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Migratory Timing And Abundance Estimates Of Sockeye Salmon Into Upper Cook Inlet, Alaska, 2005

by

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and

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June 2007

Alaska Department of Fish and Game **Division 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)

Measures (fisheries)

fork length	FL
mideye-to-fork	MEF
mideye-to-tail-fork	METF
standard length	SL
total length	TL

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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ABSTRACT

A test fishery was conducted during the 2005 Upper Cook Inlet (UCI) commercial salmon fishery. The primary objective of the test fishery was to estimate the abundance and timing of the sockeye salmon *Oncorhynchus nerka* run, as measured along a transect near the southern boundary of the UCI management area. The test fishery was conducted from 1 July to 30 July and captured 4,108 sockeye salmon, representing 2,643 catch per unit of effort (CPUE) points. The midpoint of the 2005 run occurred on 21 July, which was 6 days late relative to the historical mean date of 15 July. This represents the latest run-timing since the test fishery began in 1979. A non-linear mathematical model estimated the 2005 test fish project spanned approximately 68.8% of the sockeye salmon run. The test fish final passage rate was estimated at approximately 2,500 sockeye salmon per CPUE point. Two formal estimates of the size and timing of the 2005 sockeye salmon run were made during the commercial fishing season, with the first best-fit estimator from each analysis forecasting a total run to UCI of 9.2 and 8.2 million sockeye salmon, respectively. These estimates deviated from the preliminary total run estimate of 7.8 million by 18% and 5%, respectively. The test fish project once again provided valuable data used to aid in critical inseason commercial fishery management decisions.

Key words: Salmon, *Oncorhynchus*, Upper Cook Inlet, Alaska, test fishery, migratory behavior.

INTRODUCTION

In 1979 the Alaska Department of Fish and Game (ADF&G) began an Offshore Test Fish (OTF) project near the southern boundary of the Upper Cook Inlet (UCI) salmon management area (Figure 1). The objective of the project has been to estimate the total run and run-timing of sockeye salmon *Oncorhynchus nerka* returning to UCI during the commercial salmon fishing season. These data have become extremely important to ADF&G management biologists as they help set and adjust commercial fishing times and areas to most efficiently harvest sockeye salmon that are surplus to spawning needs. Moreover, the Alaska Board of Fisheries (BOF) has assembled management plans which require inseason estimates of the size of the sockeye salmon run in order to implement specific components of the various plans. The OTF project has increasingly become one of the most important tools fishery managers utilize to make inseason fishery management decisions.

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

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). 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 30 July. The vessel fished 366 m (1,200 ft or 200 fathoms) of 13 cm (5 1/8 in) multi-filament drift gillnet. The net was 45 meshes deep and constructed of double knot Super Crystal shade number 1, with a filament size of number 53/S6F[1].

The following physical and chemical readings were taken at the start of each set: air temperature, water temperature (at 1 m below the surface), wind velocity and direction, tide stage, water depth, and water clarity. Air and water temperatures were measured using a 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). 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.

All salmon captured in the drift gillnet were enumerated and identified to species and sex. Sockeye salmon (n $\leq$ 30 at each station) were measured for fork length (mideye to tail fork) to the nearest mm and also had a scale removed (for age determination) as described by Koo (1955). Scales were mounted on gum cards and impressions made in cellulose acetate, as described by Clutter and Whitesel (1956). The age of each fish was determined after examining scales with a microfiche viewer under 40x magnification. Ages were reported in European notation (Koo 1962) and followed criteria established by Mosher (1969) and Tobias et al. (1994).

The number of fish caught at each station (*s*) on each day (*i*) was expressed as a catch per unit of effort (CPUE) statistic, or index, and standardized to the number of fish caught in 100 fathoms of gear in 1 hour of fishing time.

$$CPUE_{s,i} = \frac{100\,fm \;\; x \;\; 60\,\text{min} \;\; x \;\; number\ of\ fish}{fm\ of\ gear \;\; x \;\; MFT} \qquad (1)$$

where:

MFT = mean fishing time.

Mean fishing time (MFT) was calculated as:

$$MFT = (C - B) + \frac{(\text{B} - \text{A}) + (\text{D} - \text{C})}{2} \qquad (2)$$

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 was fished 30 minutes before retrieval started. However, the net was capable of capturing fish prior to being fully deployed, and during the time it was being retrieved. MFT was therefore adjusted by summing the total time it took to set and retrieve the net,

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

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:

$$CPUE_i = \sum_{s=1}^{m} CPUE_{s,i} \quad (3)$$

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

$$CCPUE_d = \sum_{i=1}^{d} CPUE_i \quad (4)$$

where:

d = day for which estimate is being made.

DESCRIBING THE SALMON MIGRATION AND PROJECTING TOTAL RUN

The run entry pattern was described for each of the previous years based on the respective test fishing data as per Mundy (1979):

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

where:

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

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 models 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 (1983a):

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

This model assumes that the average day of return and its variance for previous year *yr* is the same for the current season (Mundy 1979). To test this assumption, in-season 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:

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

where:

n+1 = number of days in the comparison.

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

$$q_d = \frac{CCPUE_d}{r_d} \tag{9}$$

where:

q_d = estimated cumulative catchability as of day *d*,

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

The cumulative total run on day d was estimated from the sum of all commercial, recreational, and personal use harvests to date, the estimated total escapement to date, and an estimate of the number of sockeye salmon residual in the district at that time. Commercial harvest data is 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 fishermen or the processors they sell their fish to within 12 hours of the close of a fishing period. For a complete list of reporting requirements, please see the following statute: 16.05.690(a) and regulation: 5 AAC 39.130. Recreational harvest data was estimated inseason and provided by Division of Sport Fish staff. Personal use harvests were also estimated inseason from daily reports from the various fisheries in combination with an assessment of previous year's personal use catches from runs of similar abundance. 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 fish residual in the district was estimated by assuming exploitation rates of 70% in set net fisheries, 40% in district-wide drift net fisheries, 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 inlet wide fishing period, the number of sockeye salmon originally in the district would have been estimated at 1,250 thousand (500/0.40 = 1,250) and the number remaining, or the residual, would have been estimated at 750 thousand (1,250 - 500 = 750).

Passage rate, the expansion factor used to convert CPUE into estimated numbers of salmon passing the test fishing transect, was calculated as:

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

Total run at the end of the season (TR_f) was then estimated from:

$$TR = PR \cdot CCPUE_f \tag{11}$$

To calculate the midpoint of the run, which is the day on which approximately 50% of the total run had passed the OTF transect, the following formula was used:

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

where:

M = mean date of run,

a and b = model parameters.

Because the test fishery did not encompass the entire sockeye salmon run, the total $CCPUE_f$ for the test fishery was estimated after the season using the following two methods:

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

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).

$$CCPUE_t^r = CCPUE_f \cdot \frac{E_t + H_t}{\sum_{S=1}^{6} E_L + H_L} \tag{14}$$

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 Upper Cook Inlet escapement through final day of test fishery

H_L = total Upper Cook Inlet commercial harvest through final day of test fishery

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

The total run adjustment to $CCPUE_f$ (Equation 14) has replaced adjustments based on harvest alone (Equation 9) primarily due to modifications to commercial fishing management plans made by the BOF. Current management plans allow for much less fishing 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 computed by summing all commercial harvest data and estimates of escapement from the 4 sockeye salmon sonar enumeration sites, 1 weir site, and an estimate of escapement to all unmonitored systems through day *d*. An estimate of sockeye salmon escapement to all non-monitored systems in UCI is considered to be 15% of the monitored runs. Lag times are the approximate time needed for fish to migrate from the test fish transect to a destination. As suggested by Mundy et al. (1993), lag times must be accounted for 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. The following lag times were assumed for fish entering the escapement: Crescent River, 1 day; Kasilof and Kenai rivers, 2 days; and Yentna River and Fish Creek, 7 days (15% of these totals are allocated to unmonitored systems) (Mundy et al. 1993). The number of sockeye salmon harvested in sport and personal use fisheries after test fishing ceased that are not already accounted for in escapement monitoring are assumed to be insignificant and therefore are not utilized in the $CCPUE_f$ post test 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

A total of 4,108 sockeye salmon were captured during the 2005 test fishery, as well as 186 pink salmon *O. gorbuscha*, 448 chum salmon *O. keta*, 546 coho salmon *O. kisutch*, and 8 Chinook salmon *O. tshawytscha* (Tables 1 and 2, Appendices A1–A12). The test boat was unable to fish 2 of the 6 stations on 10 July due to rough water, therefore catch data for these days were interpolated by averaging 9 July and 11 July catch data from these 2 stations. Sockeye salmon daily cumulative catches ranged from 25 to 467 fish (Table 1). The unadjusted total sockeye salmon $CCPUE_f$ for the 2005 project was 2,643, with daily CPUE values ranging from 19 to 208. The $CCPUE_f$ of 2,643 represented the highest final CPUE value ever measured in the OTF program, yet the total estimated run in 2005 was only the third strongest during this same time period. In 1992, the number of stations sampled by the test fish boat was standardized to the current 6 still being fished (Tarbox 1994). Since that time, the relationship between the annual test fish unadjusted $CCPUE_f$ and the total annual run of sockeye salmon to UCI has been significantly correlated ($P < 0.05$), but the fit of the data ($R^2 = 0.29$) is not strong enough to utilize test fish $CCPUE_f$ alone to predict the total annual run (Figure 2). Moreover, the autocorrelation and partial autocorrelation functions of the regression residuals indicated no significant ($p<0.05$) correlations at lags up to 5 years. However, the annual $CCPUE_f$ statistic is reliable enough to provide a rough gauge of annual run strength, as the regression formula averaged about 27% error in predicting the size of the annual run from the true value.

