47	0.13
n_{eff}	437	Upper 90% CI	0.06	0.11	0.07	0.14	0.02	0.05	0.59	0.22
Start Date	07/14	Proportion	0.04	0.02	0.07	0.11	0.00	0.03	0.61	0.12
End Date	07/18	S.D.	0.01	0.01	0.02	0.03	0.00	0.01	0.03	0.02
n	404	Lower 90% CI	0.02	0.01	0.05	0.06	0.00	0.01	0.56	0.08
n_{eff}	399	Upper 90% CI	0.06	0.05	0.10	0.15	0.00	0.05	0.66	0.16
Start Date	07/19	Proportion	0.05	0.02	0.04	0.08	0.00	0.03	0.67	0.10
End Date	07/23	S.D.	0.01	0.01	0.01	0.02	0.00	0.01	0.03	0.02
n	429	Lower 90% CI	0.04	0.01	0.03	0.05	0.00	0.02	0.62	0.06
n_{eff}	427	Upper 90% CI	0.08	0.04	0.07	0.11	0.00	0.05	0.72	0.13
Start Date	07/24	Proportion	0.05	0.04	0.05	0.06	0.00	0.02	0.69	0.09
End Date	08/02	S.D.	0.02	0.01	0.01	0.02	0.00	0.01	0.03	0.02
n	438	Lower 90% CI	0.03	0.02	0.03	0.03	0.00	0.00	0.64	0.06
n_{eff}	434	Upper 90% CI	0.08	0.06	0.08	0.09	0.00	0.04	0.74	0.13

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Table 9.–Page 3 of 4.

			Reporting Group[a]							
			Crescent	West	JCL	SusYen	Fish	KTNE	Kenai	Kasilof
2008										
Start Date	07/01	Proportion	0.03	0.11	0.05	0.04	0.01	0.03	0.27	0.45
End Date	07/07	S.D.	0.01	0.02	0.01	0.02	0.01	0.01	0.03	0.03
n	422	Lower 90% CI	0.02	0.07	0.04	0.02	0.00	0.02	0.22	0.40
n_{eff}	418	Upper 90% CI	0.05	0.15	0.08	0.08	0.03	0.05	0.32	0.50
Start Date	07/08	Proportion	0.04	0.12	0.07	0.10	0.00	0.01	0.43	0.22
End Date	07/12	S.D.	0.01	0.02	0.01	0.02	0.00	0.01	0.03	0.02
n	465	Lower 90% CI	0.02	0.09	0.05	0.07	0.00	0.00	0.39	0.18
n_{eff}	457	Upper 90% CI	0.06	0.16	0.10	0.14	0.00	0.02	0.48	0.26
Start Date	07/13	Proportion	0.05	0.13	0.10	0.05	0.00	0.03	0.49	0.15
End Date	07/17	S.D.	0.01	0.02	0.02	0.02	0.00	0.01	0.03	0.02
n	436	Lower 90% CI	0.03	0.09	0.07	0.01	0.00	0.01	0.44	0.11
n_{eff}	429	Upper 90% CI	0.07	0.16	0.14	0.09	0.00	0.05	0.54	0.19
Start Date	07/18	Proportion	0.03	0.13	0.06	0.04	0.00	0.02	0.58	0.14
End Date	07/31	S.D.	0.01	0.02	0.01	0.01	0.00	0.01	0.03	0.02
n	438	Lower 90% CI	0.01	0.10	0.04	0.02	0.00	0.01	0.54	0.11
n_{eff}	426	Upper 90% CI	0.05	0.16	0.08	0.06	0.00	0.03	0.63	0.18

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Table 9.–Page 4 of 4.

			Reporting Group[a]							
			Crescent	West	JCL	SusYen	Fish	KTNE	Kenai	Kasilof
					2009					
Start Date	07/01	Proportion	0.02	0.24	0.02	0.00	0.03	0.04	0.33	0.31
End Date	07/05	S.D.	0.01	0.03	0.01	0.00	0.01	0.01	0.03	0.03
n	401	Lower 90% CI	0.00	0.20	0.01	0.00	0.02	0.02	0.28	0.26
neff	392	Upper 90% CI	0.04	0.28	0.04	0.01	0.05	0.06	0.38	0.36
Start Date	07/06	Proportion	0.04	0.18	0.03	0.09	0.01	0.04	0.33	0.28
End Date	07/09	S.D.	0.01	0.03	0.02	0.03	0.01	0.01	0.03	0.03
n	445	Lower 90% CI	0.02	0.13	0.00	0.05	0.02	0.02	0.28	0.23
neff	431	Upper 90% CI	0.07	0.22	0.06	0.14	0.06	0.06	0.38	0.33
Start Date	07/10	Proportion	0.07	0.20	0.05	0.09	0.01	0.03	0.48	0.07
End Date	07/13	S.D.	0.02	0.03	0.02	0.03	0.01	0.01	0.03	0.02
n	407	Lower 90% CI	0.04	0.15	0.03	0.04	0.01	0.01	0.43	0.04
neff	398	Upper 90% CI	0.10	0.25	0.08	0.14	0.05	0.05	0.53	0.10
Start Date	07/14	Proportion	0.07	0.13	0.03	0.06	0.01	0.02	0.63	0.05
End Date	07/16	S.D.	0.02	0.02	0.01	0.02	0.01	0.01	0.03	0.02
n	406	Lower 90% CI	0.04	0.09	0.01	0.04	0.00	0.01	0.58	0.03
neff	395	Upper 90% CI	0.10	0.16	0.05	0.09	0.03	0.03	0.68	0.08
Start Date	07/17	Proportion	0.07	0.10	0.02	0.07	0.01	0.02	0.67	0.04
End Date	07/22	S.D.	0.02	0.03	0.01	0.03	0.01	0.01	0.03	0.02
n	402	Lower 90% CI	0.05	0.06	0.01	0.02	0.00	0.01	0.62	0.01
neff	397	Upper 90% CI	0.10	0.15	0.04	0.11	0.02	0.04	0.72	0.07
Start Date	07/23	Proportion	0.05	0.12	0.04	0.02	0.00	0.03	0.72	0.01
End Date	07/30	S.D.	0.02	0.02	0.01	0.01	0.00	0.01	0.03	0.02
n	331	Lower 90% CI	0.03	0.09	0.02	0.01	0.00	0.01	0.67	0.00
neff	324	Upper 90% CI	0.08	0.16	0.06	0.05	0.00	0.05	0.77	0.04

Source: Reproduced from Barclay et al. 2010a, b.

Note: Effective sample size (*neff*) is number of samples successfully screened from each stratum after excluding individuals with <80% scorable markers (see text). Proportions for a given mixture may not sum to 1 due to rounding error.

[a] Crescent = largest producer on the west side of Cook Inlet; West = the remaining West Cook Inlet producers; JCL= the lakes with weirs in the Susitna/Yentna Rivers (Judd/Chelatna/Larson); SusYen = the remaining producers in the Susitna/Yentna Rivers; Fish = the only major creek with a weir in the Knik/Turnagain/Northeast Cook Inlet area; KTNE = the remaining Knik/Turnagain/Northeast Cook Inlet producers; Kenai = the composite of all populations within the Kenai River; Kasilof = the composite of all populations within the Kasilof River.

Table 10.–Stock composition estimates, standard deviation (SD), and 90% credibility interval (CI), and effective sample size (n_{eff}) for spatially grouped mixtures of sockeye salmon captured in the Cook Inlet offshore test fishery by station from 1–30 July, 2009.

		Reporting Group							
		Crescent	West	JCL	SusYen	Fish	KTNE	Kenai	Kasilof
Station 4	Proportion	0.03	0.08	0.06	0.03	0.05	0.04	0.68	0.03
n_{eff} = 183	SD	0.02	0.03	0.02	0.02	0.02	0.02	0.04	0.03
	Lower 90% CI	0.00	0.03	0.03	0.00	0.02	0.02	0.61	0.00
	Upper 90% CI	0.06	0.13	0.10	0.08	0.08	0.08	0.75	0.08
Station 5	Proportion	0.02	0.18	0.04	0.05	0.01	0.03	0.53	0.15
n_{eff} = 698	SD	0.01	0.02	0.01	0.02	0.00	0.01	0.03	0.02
	Lower 90% CI	0.01	0.15	0.03	0.02	0.00	0.02	0.49	0.12
	Upper 90% CI	0.03	0.21	0.06	0.08	0.01	0.04	0.57	0.18
Station 6	Proportion	0.06	0.13	0.02	0.04	0.02	0.03	0.53	0.16
n_{eff} = 378	SD	0.02	0.02	0.01	0.02	0.01	0.01	0.03	0.03
	Lower 90% CI	0.03	0.10	0.01	0.02	0.00	0.01	0.48	0.12
	Upper 90% CI	0.09	0.17	0.04	0.08	0.03	0.05	0.59	0.20
Station 6.5	Proportion	0.04	0.19	0.04	0.06	0.02	0.01	0.49	0.15
n_{eff} = 481	SD	0.01	0.02	0.02	0.02	0.01	0.01	0.03	0.02
	Lower 90% CI	0.02	0.16	0.01	0.02	0.01	0.00	0.45	0.12
	Upper 90% CI	0.06	0.23	0.06	0.10	0.04	0.02	0.54	0.19
Station 7	Proportion	0.08	0.18	0.04	0.02	0.01	0.04	0.48	0.15
n_{eff} = 434	SD	0.02	0.02	0.02	0.02	0.01	0.01	0.03	0.02
	Lower 90% CI	0.06	0.14	0.01	0.00	0.00	0.03	0.43	0.11
	Upper 90% CI	0.11	0.22	0.06	0.05	0.20	0.06	0.53	0.19
Station 8	Proportion	0.26	0.19	0.00	0.07	0.00	0.03	0.39	0.06
n_{eff} = 163	SD	0.04	0.05	0.00	0.03	0.00	0.02	0.05	0.02
	Lower 90% CI	0.20	0.11	0.00	0.02	0.00	0.01	0.31	0.03
	Upper 90% CI	0.34	0.27	0.00	0.13	0.00	0.06	0.46	0.11

Source: Reproduced from Barclay et al. 2010a.