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

Tarbox and Waltemeyer (1989) provided further detail into some of the assumptions the curve fitting procedures utilized to estimate the total CPUE 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 has been the approximate date that commercial fishery staff have used for their first formal estimate of each year's total run size. By this time in the run, there are enough data points in the current year's run-timing curve to provide a more accurate estimate of what the total CPUE will be at the end of the season. In addition, Tarbox and King (1992) and later OTF annual reports all suggested that the initial first best fit estimate made around mid July was not always the most accurate, i.e., the second or third best fit estimate should carefully be considered. Therefore, the method now used to make the first formal inseason estimate of the total run includes an examination of the top five or six best fits. Careful consideration is given to those years whose fits reveal the least day to day change in predicting what the final test fish CPUE will be. These years are identified as being potentially better fits, especially if the mean sum of squares statistic is also improving. Sockeye salmon run-timing from other areas of the state has also been considered to see if a consistent pattern exists. Until more years of data are collected from various runs, caution is advised when choosing the top fits to make projections of the final test fish CPUE, especially prior to 20 July.

The first formal estimate of the 2005 total run of sockeye salmon to UCI was made after the 21 July inlet-wide drift gillnet fishing period (Table 4). The 2005 test fish *CCPUE* curve was mathematically compared (mean sum of squares statistic) to runs from 1979 through 2004, with fits of the data ranked from best to worst. Based on an estimate of the run to date of 4.4 million sockeye salmon through 21 July (this estimate included an estimate of the number of fish residual in the district based upon assumed exploitation rates by different gear types), a passage rate of 3,009 was calculated. The best fit of the current year's *CCPUE* curve tracked the 1994 run, which was a 4-day late run, and estimated a total run of 9.17 million fish. As cautioned earlier, the first best fit using data from approximately 20 July often turns out not to be the best fit by year's end, so the top five best fits were considered. From these data, a total run estimate of 5.8 to 9.2 million was determined. The top three best fits all tracked runs that were 1 or more days late relative to the 15 July mean date of entry at the test fish transect line.

The next formal estimate of the total run of sockeye salmon to UCI in 2005 was made following the 25 July fishing period (Table 4). The run to date was now estimated at 5.3 million fish, with a *CCPUE* of 1,922. The passage rate was therefore estimated at 2,769 fish per CPUE point. The best fit still tracked the 1994 run, which projected a *CCPUE* of 2,947 and a total run of 8.2 million fish. The top five best fits now all tracked late runs and projected a total run to UCI of 5.9 to 8.2 million fish. The actual total run estimate of sockeye salmon to UCI in 2005 was 7.8 million fish, which includes commercial, sport, and personal use harvests, as well as escapement to all systems. Therefore, the first best fit run estimates from the two formal inseason forecasts of the 2005 run size were approximately 18% and 5% higher than the actual run size, respectively.

Figure 4 depicts the OTF error in projecting the total sockeye salmon run based on the best fits of the data on or soon after 20 July. As can be seen in this figure, the error in the 20 July estimate has been significant (>30%) only on runs that were 2 or more days early. In fact, for runs that are 1-day early, on time, or late, the error in the 20 July estimate of the total run ranges from -6.4% to +17.6% (average = +5.3%) of the actual run. Conversely, for runs that enter the district 2 or more days earlier than average, the OTF curve-fitting estimator does not perform nearly as well, with a range in error of +8.8% to +75.4%, or an average of +36.5%. It is quite likely that as additional data representing runs with more variable run timing are added to the database, the OTF projections will become more accurate for early runs.

UCI commercial fishery management plans compel ADF&G to make an inseason estimate of the number of sockeye salmon in each year's run that are of Kenai River origin. Various management actions in both sport and commercial fisheries are tied to the total abundance of Kenai River sockeye salmon, which is characterized by three different ranges: less than 2 million fish, between 2 and 4 million fish, and greater than 4 million fish (Shields 2006). Based on commercial, sport, and personal use harvest, and escapement data through 21 July, the total sockeye salmon run through this date of Kenai River origin was estimated at 2.6 million fish (Table 5). Again, using the top five best fits of the current year's *CCPUE* curve to estimate the total sockeye salmon run, and assuming that 65% of the remaining run would be of Kenai River origin, the estimated total Kenai River run for 2005 was estimated at 3.7 to 5.9 million fish. The 25 July run projection from the top five best fits from the test fishery estimated that the total Kenai River sockeye salmon run would be 3.9 to 5.5 million fish. These formal run projections of the size of the Kenai River sockeye salmon run were critical to inseason commercial fishery management decisions, as management plans are tied to the size of the Kenai River sockeye salmon run. For example, if the size of the Kenai River run exceeds 4 million fish, management of the commercial fishery is significantly altered, including: (1) the Central District Drift Gillnet Fishery Management Plan (5 AAC 21.353), which states that there will be no mandatory restrictions to the fishery from July 16 to July 31, (2) the Northern District Salmon Management Plan (5 AAC 21.358), which says the Yentna River sockeye salmon sustainable escapement goal of 90,000 to 160,000 fish changes to an optimal escapement goal of 75,000 to 180,000 fish, and (3) the Kenai River Late-Run Sockeye Salmon Management Plan (5 AAC 21.360), which directs ADF&G to manage for an inriver goal range of 850,000 to 1,100,000 fish and requires only one continuous 36 hour closure to the Upper Subdistrict set gillnet fishery. In 2005, the official announcement that the Kenai River sockeye salmon run would likely exceed 4 million fish occurred on 26 July and the various management plan changes just outlined went into effect. The test fish data was heavily relied upon to make this formal projection.

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. Two methods were developed to estimate the percentage of the run that occurred after the test fishery ceased so that postseason adjustments could be made to 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 accounts for the number of fish harvested commercially after the test fishery ends (Equation 13), while the second method enumerates both escapement and commercial catch (total run) after the test fishery terminates (Equation 14). The sport and personal-use harvest of sockeye salmon that occurs after the test fishery concludes is assumed to be very minimal and therefore is not considered. Table 6 shows the differences in the annual *CCPUE* statistic after postseason adjustments were made using either the harvest or total run method. Although the changes are relatively minor, they do have an effect on the algorithms that are used to fit the current year's *CCPUE* to run-timing curves from previous years, because the a and b coefficients in the equation describing the historical run timings are changed. Beginning in 2002, the total run method was used to make postseason adjustments to all previous years' *CCPUE* statistics (Shields 2003). For the 2005 season, the final test fish *CCPUE* of 2,643 was adjusted to 3,180; in other words, approximately 20.3% of the total sockeye salmon run occurred after the test fishery ceased.

A non-linear mathematical model (Mundy 1979) was fit to the *CCPUE* proportions of the sockeye salmon run to UCI. Using the total run-adjusted *CCPUE*, this analysis suggested that 6.4% of the run had passed the transect prior to the start of test fishing on 1 July and that the run was 75.2% complete at project termination (Figure 3 and Appendix A13). Therefore, the mathematical model indicated that test fishing spanned only 68.8% of the run. The median date of the 2005 UCI sockeye salmon run (the day on which approximately 50% of the total run has entered UCI at the test fish transect) occurred on day 28.4, or 21 July, which was 6 days late relative to the historic average median date of 15 July (Table 7). This entry timing represents the latest run that had ever been observed since the test fish project began in 1979. Moreover, 39% of the sockeye salmon escapement into the Kenai River occurred in August, which is the second largest percentage of escapement in August since escapement monitoring began in 1978. Incidentally, the midpoint date of the sockeye salmon run at the test fish transect in 1994 was 20 July (Table 7), the second latest midpoint date of run since the test fishery began.

The strength of the latter portion of the 2005 run, however, was predicted inseason by the test fish program. For example, from 21 July to 30 July, the test fish *CCPUE* was 1,360 points, which suggested that as many as 3.7 million sockeye salmon had entered the district during this time period. The cumulative run through July 21 was estimated at 4.4 million (Table 4) fish, while the total run in 2005 was estimated at 7.8 million, so about 3.4 million fish went into catch and escapement after July 20. This is only slightly below (0.1 million) what the OTF *CCPUE* had suggested. In addition, 2.7 million sockeye salmon were harvested after July 20, which is slightly more than half of the total harvest. Surprisingly though, there was no single significant harvest event within the first week after the large test fish catches, instead the later harvests were more spread out over time.

Water temperatures measured along the test fish transect ranged from 9.6° to 14.5°C and averaged 11.7°C for the year (Appendices A14 and A15). The average surface water temperature was the warmest observed at each station during the past 10 years. Strangely, these warmer than average surface water temperatures did not fit with the run-timing of this year's run. Burgner (1980) showed that the arrival dates of Bristol Bay sockeye salmon were early during years where water temperatures were warmer than average, while Blackbourn (1987) provided a model that explained the negative relationship between sea surface temperatures in the Gulf of Alaska and the timing of the run of sockeye salmon stocks from Alaska. Therefore, based on surface water temperatures at the test fish transect in 2005, which were warmer than average, it could have been expected that this year's run would have been early. In the third volume of a series of books dealing with Fishery Oceanography, Pearcy (1992) summarized many 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 factor 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). It is altogether possible that some combination of these factors (other than just water temperature) may affect fish migration and run timing.

For the past 2 years, ADF&G has been conducting a companion study on board the test fish vessel, using side-scan sonar to observe fish distribution in the water column 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 enhanced and improved using this additional information.