Note: Effective sample size (neff) is the number of samples successfully screened from each stratum after excluding individuals with <80% scorable markers. Proportions for a given mixture may not sum to 1 due to rounding error.

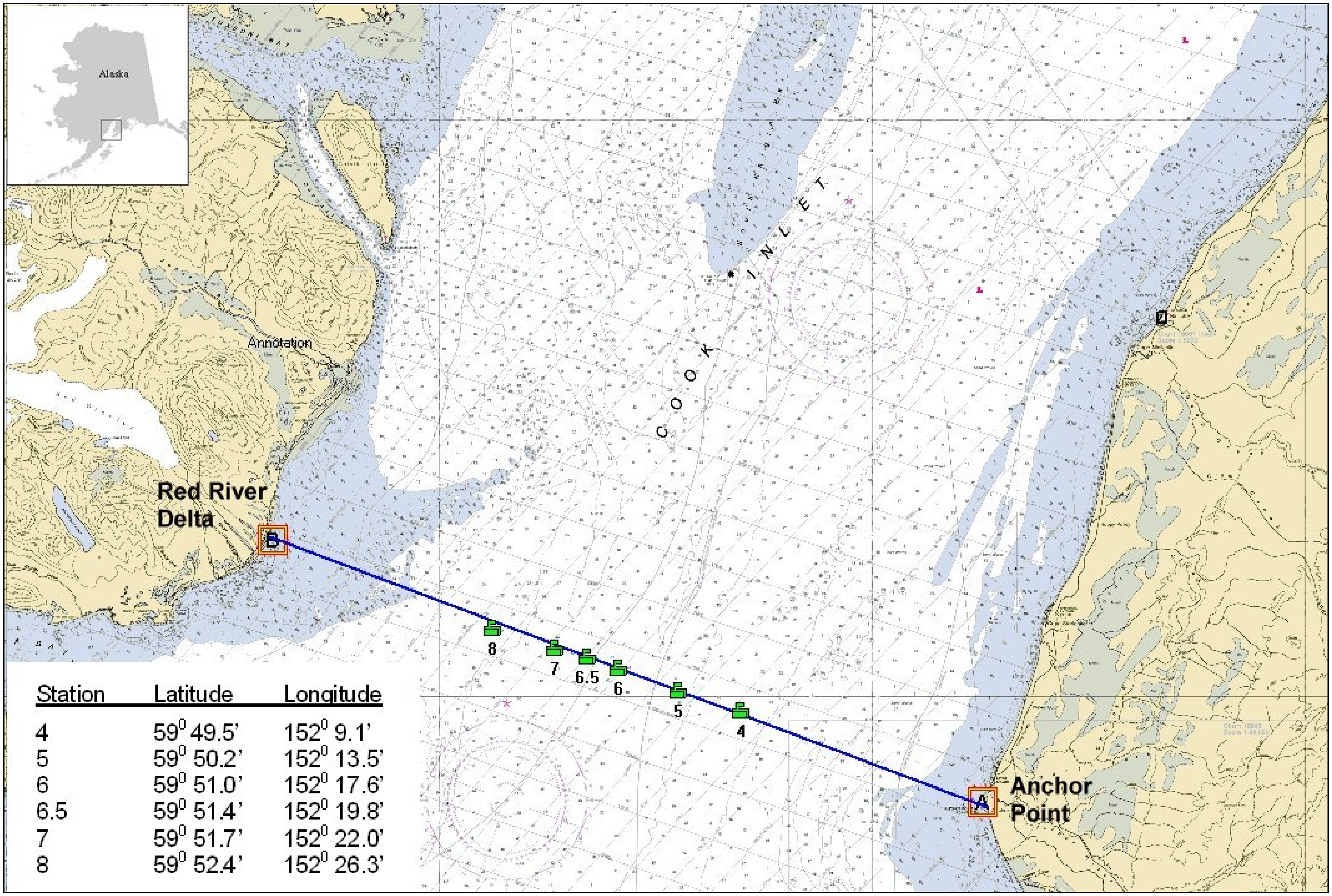

Figure 1.–Location of offshore test fish transect and fishing stations in Cook Inlet, Alaska, 2010.

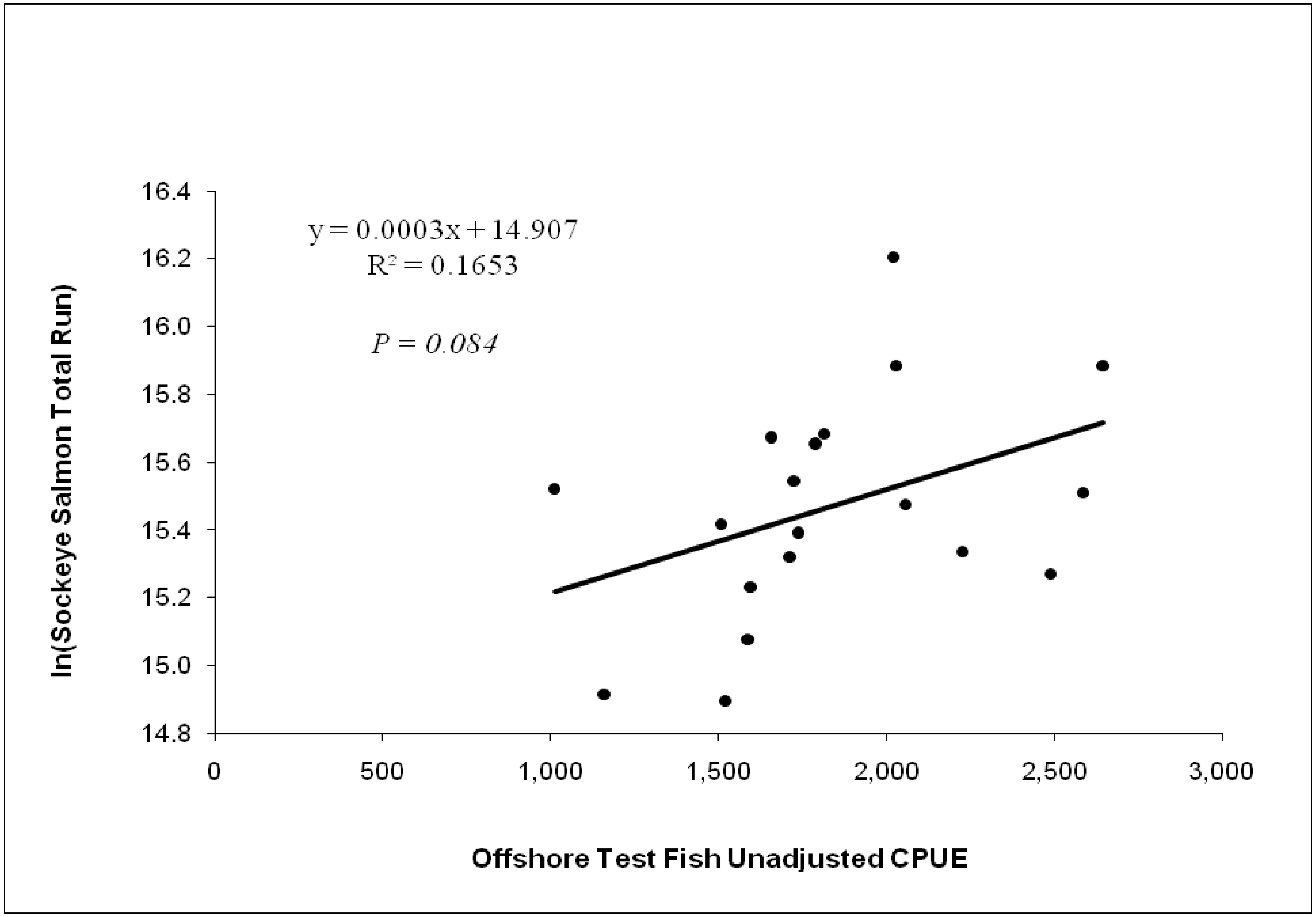

Figure 2.–Linear regression of the relationship between offshore test fish unadjusted cumulative CPUE and Upper Cook Inlet logged sockeye salmon total annual run, 1992–2010.