Air temperatures along the test fish transect ranged from 10° to 19°C and averaged 12.9°C, with station averages nearly identical to the previous 10-year averages (Appendices A14 and A15).

Wind velocities averaged 7.1 knots for the month, which represents the calmest conditions observed during the past 10 years. Wind direction was variable, but in general winds originated out of the south. The average water and air temperature from all stations combined was warmer than long-term values, while the average wind velocity was less than long-term measurements (Appendix 16). Salinity and secchi disk readings were nearly identical to the averages from all previous years.

Appendix A15 provides a summary of the physical data that has been collected at each of the 6 test fish stations for the past 10 years. Station 4, which is on the east side of Cook Inlet, was the shallowest station, averaging 24.0 fathoms (144 feet) in depth. It should be noted that changes in depth are a result of different stages of tide as well as minor differences in set location from day to day. Station 4 also had the clearest water, with a 1996–2005 secchi disk average depth of 8.1 m. In general, water clarity along the test fish transect decreases as you travel from east to west (secchi disk average depth decreases from 8.1 m at station 4 to 2.8 m at station 8) as a result of numerous glacial watersheds draining into the west side of Cook Inlet.

Since 2002, scale samples have been collected from all sockeye salmon that are measured to estimate mean length. The dominant age-class of sockeye salmon entering UCI at the test fish transect in 2005 was 1.3 (5-year olds), comprising nearly 80% of the run (Table 8). This estimate compared favorably with age composition samples collected from sockeye salmon harvested commercially by the drift gillnet fleet in UCI, which revealed the 1.3 age class comprised 79% of the 2005 harvest (T. Tobias, Commercial Fisheries Technician, ADF&G, Soldotna; personal communication). The scale samples from the OTF program were also analyzed with the intent of assessing whether or not Kenai River sockeye salmon, which are the dominant stock in Cook Inlet runs, might be identified using "size at age" criteria as they entered the district at the test fish transect. Statistical analyses will be conducted comparing the average size of each age class of sockeye salmon collected at various escapement monitoring sites throughout UCI to the average size of the same age classes collected at the 6 stations along the test fish transect. The results of this "mixture-model" analysis will be summarized in future test fish annual reports.

The UCI test fishery continues to provide fishery managers with very important data about the strength and timing of each year's sockeye salmon run. And, because commercial, sport, and personal use fishery management plans are intrinsically linked to the strength of the annual sockeye salmon run, the UCI test fishery is essentially relied upon to provide fishermen and fishery managers with an early indication of annual run strength and timing.

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TABLES AND FIGURES

Table 1.–Summary of sockeye salmon fishing effort, daily and cumulative catch, and daily and cumulative CPUE, Upper Cook Inlet offshore test fish project, 2005.

Date	Number of Stations	Mean Fishing Time (min)	CATCH		CPUE		Mean Length (mm)
			Daily	Cum	Daily	Cum	
7/01	6	231.5	47	47	35	35	556
7/02	6	230.0	43	90	33	68	544
7/03	6	240.0	142	232	98	165	559
7/04	6	227.5	46	278	36	201	560
7/05	6	239.7	68	346	47	249	568
7/06	6	241.0	94	440	68	317	563
7/07	6	246.5	171	611	118	434	565
7/08	6	256.0	196	807	127	561	566
7/09	6	252.5	199	1,006	124	685	572
7/10[a]	6	236.2	66	1,072	46	731	569
7/11	6	235.0	50	1,122	36	767	568
7/12	6	233.5	81	1,203	60	827	565
7/13	6	235.5	100	1,303	76	903	569
7/14	6	225.5	38	1,341	30	932	568
7/15	6	267.0	217	1,558	136	1,068	572
7/16	6	252.5	35	1,593	25	1,093	578
7/17	6	227.0	39	1,632	30	1,122	570
7/18	6	234.0	56	1,688	37	1,160	577
7/19	6	220.0	37	1,725	29	1,188	570
7/20	6	245.5	149	1,874	95	1,283	572
7/21	6	267.5	294	2,168	168	1,451	576
7/22	6	242.0	136	2,304	94	1,545	565
7/23	6	257.0	212	2,516	133	1,678	569
7/24	6	243.0	128	2,644	91	1,769	565
7/25	6	256.0	238	2,882	153	1,922	567
7/26	6	258.0	227	3,109	149	2,071	570
7/27	6	222.0	25	3,134	19	2,090	567
7/28	6	243.5	196	3,330	148	2,238	572
7/29	6	260.0	311	3,641	196	2,435	575
7/30	6	287.0	467	4,108	208	2,643	571

[a] Two of the 6 stations were not fished due to weather; the data for these stations were interpolated.

Table 2.–Estimated sockeye salmon catch by date and station, Upper Cook Inlet offshore test fish project, 2005.

	Station Number						
Date	**4**	**5**	**6**	**6.5**	**7**	**8**	**Total**
7/01	0	5	36	3	2	1	47
7/02	1	15	11	12	4	0	43
7/03	50	7	1	73	10	1	142
7/04	3	4	13	22	3	1	46
7/05	0	6	13	43	6	0	68
7/06	5	22	18	4	44	1	94
7/07	15	6	29	72	48	1	171
7/08	7	93	21	39	34	2	196
7/09	0	1	34	69	94	1	199
7/10[a]	0	14	39	12	1	0	66
7/11	1	27	2	0	3	17	50
7/12	0	25	3	32	8	13	81
7/13	13	2	16	16	28	25	100
7/14	0	7	2	8	3	18	38
7/15	12	20	17	103	43	22	217
7/16	3	1	9	2	12	8	35
7/17	8	4	1	2	24	0	39
7/18	6	38	9	1	2	0	56
7/19	4	6	1	5	3	18	37
7/20	3	11	97	35	0	3	149
7/21	1	16	16	45	48	168	294
7/22	2	26	7	1	59	41	136
7/23	1	0	18	63	91	39	212
7/24	6	14	18	13	20	57	128
7/25	1	3	91	26	72	45	238
7/26	0	31	76	72	22	26	227
7/27	0	0	0	18	2	5	25
7/28	20	69	39	31	31	6	196
7/29	19	91	47	131	23	0	311
7/30	12	10	338	87	19	1	467
Total	193	574	1,022	1,040	759	520	4,108
Percent	4.7%	14.0%	24.9%	25.3%	18.5%	12.7%	100%

[a] Two of the 6 stations were not fished due to weather; the data for these stations were interpolated.

Table 3.–Estimated sockeye salmon CPUE by date and station, Upper Cook Inlet offshore test fish project, 2005.

	Station Number						
Date	**4**	**5**	**6**	**6.5**	**7**	**8**	**Total**
7/01	0	4	26	2	2	1	35
7/02	1	12	8	9	3	0	33
7/03	36	6	1	47	8	1	98
7/04	2	3	10	17	2	1	36
7/05	0	5	9	29	5	0	47
7/06	4	16	14	3	31	1	68
7/07	12	5	19	50	32	1	118
7/08	5	55	15	26	23	2	127
7/09	0	1	24	41	57	1	124
7/10[a]	0	10	26	9	1	0	46
7/11	1	19	2	0	2	13	36
7/12	0	19	2	22	6	10	60
7/13	10	2	12	12	20	19	76
7/14	0	5	2	6	2	14	30
7/15	9	15	13	56	28	15	136
7/16	2	1	6	2	9	6	25
7/17	6	3	1	2	18	0	30
7/18	5	23	7	1	2	0	37
7/19	3	5	1	4	2	13	29
7/20	2	9	58	24	0	2	95
7/21	1	12	12	31	32	81	168
7/22	2	19	6	1	39	28	94
7/23	1	0	13	39	54	26	133
7/24	5	11	13	10	15	38	91
7/25	1	2	54	20	44	33	153
7/26	0	21	47	46	16	19	149
7/27	0	0	0	14	2	4	19
7/28	15	56	27	23	23	4	148
7/29	14	56	31	77	18	0	196
7/30	9	8	125	51	14	1	208
Total	146	399	582	674	510	331	2,643
Percent	5.5%	15.1%	22.0%	25.5%	19.3%	12.5%	100%

[a] Two of the 6 stations were not fished due to weather; the data for these stations were interpolated.

Table 4.–Total run estimates for sockeye salmon to Upper Cook Inlet, Alaska, made during the 2005 season.

Based on data through 7/21/2005						
Escapement						**1,158,782**
Cumulative Catch						**2,909,242**
Residual in District						**298,693**
Total Run Through 7/21/2005 =						**4,366,718**
2005 Cumulative OTF CPUE through 7/21/2005 =						**1,451**
Passage Rate (Total Run/Cumulative CPUE) based on 7/21/2005 harvest =						**3,009**
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
1994	0.001599	3,048	3,099	-51	Late 4 days	9,171,546
1997	0.001746	2,451	2,471	-19	Late 1 day	7,375,241
1998	0.001786	2,414	2,433	-19	Late 3 days	7,263,442
1985	0.001924	1,987	1,986	1	On Time	5,976,972
1988	0.001947	1,921	1,918	3	Early 2 days	5,780,151
1982	0.001956	2,116	2,124	-8	Late 2 days	6,366,764
2001	0.001982	1,651	1,642	9	Early 2 days	4,967,382
2002	0.002086	1,665	1,658	7	Early 2 days	5,008,900
1986	0.002146	2,076	2,087	-11	Late 1 day	6,246,090
1993	0.002195	1,956	1,962	-6	Early 1 day	5,885,571
1984	0.002629	1,574	1,554	20	Early 4 days	4,735,751
1983	0.003049	2,119	2,143	-24	On Time	6,375,820
1987	0.003287	2,879	2,962	-83	Late 2 days	8,661,381
1996	0.003321	1,809	1,817	-8	Early 2 days	5,442,467
2003	0.003455	1,913	1,928	-15	Early 1 day	5,756,232
2004	0.003917	2,481	2,539	-58	Late 2 days	7,463,724
1991	0.003975	2,430	2,485	-55	Late 2 days	7,309,504
1989	0.004116	1,973	1,950	24	On Time	5,936,206
1995	0.004202	2,045	2,073	-28	On Time	6,152,162
2000	0.004219	1,653	1,654	-2	Early 2 days	4,971,804
1979	0.004614	1,398	1,369	29	Early 5 days	4,206,150
1999	0.005580	2,626	2,716	-90	Late 3 days	7,899,728
1990	0.006694	3,028	3,181	-153	Late 3 days	9,108,877
1992	0.006838	2,550	2,644	-94	Late 2 days	7,671,797
1981	0.019323	1,264	1,225	39	Early 9 days	3,803,120
1980	0.021614	1,298	1,259	40	Early 9 days	3,905,352

-continued-

Table 4.–Page 2 of 2.