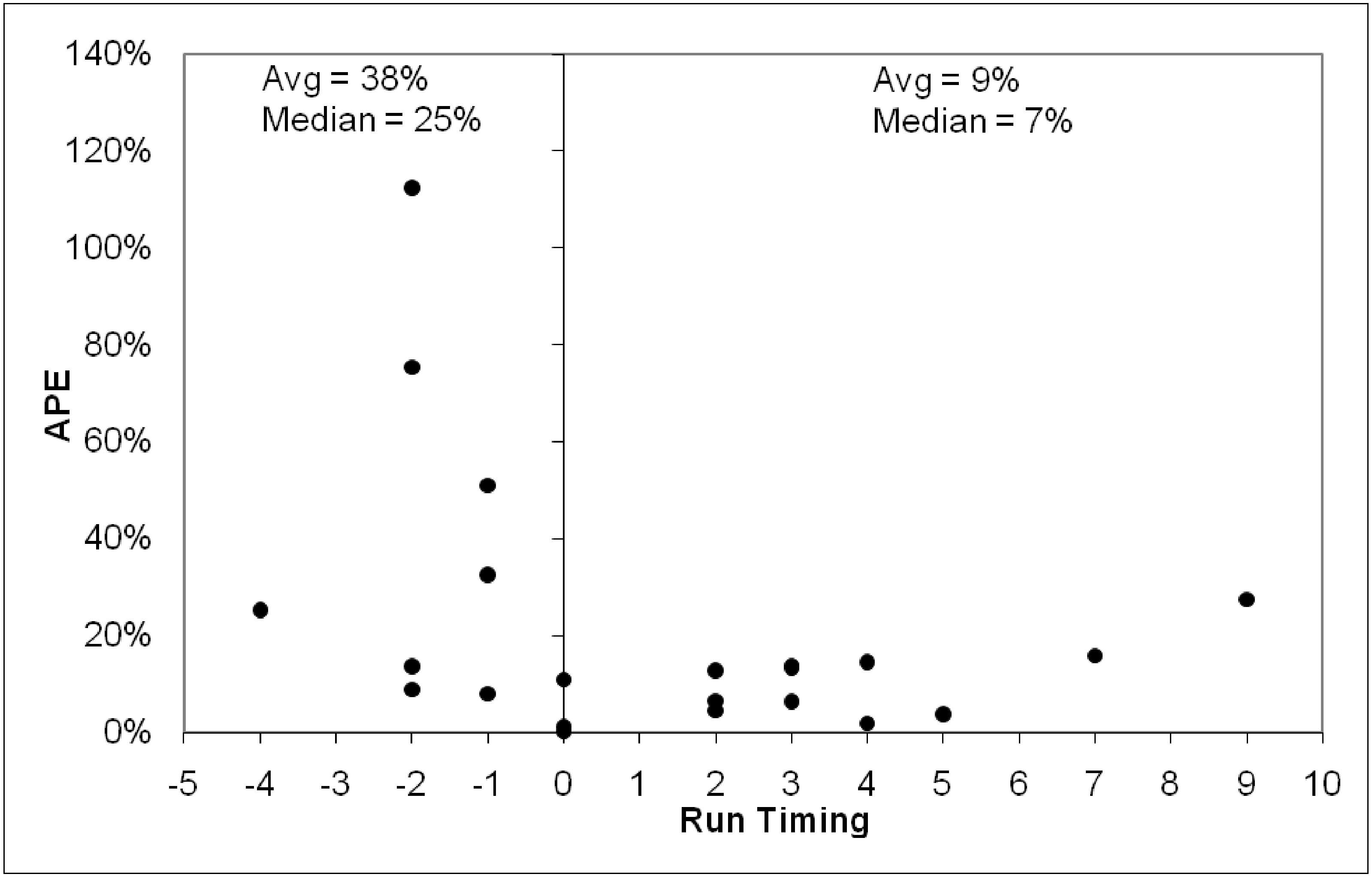

Figure 3.–Actual Percentage Error (APE) in forecasting the total sockeye salmon run to Upper Cook Inlet using the 20 July best fit estimate.

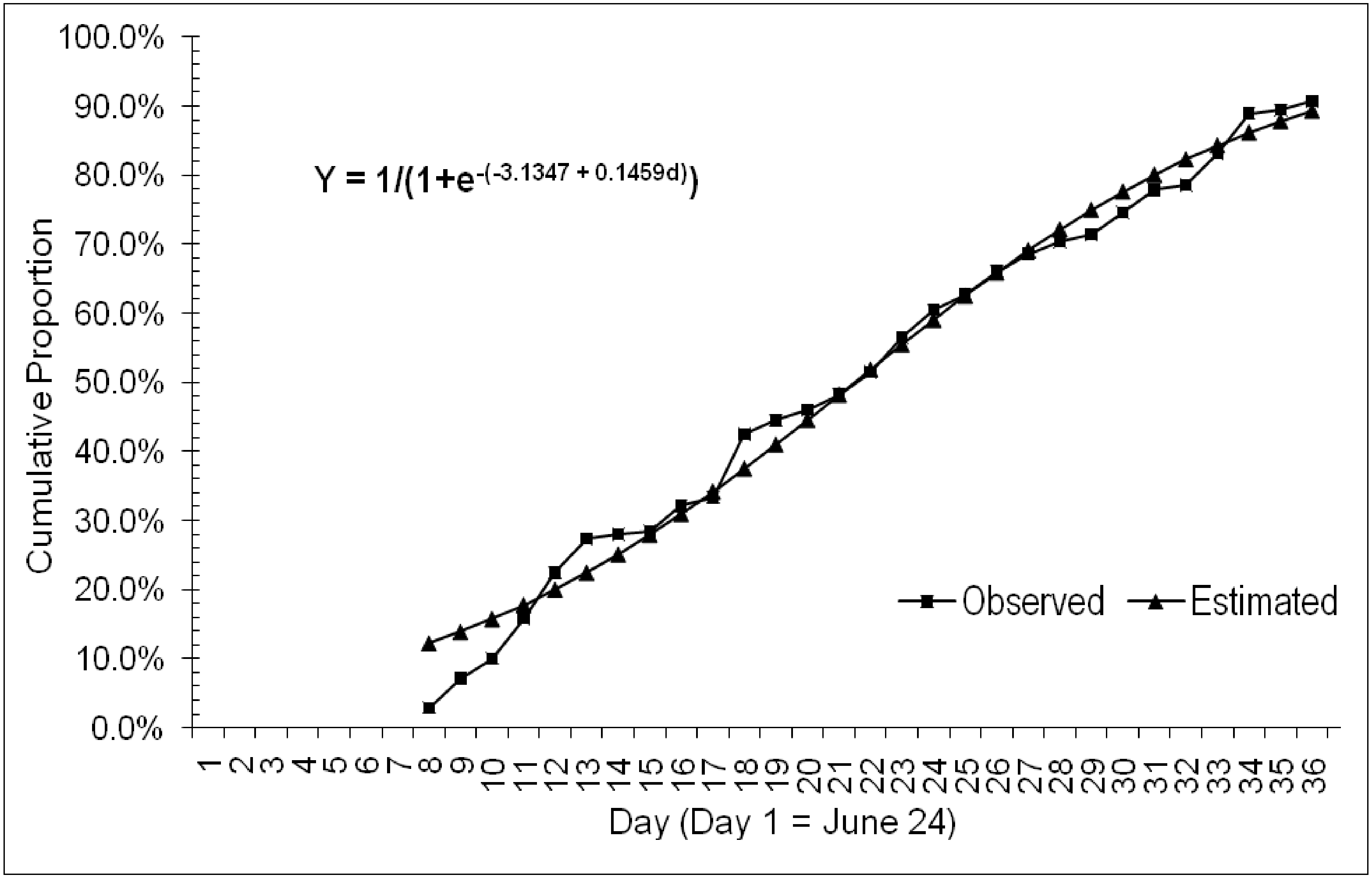

Figure 4.–Cumulative proportions estimated for the sockeye salmon run to Upper Cook Inlet, Alaska, 2010.

APPENDIX A

Appendix A1.–Summary of pink salmon fishing effort, daily and cumulative catch, and daily and cumulative CPUE, Upper Cook Inlet offshore test fish project, 2010.

Date	Number of Stations	Mean Fishing Time (min)	CATCH		CPUE	
			Daily	Cum	Daily	Cum
7/1	6	228.0	2	2	2	2
7/2	6	238.5	0	2	0	2
7/3	6	223.5	0	2	0	2
7/4	6	255.5	0	2	0	2
7/5	6	248.0	1	3	1	2
7/6	6	242.5	0	3	0	2
7/7	6	227.0	0	3	0	2
7/8	6	217.0	0	3	0	2
7/9	6	235.5	2	5	1	4
7/10	5[a]	234.5	3	8	2	6
7/11	6	244.5	2	10	1	7
7/12	6	225.5	5	15	4	11
7/13	6	228.5	5	20	4	15
7/14	6	226.0	7	27	6	21
7/15	0[a]	226.0	25	52	15	36
7/16	3[a]	269.0	42	94	24	61
7/17	2[a]	259.0	20	114	13	74
7/18	5[a]	235.0	6	120	3	77
7/19	6	235.0	10	130	7	84
7/20	6	227.5	11	141	8	92
7/21	0[a]	232.0	10	151	6	98
7/22	6	232.0	6	157	4	102
7/23	3[a]	227.0	12	169	6	109
7/24	6	246.5	21	190	14	123
7/25	6	220.5	5	195	4	127
7/26	6	235.5	33	228	25	151
7/27	6	271.5	28	256	16	168
7/28	6	220.0	7	263	6	173
7/29	6	222.5	3	266	2	176

[a] Not all stations fished because of weather; the data for missing stations was interpolated.