Based on data through 7/25/2005	
Escapement	**1,401,796**
Cumulative Catch	**3,650,920**
Residual in District	**269,511**
TOTAL RUN THROUGH 7/25/2005 =	**5,322,227**
2004 Cumulative OTF CPUE through 7/25/2005 =	**1,922**
Passage Rate (Total Run/Cumulative CPUE) through 7/25/2005 =	**2,769**

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
1994	0.001531	2,947	2,954	-7	Late 4 days	8,161,541
1997	0.001541	2,459	2,442	17	Late 1 day	6,809,306
1998	0.001583	2,424	2,407	18	Late 3 days	6,713,954
1982	0.001942	2,165	2,138	26	Late 2 days	5,995,229
1986	0.002102	2,120	2,094	26	Late 1 day	5,870,023
1985	0.002280	2,064	2,031	33	On Time	5,716,319
1993	0.002378	2,017	1,987	30	Early 1 day	5,585,823
1988	0.002516	2,007	1,973	35	Early 2 days	5,559,264
1983	0.002736	2,127	2,108	19	On Time	5,890,960
2003	0.003344	1,955	1,928	27	Early 2 days	5,413,757
1987	0.003480	2,701	2,722	-21	Late 2 days	7,480,258
1996	0.003605	1,873	1,841	31	Early 2 days	5,186,414
2004	0.003712	2,386	2,388	-2	Late 2 days	6,607,137
1991	0.003714	2,346	2,346	0	Late 2 days	6,496,996
1995	0.003751	2,048	2,029	19	On Time	5,672,174
2002	0.003918	1,772	1,732	40	Early 1 days	4,907,559
2001	0.004058	1,763	1,722	41	Early 2 days	4,883,603
1989	0.005235	2,119	2,072	47	On Time	5,867,835
2000	0.005303	1,741	1,704	37	Early 2 days	4,821,430
1999	0.005743	2,450	2,467	-17	Late 3 days	6,783,938
1984	0.006357	1,717	1,670	47	Early 4 days	4,755,849
1992	0.006961	2,373	2,389	-16	Late 2 days	6,571,799
1990	0.008017	2,683	2,733	-49	Late 3 days	7,431,655
1979	0.012549	1,569	1,516	53	Early 5 days	4,346,498
1981	0.032592	1,466	1,406	59	Early 9 days	4,059,529
1980	0.033135	1,501	1,442	60	Early 9 days	4,157,235

Table 5.–Estimated total Kenai River sockeye run (millions) in 2005 estimated from total offshore test fish CPUE and age composition stock allocation estimates through July 21, and July 27.

Data through 21-July

		Est. Total OTF CPUE										
Year	**MSS**	**Current**	**Prev. Day**	**Timing**	**Passage Rate**	**Estimated UCI Total run**	**Estimated UCI Run to Date**	**Estimated UCI Run Remaining**	**Estimated Kenai Run to Date**	**Prop. Kenai**	**Estimated Kenai Run Remaining**	**Estimated Total Kenai Run**
1994	0.00160	3,048	3,099	Late 4 days	3,009	9.2	4.1	5.1	2.6	65%	3.3	5.9
1997	0.00175	2,451	2,471	Late 1 day	3,009	7.4	4.1	3.3	2.6	65%	2.1	4.7
1998	0.00179	2,414	2,433	Late 3 days	3,009	7.3	4.1	3.2	2.6	65%	2.1	4.6
1985	0.00192	1,987	1,986	On Time	3,009	6.0	4.1	1.9	2.6	65%	1.2	3.8
1988	0.00195	1,921	1,918	Early 2 days	3,009	5.8	4.1	1.7	2.6	65%	1.1	3.7

Data through 25-July

		Est. Total OTF CPUE										
Year	**MSS**	**Current**	**Prev. Day**	**Timing**	**Passage Rate**	**Estimated UCI Total run**	**Estimated UCI Run to Date**	**Estimated UCI Run Remaining**	**Estimated Kenai Run to Date**	**Prop. Kenai**	**Estimated Kenai Run Remaining**	**Estimated Total Kenai Run**
1994	0.00153	2,947	2,954	Late 4 days	2,769	8.2	5.1	3.1	3.3	69%	2.1	5.5
1997	0.00154	2,459	2,442	Late 1 day	2,769	6.8	5.1	1.8	3.3	69%	1.2	4.6
1998	0.00158	2,424	2,407	Late 3 days	2,769	6.7	5.1	1.7	3.3	69%	1.1	4.5
1982	0.00194	2,165	2,138	Late 2 days	2,769	6.0	5.1	0.9	3.3	69%	0.6	4.0
1986	0.00210	2,120	2,094	Late 1 day	2,769	5.9	5.1	0.8	3.3	69%	0.6	3.9

Note: MSS is the mean sum of squares.

Table 6.–A comparison of methods used to make post-season adjustments to the offshore test fish final CPUE.

Year	Final OTF CPUE	Post-Season OTF CPUE Adjustment		Harvest Adjusted		Total Run Adjusted	
		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	3,015	3,180	-3.7499	0.1360	-3.7170	0.1305

Table 7.–Mean date of the sockeye salmon run across the Anchor Point transect, Upper Cook Inlet offshore test fish project, 1979–2005.

	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	16-Jul
1987	26.0	19-Jul
1988	21.4	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
1979–2004 Average	21.8	15-Jul
2005	28.4	21-Jul

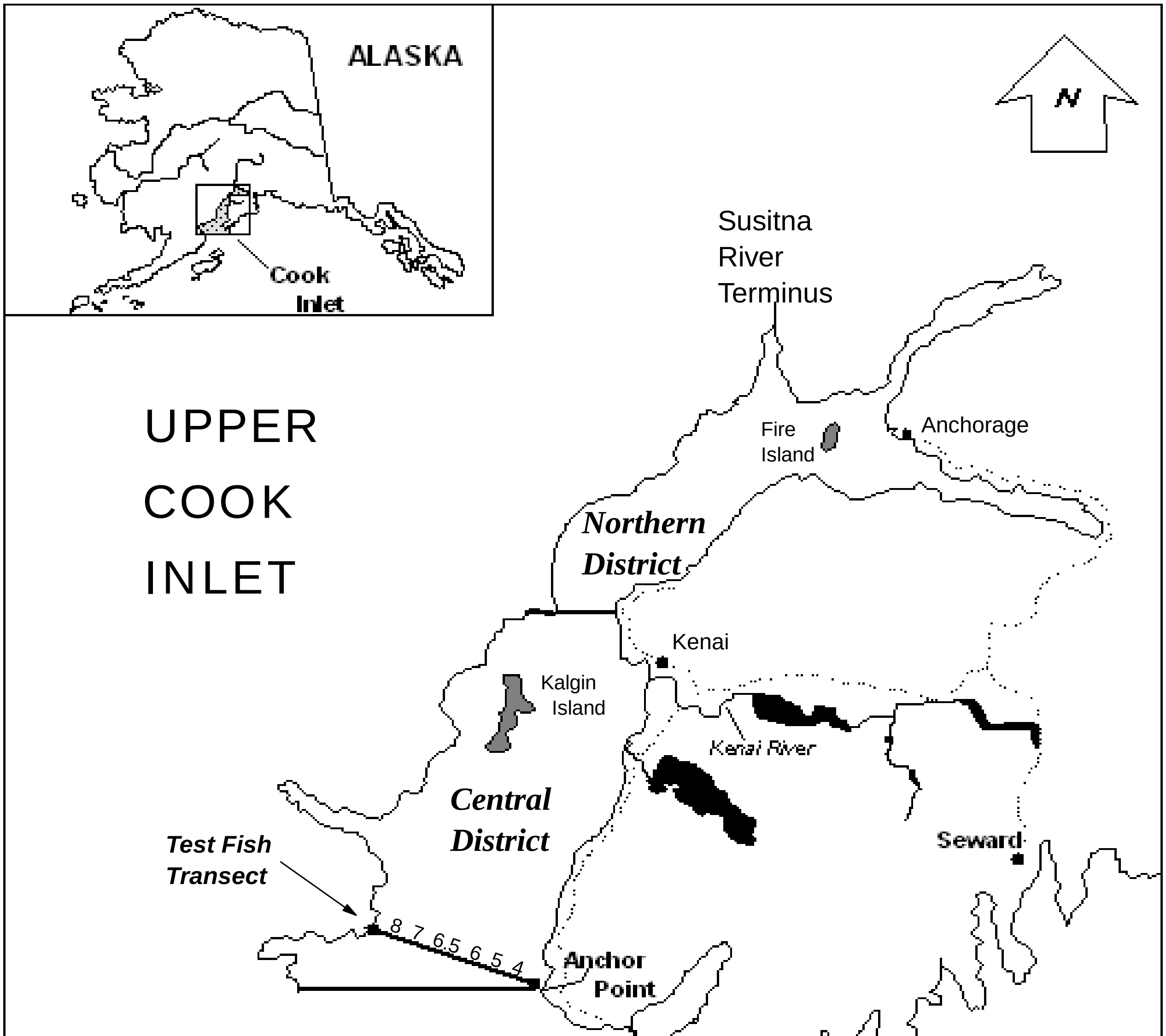
[a] Day (1) = June 24.