Appendix A2.–Estimated pink salmon catch by date and station, Upper Cook Inlet offshore test fish project, 2010.

	Station Number						
Date	4	5	6	6.5	7	8	Total
7/1	2	0	0	0	0	0	2
7/2	0	0	0	0	0	0	0
7/3	0	0	0	0	0	0	0
7/4	0	0	0	0	0	0	0
7/5	0	1	0	0	0	0	1
7/6	0	0	0	0	0	0	0
7/7	0	0	0	0	0	0	0
7/8	0	0	0	0	0	0	0
7/9	0	0	1	1	0	0	2
7/10[a]	0	1	0	0	2	0	3
7/11	0	0	0	0	2	0	2
7/12	1	0	2	1	0	1	5
7/13	0	0	1	2	1	1	5
7/14	0	4	1	0	2	0	7
7/15[a]	2	5	7	4	4	3	25
7/16[a]	4	9	12	8	6	3	42
7/17[a]	4	4	5	2	4	1	20
7/18[a]	4	0	0	0	1	1	6
7/19	4	2	3	1	0	0	10
7/20	8	2	0	1	0	0	11
7/21[a]	4	2	1	3	0	0	10
7/22	0	1	1	4	0	0	6
7/23[a]	1	2	2	0	7	0	12
7/24	1	2	2	11	5	0	21
7/25	2	0	1	2	0	0	5
7/26	2	2	13	10	5	1	33
7/27	0	18	0	4	5	1	28
7/28	0	4	0	2	0	1	7
7/29	0	0	1	1	1	0	3
Total	37	59	53	57	45	13	266
%	14%	22%	20%	21%	17%	5%	100%

[a] Not all stations fished because of weather; the data for missing stations was interpolated.

Appendix A3.–Estimated pink salmon CPUE by date and station, Upper Cook Inlet offshore test fish project 2010.

	Station Number						
Date	4	5	6	6.5	7	8	Total
7/1	1.6	0.0	0.0	0.0	0.0	0.0	1.6
7/2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/5	0.0	0.8	0.0	0.0	0.0	0.0	0.8
7/6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/9	0.0	0.0	0.8	0.7	0.0	0.0	1.4
7/10[a]	0.0	0.8	0.0	0.0	1.6	0.0	2.4
7/11	0.0	0.0	0.0	0.0	1.3	0.0	1.3
7/12	0.8	0.0	1.5	0.8	0.0	0.8	4.0
7/13	0.0	0.0	0.8	1.6	0.8	0.8	4.0
7/14	0.0	3.1	0.8	0.0	1.7	0.0	5.5
7/15[a]	1.8	3.4	3.7	2.4	2.9	1.2	15.4
7/16[a]	2.3	5.3	6.6	4.9	4.0	1.2	24.3
7/17[a]	2.3	2.7	3.3	1.4	2.4	1.0	13.1
7/18[a]	2.3	0.0	0.0	0.0	0.8	0.3	3.4
7/19	2.8	1.5	2.2	0.8	0.0	0.0	7.3
7/20	5.2	1.6	0.0	0.8	0.0	0.0	7.6
7/21[a]	2.6	1.2	0.4	1.8	0.0	0.0	6.0
7/22	0.0	0.8	0.8	2.8	0.0	0.0	4.4
7/23[a]	0.4	1.2	1.1	0.0	3.8	0.0	6.5
7/24	0.8	1.7	1.4	6.1	3.9	0.0	13.8
7/25	1.6	0.0	0.8	1.5	0.0	0.0	4.0
7/26	1.6	1.5	10.1	7.6	3.4	0.7	24.9
7/27	0.0	9.3	0.0	2.6	3.6	0.6	16.0
7/28	0.0	3.2	0.0	1.6	0.0	0.8	5.6
7/29	0.0	0.0	0.8	0.8	0.7	0.0	2.4
Total	26	38	35	38	31	7	176
Percent	15%	22%	20%	22%	17%	4%	100%

[a] Not all stations fished because of weather; the data for missing stations was interpolated.

Appendix A4.–Summary of chum salmon fishing effort, daily and cumulative catch, and daily and cumulative CPUE, Upper Cook Inlet offshore test fish project, 2010.

Date	Number of Stations	Mean Fishing Time (min)	CATCH		CPUE	
			Daily	Cum	Daily	Cum
7/1	6	228.0	0	0	0	0
7/2	6	238.5	2	2	1	1
7/3	6	223.5	7	9	5	7
7/4	6	255.5	12	21	8	15
7/5	6	248.0	19	40	14	28
7/6	6	242.5	24	64	16	44
7/7	6	227.0	3	67	2	47
7/8	6	217.0	2	69	2	48
7/9	6	235.5	12	81	9	57
7/10	5[a]	234.5	7	88	5	62
7/11	6	244.5	20	108	14	76
7/12	6	225.5	7	115	5	82
7/13	6	228.5	17	132	13	94
7/14	6	226.0	7	139	5	100
7/15	0[a]	226.0	141	280	86	185
7/16	3[a]	269.0	277	557	168	353
7/17	2[a]	259.0	108	665	77	431
7/18	5[a]	235.0	35	700	24	455
7/19	6	235.0	20	720	15	470
7/20	6	227.5	42	762	28	498
7/21	0[a]	232.0	31	793	21	519
7/22	6	232.0	19	812	13	532
7/23	3[a]	227.0	70	882	38	570
7/24	6	246.5	65	947	38	608
7/25	6	220.5	6	953	5	613
7/26	6	235.5	45	998	35	647
7/27	6	271.5	146	1,144	81	728
7/28	6	220.0	5	1,149	4	732
7/29	6	222.5	6	1,155	4	736

[a] Not all stations fished because of weather; the data for missing stations was interpolated.

Appendix A5.–Estimated chum salmon catch by date and station, Upper Cook Inlet offshore test fish project, 2010.

	Station Number						
Date	4	5	6	6.5	7	8	Total
7/1	0	0	0	0	0	0	0
7/2	0	0	0	0	2	0	2
7/3	5	2	0	0	0	0	7
7/4	0	3	2	5	0	2	12
7/5	2	1	4	4	5	3	19
7/6	0	2	0	10	1	11	24
7/7	0	0	2	0	0	1	3
7/8	1	0	0	1	0	0	2
7/9	0	0	3	5	1	3	12
7/10[a]	1	0	1	1	2	2	7
7/11	0	1	5	5	8	1	20
7/12	0	0	5	1	1	0	7
7/13	0	14	0	1	1	1	17
7/14	0	4	2	1	0	0	7
7/15[a]	9	21	52	31	14	14	141
7/16[a]	18	42	102	61	27	27	277
7/17[a]	19	22	24	10	14	19	108
7/18[a]	20	2	1	5	1	6	35
7/19	3	12	2	3	0	0	20
7/20	36	6	0	0	0	0	42
7/21[a]	18	3	0	10	0	0	31
7/22	0	0	0	19	0	0	19
7/23[a]	0	0	4	0	66	0	70
7/24	2	0	7	54	2	0	65
7/25	1	0	0	4	1	0	6
7/26	1	5	3	6	21	9	45
7/27	0	108	0	33	3	2	146
7/28	0	4	0	1	0	0	5
7/29	0	0	0	0	6	0	6
Total	136	252	219	271	176	101	1,155
Percent	12%	22%	19%	23%	15%	9%	100%

[a] Not all stations fished because of weather; the data for missing stations was interpolated.

Appendix A6.–Estimated chum salmon CPUE by date and station, Upper Cook Inlet offshore test fish project, 2010.

	Station Number						
Date	4	5	6	6.5	7	8	Total
7/1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/2	0.0	0.0	0.0	0.0	1.2	0.0	1.2
7/3	3.9	1.6	0.0	0.0	0.0	0.0	5.4
7/4	0.0	2.1	1.2	3.2	0.0	1.6	8.1
7/5	1.5	0.8	2.5	2.8	3.7	2.3	13.6
7/6	0.0	1.6	0.0	6.3	0.8	7.3	16.0
7/7	0.0	0.0	1.6	0.0	0.0	0.8	2.3
7/8	0.8	0.0	0.0	0.9	0.0	0.0	1.7
7/9	0.0	0.0	2.3	3.4	0.8	2.4	8.8
7/10[a]	0.8	0.0	0.7	0.8	1.6	1.6	5.4
7/11	0.0	0.9	3.6	3.4	5.0	0.8	13.6
7/12	0.0	0.0	3.9	0.8	0.8	0.0	5.5
7/13	0.0	10.4	0.0	0.8	0.8	0.8	12.8
7/14	0.0	3.1	1.5	0.8	0.0	0.0	5.4
7/15[a]	4.5	13.1	28.8	19.0	9.0	11.3	85.7
7/16[a]	11.6	27.5	56.1	37.2	18.1	17.4	167.9
7/17[a]	13.1	14.5	15.8	6.8	9.4	17.8	77.4
7/18[a]	14.6	1.5	0.8	4.1	0.8	2.1	23.9
7/19	2.1	9.1	1.5	2.4	0.0	0.0	15.1
7/20	23.4	4.7	0.0	0.0	0.0	0.0	28.1
7/21[a]	11.7	2.4	0.0	6.7	0.0	0.0	20.8
7/22	0.0	0.0	0.0	13.5	0.0	0.0	13.5
7/23[a]	0.0	0.0	2.5	0.0	35.6	0.0	38.1
7/24	1.5	0.0	5.0	29.7	1.5	0.0	37.8
7/25	0.8	0.0	0.0	3.0	0.8	0.0	4.7
7/26	0.8	4.0	2.3	4.6	14.1	9.0	34.7
7/27	0.0	55.8	0.0	21.4	2.1	1.2	80.5
7/28	0.0	3.2	0.0	0.8	0.0	0.0	4.0
7/29	0.0	0.0	0.0	0.0	4.3	0.0	4.3
Total	91	156	130	172	110	76	736
Percent	12%	21%	18%	23%	15%	10%	100%

[a] Not all stations fished because of weather; the data for missing stations was interpolated.

Appendix A7.–Summary of coho salmon fishing effort, daily and cumulative catch, and daily and cumulative CPUE, Upper Cook Inlet offshore test fish project, 2010.

Date	Number of Stations	Mean Fishing Time (min)	CATCH		CPUE	
			Daily	Cum	Daily	Cum
7/1	6	228.0	4	4	3	3
7/2	6	238.5	4	8	3	6
7/3	6	223.5	3	11	2	8
7/4	6	255.5	5	16	3	11
7/5	6	248.0	22	38	16	27
7/6	6	242.5	6	44	4	31
7/7	6	227.0	3	47	2	34
7/8	6	217.0	1	48	1	35
7/9	6	235.5	16	64	12	46
7/10	5[a]	234.5	8	72	6	52
7/11	6	244.5	10	82	7	59
7/12	6	225.5	16	98	12	72
7/13	6	228.5	13	111	10	82
7/14	6	226.0	8	119	6	88
7/15	0[a]	226.0	84	203	41	129
7/16	3[a]	269.0	144	347	88	217
7/17	2[a]	259.0	54	401	36	253
7/18	5[a]	235.0	5	406	4	257
7/19	6	235.0	41	447	31	288
7/20	6	227.5	24	471	18	305
7/21	0[a]	232.0	21	492	15	320
7/22	6	232.0	16	508	12	332
7/23	3[a]	227.0	34	542	19	351
7/24	6	246.5	25	567	15	366
7/25	6	220.5	4	571	3	369
7/26	6	235.5	45	616	32	401
7/27	6	271.5	71	687	43	444
7/28	6	220.0	7	694	6	449
7/29	6	222.5	6	700	4	454

[a] Not all stations fished because of weather; the data for missing stations was interpolated.

Appendix A8.–Estimated coho salmon catch by date and station, Upper Cook Inlet offshore test fish project, 2010.

	Station Number						
Date	4	5	6	6.5	7	8	Total
7/1	0	1	3	0	0	0	4
7/2	0	1	0	0	3	0	4
7/3	0	1	1	1	0	0	3
7/4	0	3	1	1	0	0	5
7/5	0	1	3	7	3	8	22
7/6	0	0	0	1	1	4	6
7/7	0	0	2	0	0	1	3
7/8	0	0	0	0	0	1	1
7/9	0	0	0	6	6	4	16
7/10[a]	1	1	2	2	0	2	8
7/11	0	1	1	6	2	0	10
7/12	0	3	10	3	0	0	16
7/13	1	4	2	3	1	2	13
7/14	0	0	3	1	2	2	8
7/15[a]	7	17	27	13	9	11	84
7/16[a]	11	27	50	24	15	17	144
7/17[a]	6	15	10	4	8	11	54
7/18[a]	1	3	0	0	0	1	5
7/19	5	24	8	4	0	0	41
7/20	10	10	1	3	0	0	24
7/21[a]	5	5	2	7	2	0	21
7/22	0	0	2	11	3	0	16
7/23[a]	1	1	1	0	30	1	34
7/24	0	1	0	21	3	0	25
7/25	3	0	1	0	0	0	4
7/26	0	2	4	14	24	1	45
7/27	0	31	1	24	12	3	71
7/28	0	0	3	2	0	2	7
7/29	0	0	1	0	5	0	6
Total	51	152	139	158	129	71	700
Percent	7%	22%	20%	23%	18%	10%	100%

[a] Not all stations fished because of weather; the data for missing stations was interpolated.

Appendix A9.–Estimated coho salmon CPUE by date and station, Upper Cook Inlet offshore test fish project, 2010.

	Station Number						
Date	4	5	6	6.5	7	8	Total
7/1	0.0	0.7	2.4	0.0	0.0	0.0	3.1
7/2	0.0	0.8	0.0	0.0	1.7	0.0	2.5
7/3	0.0	0.8	0.8	0.9	0.0	0.0	2.4
7/4	0.0	2.1	0.6	0.6	0.0	0.0	3.4
7/5	0.0	0.8	1.9	4.9	2.2	6.2	16.0
7/6	0.0	0.0	0.0	0.6	0.8	2.6	4.1
7/7	0.0	0.0	1.6	0.0	0.0	0.8	2.3
7/8	0.0	0.0	0.0	0.0	0.0	0.8	0.8
7/9	0.0	0.0	0.0	4.0	4.5	3.2	11.7
7/10[a]	0.8	0.8	1.4	1.6	0.0	1.6	6.1
7/11	0.0	0.9	0.7	4.1	1.3	0.0	6.9
7/12	0.0	2.3	7.7	2.5	0.0	0.0	12.4
7/13	0.8	3.0	1.6	2.4	0.8	1.6	10.2
7/14	0.0	0.0	2.3	0.8	1.7	1.7	6.5
7/15[a]	0.6	4.7	14.9	7.7	5.9	7.2	41.0
7/16[a]	7.4	17.4	27.5	14.6	10.1	11.0	88.0
7/17[a]	4.0	9.8	6.6	2.7	5.0	7.5	35.6
7/18[a]	0.7	2.3	0.0	0.0	0.0	0.7	3.7
7/19	3.5	18.2	5.9	3.2	0.0	0.0	30.8
7/20	6.5	7.9	0.8	2.4	0.0	0.0	17.6
7/21[a]	3.3	4.0	1.2	5.1	1.2	0.0	14.8
7/22	0.0	0.0	1.6	7.8	2.5	0.0	11.9
7/23[a]	0.8	0.4	0.8	0.0	16.2	0.8	19.0
7/24	0.0	0.8	0.0	11.6	2.3	0.0	14.7
7/25	2.5	0.0	0.8	0.0	0.0	0.0	3.3
7/26	0.0	1.5	3.1	10.6	16.1	0.7	32.0
7/27	0.0	16.0	0.8	15.6	8.5	1.7	42.7
7/28	0.0	0.0	2.5	1.6	0.0	1.7	5.7
7/29	0.0	0.0	0.8	0.0	3.6	0.0	4.4
Total	31	95	88	105	84	50	454
Percent	7%	21%	19%	23%	19%	11%	100%

[a] Not all stations fished because of weather; the data for missing stations was interpolated.

Appendix A10.–Summary of Chinook salmon fishing effort, daily and cumulative catch, and daily and cumulative CPUE, Upper Cook Inlet offshore test fish project, 2010.

Date	Number of Stations	Mean Fishing Time (min)	CATCH		CPUE	
			Daily	Cum	Daily	Cum
7/1	6	228.0	0	0	0	0
7/2	6	238.5	0	0	0	0
7/3	6	223.5	0	0	0	0
7/4	6	255.5	0	0	0	0
7/5	6	248.0	0	0	0	0
7/6	6	242.5	0	0	0	0
7/7	6	227.0	0	0	0	0
7/8	6	217.0	0	0	0	0
7/9	6	235.5	0	0	0	0
7/10	5[a]	234.5	0	0	0	0
7/11	6	244.5	0	0	0	0
7/12	6	225.5	0	0	0	0
7/13	6	228.5	1	1	1	1
7/14	6	226.0	1	2	1	2
7/15	0[a]	226.0	0	2	0	2
7/16	3[a]	269.0	0	2	0	2
7/17	2[a]	259.0	0	2	0	2
7/18	5[a]	235.0	0	2	0	2
7/19	6	235.0	0	2	0	2
7/20	6	227.5	0	2	0	2
7/21	0[a]	232.0	0	2	0	2
7/22	6	232.0	0	2	0	2
7/23	3[a]	227.0	0	2	0	2
7/24	6	246.5	0	2	0	2
7/25	6	220.5	0	2	0	2
7/26	6	235.5	0	2	0	2
7/27	6	271.5	0	2	0	2
7/28	6	220.0	1	3	1	2
7/29	6	222.5	0	3	0	2

[a] Not all stations fished because of weather; the data for missing stations was interpolated.