Table 8.–Sockeye salmon age-composition, mean length (mm), and number of samples by station, Upper Cook Inlet offshore test fish project, 2005.

Station	Sample	Percent Age Composition								
No.	Size	0.3	1.2	1.3	2.2	1.4	2.3	2.4	3.2	3.3
4	126		2.6	85.5	1.0	1.0	8.8		1.0	
5	319	0.9	1.9	82.6	1.1	0.7	12.9			
6	361	0.6	1.4	80.0	1.4	0.3	16.1	0.3		
6.5	439	0.5	3.3	78.9	1.5	0.4	14.8	0.2	0.2	0.2
7	392		1.8	78.0	1.6	1.3	17.3			
8	244	0.8	1.2	77.5	2.5	0.4	17.7			
Weighted Avg =		0.7	2.3	79.9	1.7	0.9	15.6	0.2	0.6	0.2

Station	Sample	Mean Length (mm)								
No.	Size	0.3	1.2	1.3	2.2	1.4	2.3	2.4	3.2	3.3
4	126		489	570	521	594	563		511	
5	319	570	494	571	515	602	572			
6	361	564	496	570	503	581	570	621		
6.5	439	568	506	572	509	608	568	592	542	561
7	392		522	575	531	554	561			
8	244	585	534	571	528	629	564			
Weighted Avg =		572	507	572	518	583	567	607	527	561

Station	Sample	Number of Samples								
No.	Size	0.3	1.2	1.3	2.2	1.4	2.3	2.4	3.2	3.3
4	126		3	109	1	1	11		1	
5	319	3	6	264	3	2	41			
6	361	2	5	289	5	1	58	1		
6.5	439	2	14	346	7	2	65	1	1	1
7	392		7	306	6	5	68			
8	244	2	3	189	6	1	43			
Station Total =		9	38	1,503	28	12	286	2	2	1



Station	Latitude	Longitude
4	59 49.50	152 09.10
5	59 50.20	152 13.50
6	59 51.00	152 17.60
6.5	59.51.40	152 19.80
7	59 51.70	152 22.00
8	59 52.40	152 26.30

Figure 1.–Location of fishing districts and offshore test fish transect in Cook Inlet, Alaska 2005.

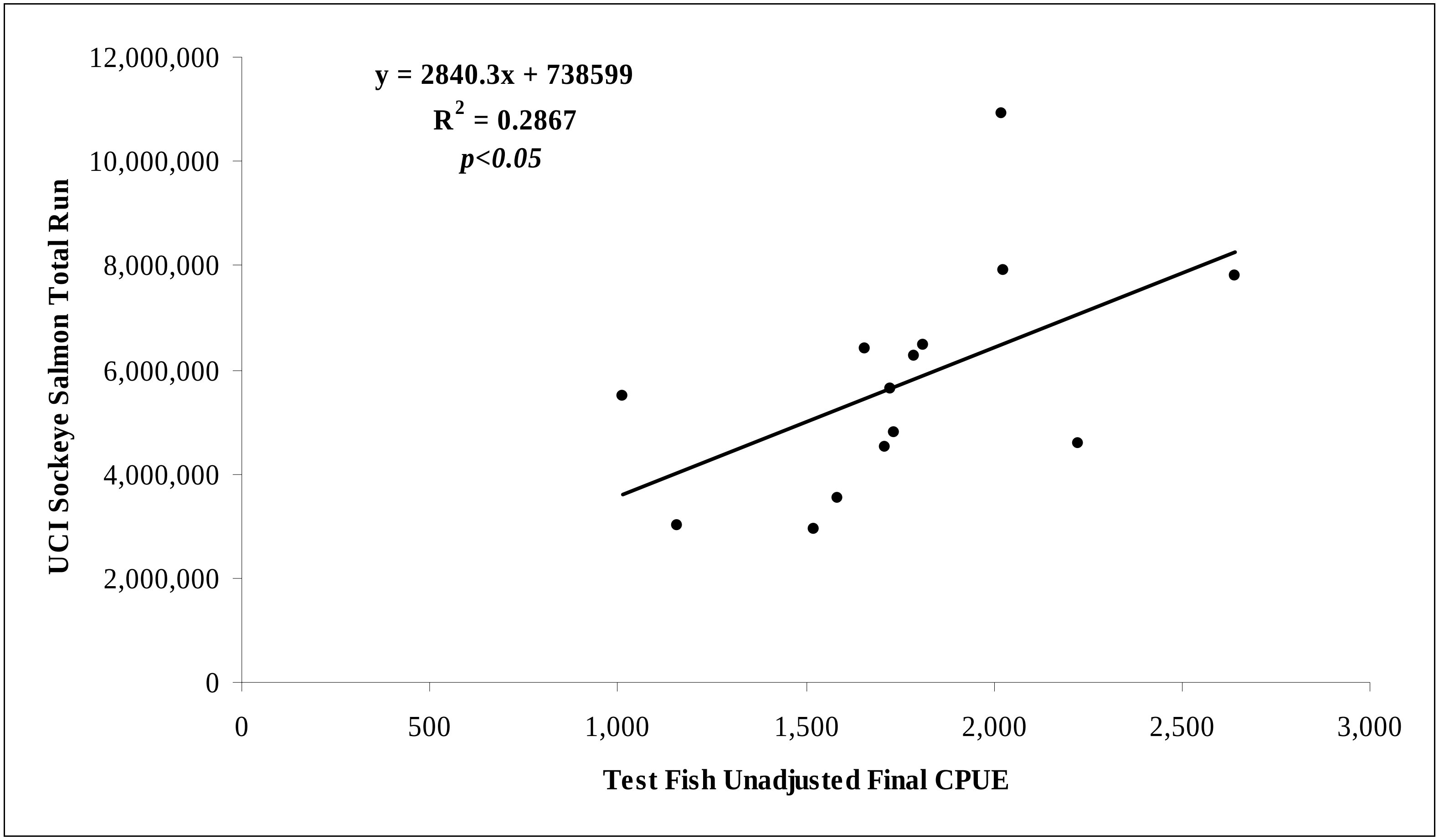


Figure 2.–Linear regression of the relationship between offshore test fish unadjusted cumulative CPUE and Upper Cook Inlet sockeye salmon total annual run.

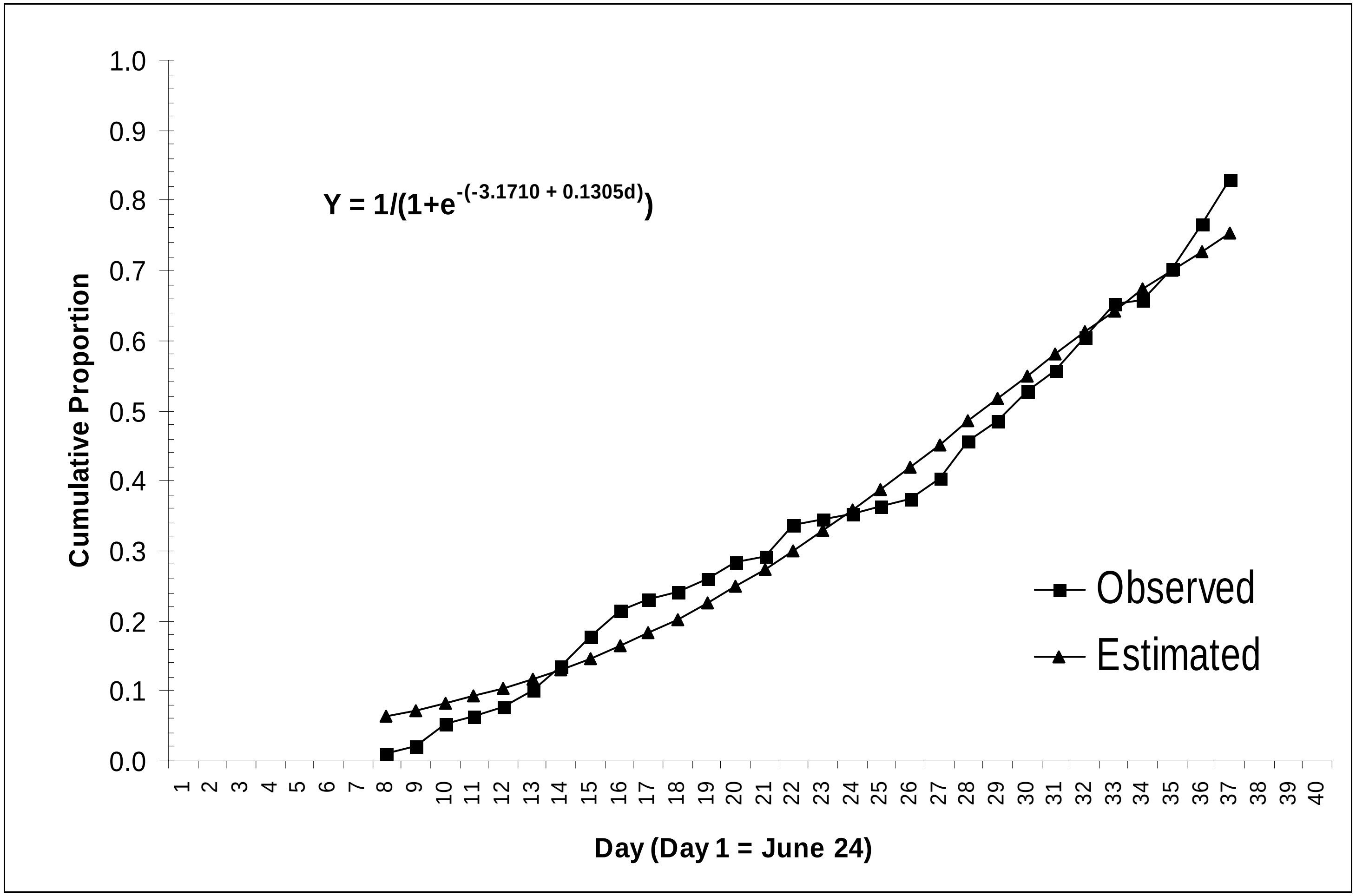


Figure 3.–Cumulative proportions estimated for the sockeye salmon run to Upper Cook Inlet, Alaska, 2005.