Appendix A11.–Estimated Chinook salmon catch by date and station, Upper Cook Inlet offshore test fish project, 2010.

	Station Number						
Date	4	5	6	6.5	7	8	Total
7/1	0	0	0	0	0	0	0
7/2	0	0	0	0	0	0	0
7/3	0	0	0	0	0	0	0
7/4	0	0	0	0	0	0	0
7/5	0	0	0	0	0	0	0
7/6	0	0	0	0	0	0	0
7/7	0	0	0	0	0	0	0
7/8	0	0	0	0	0	0	0
7/9	0	0	0	0	0	0	0
7/10[a]	0	0	0	0	0	0	0
7/11	0	0	0	0	0	0	0
7/12	0	0	0	0	0	0	0
7/13	0	0	0	0	0	1	1
7/14	0	0	0	1	0	0	1
7/15[a]	0	0	0	0	0	0	0
7/16[a]	0	0	0	0	0	0	0
7/17[a]	0	0	0	0	0	0	0
7/18[a]	0	0	0	0	0	0	0
7/19	0	0	0	0	0	0	0
7/20	0	0	0	0	0	0	0
7/21[a]	0	0	0	0	0	0	0
7/22	0	0	0	0	0	0	0
7/23[a]	0	0	0	0	0	0	0
7/24	0	0	0	0	0	0	0
7/25	0	0	0	0	0	0	0
7/26	0	0	0	0	0	0	0
7/27	0	0	0	0	0	0	0
7/28	0	0	0	0	1	0	1
7/29	0	0	0	0	0	0	0
Total	0	0	0	1	1	1	3
Percent	0%	0%	0%	33%	33%	33%	100%

[a] Not all stations fished because of weather; the data for missing stations was interpolated.

Appendix A12.–Estimated Chinook salmon CPUE by date and station, Upper Cook Inlet offshore test fish project, 2010.

	Station Number						
Date	4	5	6	6.5	7	8	Total
7/1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/10[a]	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/11	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/12	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/13	0.0	0.0	0.0	0.0	0.0	0.8	0.8
7/14	0.0	0.0	0.0	0.8	0.0	0.0	0.8
7/15[a]	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/16[a]	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/17[a]	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/18[a]	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/19	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/20	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/21[a]	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/22	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/23[a]	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/24	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/25	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/26	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/27	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/28	0.0	0.0	0.0	0.0	0.8	0.0	0.8
7/29	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	0	0	0	0.8	0.8	0.8	2
Percent	0%	0%	0%	33%	34%	33%	100%

[a] Not all stations fished because of weather; the data for missing stations was interpolated.

Appendix A13.–Entry pattern of sockeye salmon into Upper Cook Inlet, Alaska, 2010 estimated from daily CPUE measured at the latitude of Anchor Point.

Day	Date	Input y	Estimated y	Residual	Change in Input Y	Change in Estimated Y
8	1 Jul	0.0289	0.1226	-0.0937		
9	2 Jul	0.0711	0.1392	-0.0681	0.0421	0.0166
10	3 Jul	0.1004	0.1576	-0.0572	0.0294	0.0184
11	4 Jul	0.1588	0.1780	-0.0191	0.0584	0.0203
12	5 Jul	0.2248	0.2003	0.0245	0.0660	0.0223
13	6 Jul	0.2732	0.2247	0.0485	0.0483	0.0244
14	7 Jul	0.2800	0.2511	0.0289	0.0068	0.0264
15	8 Jul	0.2840	0.2795	0.0045	0.0040	0.0284
16	9 Jul	0.3212	0.3098	0.0113	0.0372	0.0303
17	10 Jul	0.3336	0.3418	-0.0082	0.0125	0.0320
18	11 Jul	0.4246	0.3754	0.0493	0.0910	0.0335
19	12 Jul	0.4450	0.4101	0.0349	0.0204	0.0348
20	13 Jul	0.4601	0.4458	0.0143	0.0151	0.0357
21	14 Jul	0.4824	0.4821	0.0003	0.0223	0.0363
22	15 Jul	0.5150	0.5185	-0.0035	0.0326	0.0364
23	16 Jul	0.5649	0.5548	0.0101	0.0499	0.0363
24	17 Jul	0.6048	0.5905	0.0144	0.0399	0.0357
25	18 Jul	0.6272	0.6252	0.0020	0.0224	0.0348
26	19 Jul	0.6606	0.6587	0.0019	0.0334	0.0335
27	20 Jul	0.6857	0.6907	-0.0050	0.0251	0.0320
28	21 Jul	0.7034	0.7210	-0.0176	0.0177	0.0303
29	22 Jul	0.7138	0.7494	-0.0356	0.0104	0.0284
30	23 Jul	0.7457	0.7757	-0.0300	0.0319	0.0264
31	24 Jul	0.7786	0.8001	-0.0215	0.0329	0.0244
32	25 Jul	0.7857	0.8224	-0.0367	0.0072	0.0223
33	26 Jul	0.8318	0.8427	-0.0109	0.0461	0.0203
34	27 Jul	0.8893	0.8611	0.0282	0.0575	0.0184
35	28 Jul	0.8943	0.8776	0.0167	0.0050	0.0165
36	29 Jul	0.9067	0.8925	0.0142	0.0124	0.0148

Appendix A14.–Chemical and physical observations made in Upper Cook Inlet, Alaska, during the 2010 offshore test fish project.

Date	Sta	Air Temp (c)	Water Temp (c)	Wind Vel. (knots)	Wind Dir	Tide Stage	Salinity (ppt)	Water Depth (f)	Secchi (m)
1 Jul	4	10	8.5	2	east	flood	31.8	25.9	8.0
	5	12	9.0	1	east	flood	30.9	33.8	6.0
	6	12	9.4	2	west	flood	30.2	48.3	4.0
	6.5	10	9.4	2	northwest	ebb	29.7	42.1	4.0
	7	11	9.7	2	northwest	ebb	29.7	44.8	3.0
	8	14	9.4	0	na	ebb	29.9	25.9	2.0
2 Jul	4	12	8.7	0	na	high	31.2	23.2	10.0
	5	11	8.7	0	na	high	31.1	33.1	9.0
	6	12	8.9	0	na	flood	30.2	49.8	7.0
	6.5	11	9.3	1	southwest	flood	29.3	41.7	4.5
	7	12	9.8	1	north	flood	29.9	46.6	2.5
	8	11	9.6	1	north	flood	29.6	30.0	2.0
3 Jul	4	10	8.5	6	north	high	31.2	24.7	9.0
	5	10	8.6	5	north	high	31.2	33.6	8.0
	6	11	9.8	3	northwest	ebb	29.7	48.3	3.5
	6.5	11	10.0	1	west	ebb	29.0	42.1	3.0
	7	11	9.9	3	west	ebb	29.3	44.6	3.0
	8	12	9.9	4	southwest	ebb	29.6	28.5	2.5
4 Jul	4	9	8.6	10	south	flood	31.2	24.6	7.0
	5	9	8.6	9	southeast	flood	31.1	36.6	7.0
	6	10	9.5	12	southwest	flood	31.2	48.7	4.0
	6.5	11	9.8	6	southeast	flood	29.3	43.1	4.0
	7	11	9.8	3	southeast	flood	29.2	45.7	3.0
	8	12	9.9	5	southwest	low	29.3	28.6	3.0
5 Jul	4	11	8.5	13	north	flood	31.2	24.7	7.0
	5	10	8.6	12	north	flood	31.2	37.1	7.0
	6	11	9.3	12	north	flood	30.6	48.7	7.0
	6.5	10	9.7	11	north	flood	29.6	43.0	3.0
	7	11	10.0	7	north	flood	28.9	45.0	2.5
	8	12	9.9	3	north	flood	29.2	28.6	2.5
6 Jul	4	8	12.1	2	northwest	flood	31.5	24.8	9.5
	5	11	8.9	1	east	flood	31.3	36.4	7.0
	6	10	8.8	2	north	flood	31.0	48.2	8.0
	6.5	10	9.5	2	east	flood	30.1	43.1	6.0
	7	11	10.1	2	north	low	28.6	44.6	2.5
	8	11	10.1	0	na	low	28.5	30.0	3.0

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Date	Sta	Air Temp (c)	Water Temp (c)	Wind Vel. (knots)	Wind Dir	Tide Stage	Salinity (ppt)	Water Depth (f)	Secchi (m)
7 Jul	4	11	9.0	8	northwest	ebb	31.4	25.5	8.0
	5	11	8.8	9	northwest	ebb	31.2	35.7	9.0
	6	11	8.9	9	northwest	flood	31.0	48.2	6.0
	6.5	11	9.7	10	northeast	flood	29.7	40.2	3.0
	7	11	10.4	13	north	flood	28.3	45.9	2.5
	8	11	10.2	14	north	flood	28.3	30.5	3.0
8 Jul	4	11	9.1	8	northeast	flood	31.3	23.5	9.5
	5	10	9.0	5	northeast	ebb	31.3	35.4	11.0
	6	11	9.1	4	north	ebb	30.6	47.3	7.0
	6.5	11	9.4	3	east	ebb	30.1	42.3	5.0
	7	12	9.7	1	northeast	ebb	29.5	44.3	4.0
	8	12	9.8	2	northeast	ebb	29.3	29.1	3.0
9 Jul	4	10	9.2	3	northwest	ebb	31.3	22.8	11.0
	5	10	9.1	5	northwest	ebb	31.4	35.4	10.0
	6	10	9.1	6	south	ebb	31.0	48.4	6.0
	6.5	11	9.2	7	northwest	flood	30.6	42.2	4.0
	7	11	9.8	5	northwest	flood	29.4	46.0	3.5
	8	12	10.2	5	northwest	flood	29.5	32.9	3.5
10 Jul	4	9	8.9	10	southeast	low	31.4	24.0	8.0
	5	11	9.0	11	north	low	31.4	34.8	7.0
	6	11	9.5	10	north	ebb	30.9	46.5	6.0
	6.5	11	9.8	10	north	ebb	29.0	42.2	6.0
	7	11	10.0	12	north	ebb	28.7	45.1	3.0
	8	nd	nd	nd	nd	nd	nd	nd	nd
11 Jul	4	10	9.1	12	south	ebb	31.5	23.5	8.0
	5	11	9.2	7	south	ebb	31.3	34.2	7.0
	6	11	9.3	5	southwest	ebb	30.6	46.9	4.0
	6.5	11	9.7	7	south	flood	30.4	42.4	3.0
	7	13	10.5	5	south	flood	29.4	45.3	3.0
	8	13	10.5	4	south	flood	29.0	32.8	2.5
12 Jul	4	10	9.3	9	southwest	ebb	31.4	22.7	6.0
	5	13	10.2	6	northeast	ebb	30.4	37.1	8.0
	6	12	10.0	4	southwest	ebb	29.2	46.4	3.0
	6.5	12	10.0	4	southeast	low	29.1	38.5	3.5
	7	13	10.3	2	southeast	flood	29.2	45.3	3.0
	8	12	10.2	2	north	flood	29.4	32.4	3.0

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Date	Sta	Air Temp (c)	Water Temp (c)	Wind Vel. (knots)	Wind Dir	Tide Stage	Salinity (ppt)	Water Depth (f)	Secchi (m)
13 Jul	4	11	9.2	4	north	ebb	31.4	23.1	8.0
	5	11	9.2	6	northwest	ebb	31.3	34.4	5.0
	6	12	9.6	3	northwest	ebb	30.2	44.6	2.5
	6.5	11	9.7	8	north	ebb	30.3	37.5	2
	7	11	9.6	8	northwest	low	30.3	44.9	2
	8	11	10	6	northwest	low	29.3	31.5	2
14 Jul	4	11	9.4	6	south	ebb	31.5	22.2	8.0
	5	11	9.3	10	southeast	ebb	31.0	32.8	8.0
	6	11	9.5	7	south	ebb	30.5	39.6	5.0
	6.5	11	9.5	5	southeast	ebb	30.5	44.4	4.5
	7	11	9.5	4	east	flood	30.4	46.6	4.0
	8	10	9.7	5	southeast	flood	30.0	33.3	3.0
15 Jul	4	nd	nd	nd	nd	nd	nd	nd	nd
	5	nd	nd	nd	nd	nd	nd	nd	nd
	6	nd	nd	nd	nd	nd	nd	nd	nd
	6.5	nd	nd	nd	nd	nd	nd	nd	nd
	7	nd	nd	nd	nd	nd	nd	nd	nd
	8	nd	nd	nd	nd	nd	nd	nd	nd
16 Jul	4	nd	nd	nd	nd	nd	nd	nd	nd
	5	nd	nd	nd	nd	nd	nd	nd	nd
	6	11	10.3	12	southeast	ebb	29.6	46.6	2.5
	6.5	11	9.9	10	southeast	flood	30.4	42.5	4.0
	7	10	10.0	11	south	flood	29.9	45.9	2.0
	8	nd	nd	nd	nd	nd	nd	nd	nd
17 Jul	4	nd	nd	nd	nd	nd	nd	nd	nd
	5	nd	nd	nd	nd	nd	nd	nd	nd
	6	10	9.9	18	southwest	flood	30.4	44.3	4.0
	6.5	10	9.8	14	south	ebb	31.2	42.1	3.0
	7	nd	nd	nd	nd	nd	nd	nd	nd
	8	nd	nd	nd	nd	nd	nd	nd	nd
18 Jul	4	13	9.9	2	southwest	flood	31.0	25.2	6.5
	5	12	9.8	1	southwest	flood	30.5	33.8	5.0
	6	13	10.1	1	east	flood	30.3	48.1	3.5
	6.5	13	10.3	1	east	flood	29.6	42.9	3.5
	7	12	10.5	1	southwest	low	29.3	45.4	2.0
	8	nd	nd	nd	nd	nd	nd	nd	nd

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Date	Sta	Air Temp (c)	Water Temp (c)	Wind Vel. (knots)	Wind Dir	Tide Stage	Salinity (ppt)	Water Depth (f)	Secchi (m)
19 Jul	4	11	9.8	8	west	flood	31.0	25.1	7.0
	5	11	9.2	9	southwest	flood	30.7	36.1	5.0
	6	11	10.3	7	west	flood	30.2	38.2	5.0
	6.5	11	10.4	11	southwest	high	29.9	42.9	3.0
	7	12	10.4	15	south	ebb	29.9	45.3	2.5
	8	11	10.2	16	southwest	ebb	30	27.5	3
20 Jul	4	11	10.0	5	southwest	flood	30.9	24.5	6.0
	5	12	10.9	4	southwest	flood	29.1	33.1	3.5
	6	11	11.1	9	southwest	flood	28.4	46.6	2.5
	6.5	11	10.8	7	southwest	low	28.8	43.2	3.0
	7	11	10.7	10	southwest	ebb	29.3	43.8	3.0
	8	12	10.4	8	southwest	ebb	29.7	30.4	1.5
21 Jul	4	nd	nd	nd	nd	nd	nd	nd	nd
	5	nd	nd	nd	nd	nd	nd	nd	nd
	6	nd	nd	nd	nd	nd	nd	nd	nd
	6.5	nd	nd	nd	nd	nd	nd	nd	nd
	7	nd	nd	nd	nd	nd	nd	nd	nd
	8	nd	nd	nd	nd	nd	nd	nd	nd
22 Jul	4	13	10.2	0	na	flood	31.2	26.4	8.5
	5	14	10.0	0	na	flood	31.0	33.8	5.5
	6	12	10.8	2	east	high	29.3	48.9	4.0
	6.5	14	11.6	2	east	ebb	29.1	43.1	3.0
	7	13	11.7	3	southwest	ebb	29.0	45.3	3.0
	8	12	10.8	7	southwest	ebb	29.5	26.7	3.0
23 Jul	4	nd	nd	nd	nd	nd	nd	nd	nd
	5	nd	nd	nd	nd	nd	nd	nd	nd
	6	nd	nd	nd	nd	nd	nd	nd	nd
	6.5	12	10.6	19	west	ebb	29.5	42.4	3.5
	7	13	11.1	9	south	ebb	28.9	44.5	3.0
	8	12	10.7	6	southeast	ebb	29.4	28.9	3.0
24 Jul	4	10	10.2	9	northwest	flood	31.2	26.2	6.0
	5	10	10.2	7	southwest	flood	30.9	37.8	5.5
	6	10	10.3	7	southeast	flood	30.4	49.7	5.0
	6.5	10	10.5	10	south	flood	29.5	44.5	3.0
	7	10	10.6	7	south	ebb	29.4	45.6	3.0
	8	11	10.5	7	south	ebb	29.5	26.8	2.0