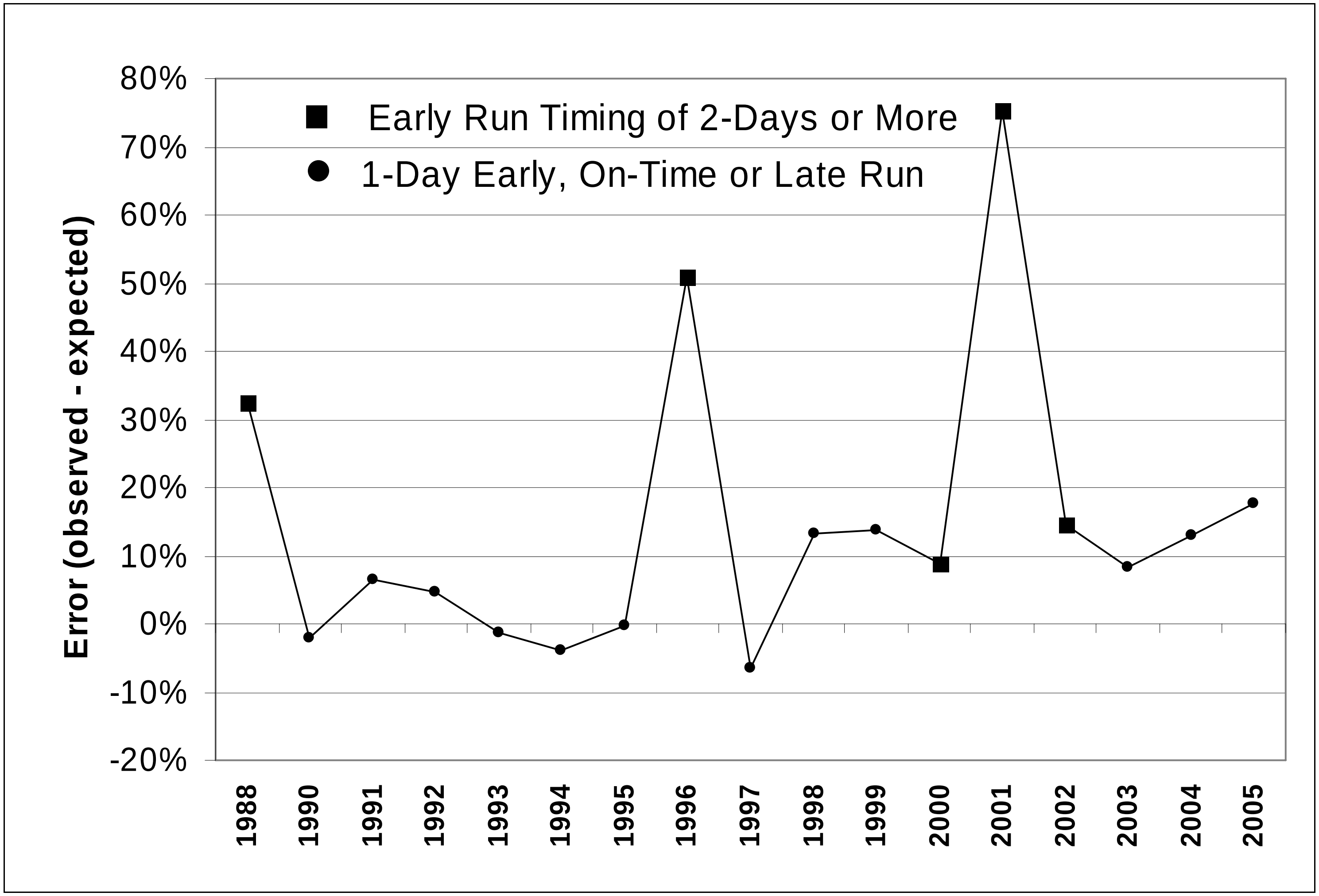


Figure 4.–OTF error in forecasting the total run of sockeye salmon to Upper Cook Inlet using the 20-July best-fit estimate.

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, 2005.

Date	Number of Stations	Mean Fishing Time (min)	CATCH		CPUE	
			Daily	Cum	Daily	Cum
7/01	6	231.5	1	1	1	1
7/02	6	230.0	3	4	2	3
7/03	6	240.0	4	8	3	6
7/04	6	227.5	4	12	3	9
7/05	6	239.7	3	15	2	11
7/06	6	241.0	3	18	2	13
7/07	6	246.5	4	22	3	16
7/08	6	256.0	14	36	9	25
7/09	6	252.5	8	44	5	31
7/10[a]	6	236.2	14	58	11	41
7/11	6	235.0	11	69	8	50
7/12	6	233.5	11	80	9	58
7/13	6	235.5	7	87	5	63
7/14	6	225.5	2	89	2	65
7/15	6	267.0	11	100	27	92
7/16	6	252.5	5	105	4	95
7/17	6	227.0	4	109	3	99
7/18	6	234.0	0	109	0	99
7/19	6	220.0	2	111	2	100
7/20	6	245.5	6	117	4	104
7/21	6	267.5	10	127	5	110
7/22	6	242.0	6	133	4	114
7/23	6	257.0	5	138	3	117
7/24	6	243.0	10	148	7	124
7/25	6	256.0	10	158	7	131
7/26	6	258.0	4	162	3	134
7/27	6	222.0	3	165	2	136
7/28	6	243.5	11	176	8	144
7/29	6	260.0	5	181	3	148
7/30	6	287.0	5	186	2	150

[a] Two of the 6 stations were not fished due to weather; the data for these stations were interpolated.

Appendix A2.–Estimated pink salmon catch by date and station, Upper Cook Inlet offshore test fish project, 2005.

	Station Number						
Date	**4**	**5**	**6**	**6.5**	**7**	**8**	**Total**
7/01	0	0	1	0	0	0	1
7/02	0	2	0	0	0	1	3
7/03	1	1	0	2	0	0	4
7/04	0	1	1	0	2	0	4
7/05	0	0	1	2	0	0	3
7/06	1	1	1	0	0	0	3
7/07	1	0	2	1	0	0	4
7/08	2	5	1	3	3	0	14
7/09	0	1	0	0	6	1	8
7/10[a]	2	1	6	4	0	1	14
7/11	5	2	0	1	2	1	11
7/12	0	1	5	1	1	3	11
7/13	1	1	3	2	0	0	7
7/14	0	0	0	0	1	1	2
7/15	0	2	2	4	2	1	11
7/16	0	0	1	1	2	1	5
7/17	0	0	0	1	2	1	4
7/18	0	0	0	0	0	0	0
7/19	0	0	1	0	1	0	2
7/20	2	0	4	0	0	0	6
7/21	1	0	0	1	0	8	10
7/22	0	0	0	0	1	5	6
7/23	0	0	1	2	2	0	5
7/24	0	2	6	0	0	2	10
7/25	1	1	2	2	1	3	10
7/26	0	0	0	3	1	0	4
7/27	0	0	1	1	1	0	3
7/28	3	0	1	0	5	2	11
7/29	1	0	3	1	0	0	5
7/30	0	0	4	1	0	0	5
Total	21	21	47	33	33	31	186
Percent	11.3	11.3	25.3	17.7	17.7	16.7	100

[a] Two of the 6 stations were not fished due to weather; the data for these stations were interpolated.

Appendix A3.–Estimated pink salmon CPUE by date and station, Upper Cook Inlet offshore test fish project, 2005.