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Date	Sta	Air Temp (c)	Water Temp (c)	Wind Vel. (knots)	Wind Dir	Tide Stage	Salinity (ppt)	Water Depth (f)	Secchi (m)
25 Jul	4	11	10.3	10.0	east	ebb	30.8	22.7	6.0
	5	11	10.5	6.0	north	ebb	29.5	32.5	4.5
	6	11	10.6	3.0	northeast	ebb	29.2	45.3	5.0
	6.5	11	10.6	3.0	northeast	ebb	29.1	44.6	4.0
	7	11	10.6	5.0	northeast	ebb	29.0	44.9	3.0
	8	11	10.5	4.0	northeast	ebb	29.2	26.6	3.0
26 Jul	4	10	10.7	6	west	ebb	30.6	23.2	6.0
	5	11	10.7	4	southwest	flood	30.7	35.6	5.0
	6	10	10.4	1	west	flood	30.1	46.4	3.5
	6.5	11	10.4	3	northwest	flood	29.9	43.3	3.0
	7	11	10.4	2	northwest	flood	30.1	37.1	3.0
	8	11	10.6	3	northwest	flood	29.5	31.4	3.0
27 Jul	4	11	10.7	3	southwest	flood	31.0	23.9	6.0
	5	10	10.9	3	southwest	ebb	28.9	47.1	5.0
	6	10	10.7	8	southwest	ebb	29.1	43.1	4.0
	6.5	12	10.6	1	southeast	ebb	29.4	43.1	4.0
	7	10	10.6	6	southeast	ebb	29.4	44.3	3.5
	8	11	10.6	5	south	high	29.3	32.8	3.0
28 Jul	4	11	9.8	3	south	ebb	31.2	23.2	7.0
	5	11	10.4	8	southwest	ebb	30.5	35.2	6.0
	6	13	10.9	10	southwest	ebb	29.1	47.1	5.0
	6.5	11	11.4	7	southwest	ebb	28.1	39.9	3.5
	7	11	11.4	9	southwest	low	28.1	44.6	3.0
	8	12	10.8	9	southwest	flood	29.0	30.6	2.5
29 Jul	4	12	9.9	2	northwest	ebb	31.3	23.0	7.0
	5	11	9.9	3	northwest	ebb	31.0	31.2	6.0
	6	13	10.6	2	northwest	ebb	30.0	47.8	5.0
	6.5	13	10.6	2	west	ebb	29.9	27.4	4.0
	7	12	10.6	3	west	flood	30	45.8	3.0
	8	12	10.3	3	southwest	flood	29	31.2	3.0
Averages		11.2	9.9	5.8	south	ebb	30.1	37.5	4.7
Min		8.0	8.5	0.0	na	na	28.1	22.2	1.5
Max		14.0	12.1	19.0	na	na	31.8	49.8	11.0

Appendix A15.–Yearly mean values of physical observations made during the conduct of the 2001–2010 offshore test fish project.

Sta	Year	Air Temp (c)	Water Temp (c)	Wind Vel. (knots)	Wind Dir	Salinity (ppt)	Water Depth (f)	Secchi (m)
4	2001	12.9	9.8	11.1	SE	31.5	23.6	8.4
	2002	12.6	9.5	12.6	S	31.4	23.6	8.1
	2003	14.1	10.6	12.0	S	31.2	23.4	8.3
	2004	10.7	9.6	7.1	E	31.3	23.8	7.9
	2005	12.9	10.9	6.2	S	31.0	24.5	7.4
	2006	11.1	9.9	6.0	SE	30.7	23.9	7.7
	2007	10.8	8.6	4.7	SE	31.2	23.9	8.1
	2008	11.0	9.3	8.0	SE	30.6	22.8	8.5
	2009	11.0	9.1	6.2	SE	33.3	24.4	7.3
	2010	10.7	9.6	5.9	S	31.2	24.1	7.6
	Avg	11.8	9.7	8.0	SE	31.3	23.8	7.9
5	2001	12.9	10.1	11.2	SE	31.0	35.5	6.9
	2002	12.8	9.7	13.9	S	30.9	35.8	6.3
	2003	14.0	11.0	13.3	SE	30.6	35.7	6.3
	2004	10.7	9.9	7.2	SE	30.7	34.7	7.1
	2005	13.1	11.1	5.9	S	30.6	36.3	6.5
	2006	11.1	10.2	7.6	S	30.2	35.4	5.6
	2007	10.8	8.7	4.6	S	30.9	35.4	7.2
	2008	10.4	8.8	6.7	SE	30.4	35.4	6.4
	2009	11.1	9.6	6.6	SE	32.4	35.9	5.8
	2010	11.0	9.5	5.5	SE	30.8	35.3	6.7
	Avg	11.8	9.9	8.2	SE	30.8	35.5	6.5
6	2001	12.8	10.7	10.7	S	30.5	46.2	5.2
	2002	12.8	10.1	13.4	S	30.4	45.1	4.2
	2003	14.7	11.5	12.9	S	29.5	46.4	4.9
	2004	10.6	10.3	8.0	SE	30.1	46.6	4.6
	2005	12.8	11.6	8.0	S	29.4	45.8	4.7
	2006	12.8	11.6	8.0	S	29.8	45.8	4.7
	2007	11.0	9.5	6.0	S	30.0	47.2	4.8
	2008	10.4	9.3	6.2	S	29.5	47.3	5.0
	2009	11.5	10.2	6.0	SE	31.3	46.7	4.0
	2010	11.2	9.9	6.1	S	30.1	46.6	4.7
	Avg	12.1	10.5	8.5	S	30.1	46.4	4.7
6.5	2001	12.8	11.1	11.8	S	29.4	42.7	4.0
	2002	12.6	10.4	13.7	S	30.0	42.6	3.3
	2003	14.4	11.7	14.9	S	29.1	41.3	4.1
	2004	10.7	10.8	10.1	SE	29.4	41.6	3.6
	2005	13.2	12.2	7.4	S	28.7	42.8	4.2
	2006	11.2	10.3	8.5	SE	29.7	41.6	3.4
	2007	11.1	9.7	6.2	S	29.8	42.9	4.3
	2008	10.4	9.6	6.3	S	29.2	42.3	4.4
	2009	11.8	10.4	6.4	S	31.0	42.5	3.7
	2010	11.2	10.1	6.2	S	29.7	41.7	3.7
	Avg	11.9	10.6	9.1	S	29.6	42.2	3.9

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Sta	Year	Air Temp (c)	Water Temp (c)	Wind Vel. (knots)	Wind Dir	Salinity (ppt)	Water Depth (f)	Secchi (m)
7	2001	13.1	11.4	9.9	SE	29.0	43.6	3.5
	2002	12.4	10.4	12.4	SE	29.9	44.0	2.8
	2003	14.3	11.6	13.0	S	29.0	44.3	3.6
	2004	10.6	11.0	9.7	SE	28.8	44.7	2.7
	2005	12.9	12.3	7.6	S	28.3	44.8	3.6
	2006	10.8	9.9	6.8	S	29.4	42.4	3.1
	2007	11.2	9.9	6.2	S	29.5	45.5	3.8
	2008	10.6	9.8	6.2	S	29.4	44.9	4.2
	2009	11.7	10.4	5.5	S	31.2	45.0	3.5
	2010	11.4	10.3	5.7	S	29.4	44.9	2.9
	Avg	11.9	10.7	8.3	S	29.4	44.4	3.4

Sta	Year	Air Temp (c)	Water Temp (c)	Wind Vel. (knots)	Wind Dir	Salinity (ppt)	Water Depth (f)	Secchi (m)
8	2001	12.8	11.3	9.5	SE	29.0	28.9	3.1
	2002	12.1	10.3	11.8	SE	30.0	29.4	2.4
	2003	13.7	11.2	11.6	SE	28.1	28.9	3.1
	2004	10.8	11.0	9.1	SE	29.3	28.7	2.4
	2005	12.8	12.1	7.7	S	28.5	29.8	3.3
	2006	11.8	10.5	6.7	S	29.0	30.4	3.0
	2007	11.2	9.9	5.5	S	29.5	29.8	3.2
	2008	10.9	9.7	5.9	SW	29.2	29.9	3.7
	2009	11.6	10.5	5.9	S	31.2	29.6	3.4
	2010	11.7	10.2	5.2	SE	29.3	29.9	2.7
	Avg	11.9	10.7	7.9	SE	29.3	29.5	3.0

Appendix A16.–Yearly mean values for selected chemical and physical variables collected during the offshore test fish project, 1979–2010.

Year	Air Temp. (c)	Water Temp. (c)	Wind Vel. (knots)	Salinity (ppt)	Secchi (m)
1979	12.4	12.2	5.9	25.0	5.7
1980	12.4	10.0	8.2	24.8	4.2
1981	13.4	11.0	10.1	23.1	4.1
1982	12.0	8.5	9.0	20.3	5.0
1983	14.9	10.9	9.4	20.6	4.7
1984	13.5	10.8	9.1	-	5.3
1985	10.8	8.2	9.2	28.0	5.5
1986	10.6	9.1	8.2	-	5.4
1987	12.6	10.1	4.1	28.4	5.1
1988	14.2	9.1	8.9	30.2	4.7
1989	13.1	10.0	4.4	27.7	4.7
1990	12.3	11.4	8.5	21.3	4.6
1991	10.9	9.9	6.6	-	4.1
1992	12.0	11.1	5.4	28.4	4.3
1993	13.5	10.5	6.9	26.2	5.0
1994	13.0	10.0	9.3	29.0	6.0
1995	13.1	9.5	7.9	26.5	4.6
1996	12.6	10.0	9.1	30.8	4.7
1997	13.8	10.5	10.0	30.6	4.0
1998	12.5	10.3	8.3	30.0	5.4
1999	13.4	10.3	12.4	30.2	4.5
2000	13.5	10.5	12.2	30.1	5.2
2001	12.9	10.7	10.7	30.1	5.2
2002	12.5	10.1	13.0	30.4	4.5
2003	14.2	11.3	12.9	29.6	5.0
2004	10.7	10.4	8.5	30.0	4.7
2005	13.0	11.7	7.1	29.4	5.0
2006	11.3	10.3	7.2	28.4	4.6
2007	11.0	9.4	5.5	30.2	5.3
2008	10.5	9.3	6.3	29.7	5.3
2009	11.4	10.0	6.1	31.8	4.7
1992–2009 Avg	12.6	10.3	9.0	29.4	4.9
2010	11.2	9.9	5.8	30.1	4.7