	Station Number						
Date	**4**	**5**	**6**	**6.5**	**7**	**8**	**Total**
7/01	0.0	0.0	0.7	0.0	0.0	0.0	0.7
7/02	0.0	1.5	0.0	0.0	0.0	0.8	2.3
7/03	0.7	0.8	0.0	1.3	0.0	0.0	2.8
7/04	0.0	0.8	0.8	0.0	1.6	0.0	3.2
7/05	0.0	0.0	0.7	1.4	0.0	0.0	2.1
7/06	0.7	0.7	0.7	0.0	0.0	0.0	2.1
7/07	0.8	0.0	1.3	0.7	0.0	0.0	2.8
7/08	1.6	2.9	0.7	2.0	2.0	0.0	9.2
7/09	0.0	0.8	0.0	0.0	3.7	0.8	5.3
7/10[a]	1.9	1.1	4.0	3.0	0.0	0.8	10.8
7/11	3.8	1.4	0.0	0.8	1.5	0.7	8.3
7/12	0.0	0.7	3.9	0.7	0.8	2.3	8.5
7/13	0.8	0.8	2.2	1.5	0.0	0.0	5.4
7/14	0.0	0.0	0.0	0.0	0.8	0.8	1.6
7/15	0.0	1.5	1.5	21.8	1.3	0.6	26.7
7/16	0.0	0.0	0.6	0.9	1.5	0.7	3.7
7/17	0.0	0.0	0.0	0.8	1.5	0.8	3.1
7/18	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/19	0.0	0.0	1.1	0.0	0.7	0.0	1.8
7/20	1.6	0.0	2.4	0.0	0.0	0.0	4.0
7/21	0.8	0.0	0.0	0.7	0.0	3.8	5.4
7/22	0.0	0.0	0.0	0.0	0.7	3.4	4.1
7/23	0.0	0.0	0.7	1.2	1.2	0.0	3.2
7/24	0.0	1.5	4.4	0.0	0.0	1.3	7.3
7/25	0.8	0.8	1.2	1.5	0.6	2.2	7.1
7/26	0.0	0.0	0.0	1.9	0.7	0.0	2.6
7/27	0.0	0.0	0.9	0.7	0.8	0.0	2.4
7/28	2.2	0.0	0.7	0.0	3.6	1.4	8.0
7/29	0.7	0.0	2.0	0.6	0.0	0.0	3.3
7/30	0.0	0.0	1.5	0.6	0.0	0.0	2.1
Total	16.5	15.3	32.1	42.1	23.1	20.5	149.7
Percent	11.0	10.2	21.4	28.2	15.5	13.7	100

[a] Two of the 6 stations were not fished due to weather; the data for these stations were 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, 2005.

Date	Number of Stations	Mean Fishing Time (min)	CATCH Daily	CATCH Cum	CPUE Daily	CPUE Cum
7/01	6	231.5	2	2	2	2
7/02	6	230.0	2	4	2	3
7/03	6	240.0	6	10	4	7
7/04	6	227.5	2	12	2	8
7/05	6	239.7	5	17	3	12
7/06	6	241.0	16	33	12	23
7/07	6	246.5	17	50	12	35
7/08	6	256.0	37	87	24	59
7/09	6	252.5	21	108	13	73
7/10[a]	6	236.2	19	127	13	86
7/11	6	235.0	12	139	8	94
7/12	6	233.5	11	150	8	102
7/13	6	235.5	6	156	5	107
7/14	6	225.5	3	159	3	110
7/15	6	267.0	55	214	33	142
7/16	6	252.5	5	219	3	145
7/17	6	227.0	8	227	6	152
7/18	6	234.0	7	234	4	156
7/19	6	220.0	6	240	4	160
7/20	6	245.5	15	255	10	171
7/21	6	267.5	35	290	22	193
7/22	6	242.0	6	296	4	197
7/23	6	257.0	22	318	14	211
7/24	6	243.0	19	337	14	224
7/25	6	256.0	21	358	14	238
7/26	6	258.0	30	388	20	258
7/27	6	222.0	4	392	3	261
7/28	6	243.5	22	414	17	278
7/29	6	260.0	17	431	11	289
7/30	6	287.0	17	448	11	300

[a] Two of the 6 stations were not fished due to weather; the data for these stations were interpolated.

Appendix A5.–Estimated chum salmon catch by date and station, Upper Cook Inlet offshore test fish project, 2005.

	Station Number						
Date	**4**	**5**	**6**	**6.5**	**7**	**8**	**Total**
7/01	0	0	0	2	0	0	2
7/02	0	1	0	1	0	0	2
7/03	0	0	0	6	0	0	6
7/04	0	0	1	0	1	0	2
7/05	0	0	0	5	0	0	5
7/06	0	1	2	1	11	1	16
7/07	0	0	3	4	8	2	17
7/08	0	11	2	14	8	2	37
7/09	0	0	5	5	11	0	21
7/10[a]	0	6	8	3	1	1	19
7/11	0	12	0	0	0	0	12
7/12	0	1	6	4	0	0	11
7/13	0	2	1	3	0	0	6
7/14	0	0	0	0	3	0	3
7/15	0	2	1	33	17	2	55
7/16	1	0	3	0	1	0	5
7/17	0	0	0	1	7	0	8
7/18	0	6	1	0	0	0	7
7/19	0	0	0	0	1	5	6
7/20	0	5	8	1	1	0	15
7/21	0	5	3	6	10	11	35
7/22	0	2	1	0	0	3	6
7/23	0	0	4	6	9	3	22
7/24	0	1	3	5	3	7	19
7/25	0	0	2	0	9	10	21
7/26[a]	0	3	17	4	2	4	30
7/27	0	1	2	1	0	0	4
7/28	1	12	2	2	4	1	22
7/29	2	6	4	5	0	0	17
7/30	0	0	1	8	7	1	17
Total	4	77	80	120	114	53	448
Percent	1%	17%	18%	27%	25%	12%	100%

[a] Two of the 6 stations were not fished due to weather; the data for these stations were interpolated.

Appendix A6.–Estimated chum salmon CPUE by date and station, Upper Cook Inlet offshore test fish project, 2005.

	Station Number						
Date	**4**	**5**	**6**	**6.5**	**7**	**8**	**Total**
7/01	0.0	0.0	0.0	1.5	0.0	0.0	1.5
7/02	0.0	0.7	0.0	0.8	0.0	0.0	1.5
7/03	0.0	0.0	0.0	3.8	0.0	0.0	3.8
7/04	0.0	0.0	0.8	0.0	0.8	0.0	1.6
7/05	0.0	0.0	0.0	3.4	0.0	0.0	3.4
7/06	0.0	0.7	1.5	0.8	7.7	0.8	11.5
7/07	0.0	0.0	2.0	2.8	5.2	1.6	11.6
7/08	0.0	6.5	1.5	9.4	5.4	1.6	24.4
7/09	0.0	0.0	3.5	3.0	6.7	0.0	13.2
7/10[a]	0.0	4.1	5.3	2.3	0.8	0.8	13.3
7/11	0.0	8.3	0.0	0.0	0.0	0.0	8.3
7/12	0.0	0.7	4.7	2.8	0.0	0.0	8.3
7/13	0.0	1.6	0.7	2.3	0.0	0.0	4.6
7/14	0.0	0.0	0.0	0.0	2.5	0.0	2.5
7/15	0.0	1.5	0.7	18.0	11.1	1.3	32.6
7/16	0.8	0.0	1.9	0.0	0.7	0.0	3.4
7/17	0.0	0.0	0.0	0.8	5.2	0.0	6.0
7/18	0.0	3.7	0.8	0.0	0.0	0.0	4.4
7/19	0.0	0.0	0.0	0.0	0.7	3.7	4.4
7/20	0.0	3.9	4.7	0.7	0.8	0.0	10.1
7/21	0.0	3.7	2.2	4.1	6.7	5.3	22.0
7/22	0.0	1.4	0.8	0.0	0.0	2.0	4.2
7/23	0.0	0.0	3.0	3.7	5.3	2.0	14.0
7/24	0.0	0.7	2.2	3.8	2.2	4.6	13.6
7/25	0.0	0.0	1.2	0.0	5.5	7.2	13.9
7/26[a]	0.0	2.1	10.5	2.5	1.4	2.9	19.5
7/27	0.0	0.8	1.8	0.7	0.0	0.0	3.3
7/28	0.7	9.7	1.4	1.5	2.9	0.7	17.0
7/29	1.5	3.7	2.6	2.9	0.0	0.0	10.8
7/30	0.0	0.0	0.4	4.7	5.3	0.8	11.2
Total	3.0	53.9	54.2	76.4	77.0	35.3	300.0
Percent	1	18	18	26	26	12	100

[a] Two of the 6 stations were not fished due to weather; the data for these stations were 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, 2005.

Date	Number of Stations	Mean Fishing Time (min)	CATCH		CPUE	
			Daily	Cum	Daily	Cum
7/01	6	231.5	3	3	2	2
7/02	6	230.0	0	3	0	2
7/03	6	240.0	4	7	3	5
7/04	6	227.5	0	7	0	5
7/05	6	239.7	1	8	1	6
7/06	6	241.0	0	8	0	6
7/07	6	246.5	2	10	1	7
7/08	6	256.0	14	24	10	17
7/09	6	252.5	1	25	1	18
7/10[a]	6	236.2	7	32	5	23
7/11	6	235.0	0	32	0	23
7/12	6	233.5	3	35	2	25
7/13	6	235.5	12	47	9	34
7/14	6	225.5	1	48	1	35
7/15	6	267.0	21	69	14	49
7/16	6	252.5	3	72	2	51
7/17	6	227.0	5	77	4	55
7/18	6	234.0	8	85	5	60
7/19	6	220.0	2	87	2	61
7/20	6	245.5	14	101	10	71
7/21	6	267.5	55	156	29	100
7/22	6	242.0	7	163	5	105
7/23	6	257.0	57	220	36	141
7/24	6	243.0	37	257	27	168
7/25	6	256.0	67	324	42	210
7/26	6	258.0	25	349	17	227
7/27	6	222.0	7	356	6	233
7/28	6	243.5	30	386	23	255
7/29	6	260.0	81	467	51	307
7/30	6	287.0	79	546	37	344

[a] Two of the 6 stations were not fished due to weather; the data for these stations were interpolated.

Appendix A8.–Estimated coho salmon catch by date and station, Upper Cook Inlet offshore test fish project, 2005.

	Station Number						
Date	**4**	**5**	**6**	**6.5**	**7**	**8**	**Total**
7/01	1	1	1	0	0	0	3
7/02	0	0	0	0	0	0	0
7/03	3	0	0	1	0	0	4
7/04	0	0	0	0	0	0	0
7/05	0	0	0	1	0	0	1
7/06	0	0	0	0	0	0	0
7/07	0	0	1	1	0	0	2
7/08	0	2	7	0	4	1	14
7/09	0	0	0	0	1	0	1
7/10[a]	0	0	4	1	2	0	7
7/11	0	0	0	0	0	0	0
7/12	0	0	2	1	0	0	3
7/13	1	2	6	0	2	1	12
7/14	0	0	0	1	0	0	1
7/15	1	7	2	5	3	3	21
7/16	0	0	2	0	1	0	3
7/17	0	1	0	0	4	0	5
7/18	1	5	1	0	0	1	8
7/19	0	0	0	0	0	2	2
7/20	0	1	5	1	0	7	14
7/21	0	0	5	2	3	45	55
7/22	0	0	2	0	2	3	7
7/23	0	0	5	14	21	17	57
7/24	0	2	10	6	16	3	37
7/25	0	0	11	2	49	5	67
7/26[a]	0	0	6	4	7	8	25
7/27	0	0	2	2	2	1	7
7/28	0	8	5	13	3	1	30
7/29	2	23	29	24	0	3	81
7/30	1	8	53	13	3	1	79
Total	10	60	159	92	123	102	546
Percent	2%	11%	29%	17%	23%	19%	100%

[a] Two of the 6 stations were not fished due to weather; the data for these stations were interpolated.

Appendix A9.–Estimated coho salmon CPUE by date and station, Upper Cook Inlet offshore test fish project, 2005.

	Station Number						
Date	**4**	**5**	**6**	**6.5**	**7**	**8**	**Total**
7/01	0.8	0.8	0.7	0.0	0.0	0.0	2.3
7/02	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/03	2.1	0.0	0.0	0.6	0.0	0.0	2.7
7/04	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/05	0.0	0.0	0.0	0.7	0.0	0.0	0.7
7/06	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/07	0.0	0.0	0.7	0.7	0.0	0.0	1.4
7/08	0.0	1.2	5.1	0.0	2.7	0.8	9.8
7/09	0.0	0.0	0.0	0.0	0.6	0.0	0.6
7/10[a]	0.0	0.0	2.6	0.8	1.6	0.0	5.0
7/11	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/12	0.0	0.0	1.6	0.7	0.0	0.0	2.3
7/13	0.8	1.6	4.5	0.0	1.4	0.8	9.1
7/14	0.0	0.0	0.0	0.8	0.0	0.0	0.8
7/15	0.8	5.2	1.5	2.7	2.0	1.9	14.1
7/16	0.0	0.0	1.3	0.0	0.8	0.0	2.0
7/17	0.0	0.8	0.0	0.0	3.0	0.0	3.8
7/18	0.8	3.1	0.8	0.0	0.0	0.8	5.4
7/19	0.0	0.0	0.0	0.0	0.0	1.5	1.5
7/20	0.0	0.8	3.0	0.7	0.0	5.5	9.9
7/21	0.0	0.0	3.7	1.4	2.0	21.6	28.7
7/22	0.0	0.0	1.6	0.0	1.4	2.0	5.0
7/23	0.0	0.0	3.7	8.8	12.4	11.2	36.0
7/24	0.0	1.5	7.4	4.6	11.9	2.0	27.3
7/25	0.0	0.0	6.5	1.5	30.0	3.6	41.6
7/26[a]	0.0	0.0	3.7	2.6	5.1	5.8	17.1
7/27	0.0	0.0	1.8	1.5	1.6	0.8	5.7
7/28	0.0	6.5	3.5	9.6	2.2	0.7	22.5
7/29	1.5	14.2	19.1	14.1	0.0	2.5	51.4
7/30	0.8	6.2	19.6	7.6	2.3	0.8	37.3
Total	7.5	41.9	92.2	59.3	80.7	62.4	343.9
Percent	2	12	27	17	24	18	100

[a] Two of the 6 stations were not fished due to weather; the data for these stations were 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, 2005.

Date	Number of Stations	Mean Fishing Time (min)	CATCH		CPUE	
			Daily	Cum	Daily	Cum
7/01	6	231.5	1	1	0.8	0.8
7/02	6	230.0	0	1	0.0	0.8
7/03	6	240.0	1	2	0.6	1.4
7/04	6	227.5	0	2	0.0	1.4
7/05	6	239.7	0	2	0.0	1.4
7/06	6	241.0	0	2	0.0	1.4
7/07	6	246.5	0	2	0.0	1.4
7/08	6	256.0	3	5	2.0	3.4
7/09	6	252.5	0	5	0.0	3.4
7/10[a]	6	236.2	0	5	0.0	3.4
7/11	6	235.0	1	6	0.8	4.2
7/12	6	233.5	0	6	0.0	4.2
7/13	6	235.5	0	6	0.0	4.2
7/14	6	225.5	0	6	0.0	4.2
7/15	6	267.0	1	7	0.7	4.8
7/16	6	252.5	0	7	0.0	4.8
7/17	6	227.0	0	7	0.0	4.8
7/18	6	234.0	0	7	0.0	4.8
7/19	6	220.0	0	7	0.0	4.8
7/20	6	245.5	0	7	0.0	4.8
7/21	6	267.5	0	7	0.0	4.8
7/22	6	242.0	0	7	0.0	4.8
7/23	6	257.0	0	7	0.0	4.8
7/24	6	243.0	0	7	0.0	4.8
7/25	6	256.0	0	7	0.0	4.8
7/26[a]	6	258.0	0	7	0.0	4.8
7/27	6	222.0	1	8	0.8	5.6
7/28	6	243.5	0	8	0.0	5.6
7/29	6	260.0	0	8	0.0	5.6
7/30	6	287.0	0	8	0.0	5.6

[a] Two of the 6 stations were not fished due to weather; the data for these stations were interpolated.

Appendix A11.–Estimated Chinook salmon catch by date and station, Upper Cook Inlet offshore test fish project, 2005.

	Station Number						
Date	**4**	**5**	**6**	**6.5**	**7**	**8**	**Total**
7/01	0	0	0	1	0	0	1
7/02	0	0	0	0	0	0	0
7/03	0	0	0	1	0	0	1
7/04	0	0	0	0	0	0	0
7/05	0	0	0	0	0	0	0
7/06	0	0	0	0	0	0	0
7/07	0	0	0	0	0	0	0
7/08	0	1	1	1	0	0	3
7/09	0	0	0	0	0	0	0
7/10[a]	0	0	0	0	0	0	0
7/11	0	0	1	0	0	0	1
7/12	0	0	0	0	0	0	0
7/13	0	0	0	0	0	0	0
7/14	0	0	0	0	0	0	0
7/15	0	0	0	0	1	0	1
7/16	0	0	0	0	0	0	0
7/17	0	0	0	0	0	0	0
7/18	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	0	0	0	0	0	0	0
7/22	0	0	0	0	0	0	0
7/23	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[a]	0	0	0	0	0	0	0
7/27	0	0	0	0	1	0	1
7/28	0	0	0	0	0	0	0
7/29	0	0	0	0	0	0	0
7/30	0	0	0	0	0	0	0
Total	0	1	2	3	2	0	8
Percent	0%	13%	25%	38%	25%	0%	1%

[a] Two of the 6 stations were not fished due to weather; the data for these stations were interpolated.

Appendix A12.–Estimated Chinook salmon CPUE by date and station, Upper Cook Inlet offshore test fish project, 2005.

	Station Number						
Date	**4**	**5**	**6**	**6.5**	**7**	**8**	**Total**
7/01	0.0	0.0	0.0	0.8	0.0	0.0	0.8
7/02	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/03	0.0	0.0	0.0	0.6	0.0	0.0	0.6
7/04	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/05	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/06	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/07	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/08	0.0	0.6	0.7	0.7	0.0	0.0	2.0
7/09	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	0.8	0.0	0.0	0.0	0.8
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	0.0	0.0
7/14	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/15	0.0	0.0	0.0	0.0	0.7	0.0	0.7
7/16	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/17	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/18	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	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	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[a]	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/27	0.0	0.0	0.0	0.0	0.8	0.0	0.8
7/28	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/29	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/30	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.0	0.6	1.5	2.1	1.5	0.0	5.6
Percent	0%	11%	26%	37%	26%	0%	100%

[a] Two of the 6 stations were not fished due to weather; the data for these stations were interpolated.

Appendix A13.–Entry pattern of sockeye salmon into Upper Cook Inlet, Alaska, 2005 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	0.0109	0.0642	-0.0537		
9	2-Jul	0.0213	0.0729	-0.0516	0.0123	0.0084
10	3-Jul	0.0520	0.0823	-0.0302	0.0060	0.0100
11	4-Jul	0.0633	0.0927	-0.0293	0.0040	0.0119
12	5-Jul	0.0782	0.1042	-0.0260	0.0129	0.0141
13	6-Jul	0.0996	0.1171	-0.0175	0.0187	0.0166
14	7-Jul	0.1366	0.1312	0.0053	0.0150	0.0195
15	8-Jul	0.1764	0.1468	0.0296	0.0107	0.0227
16	9-Jul	0.2154	0.1639	0.0515	0.0393	0.0261
17	10-Jul	0.2298	0.1826	0.0472	0.0482	0.0298
18	11-Jul	0.2413	0.2029	0.0383	0.0586	0.0335
19	12-Jul	0.2600	0.2248	0.0352	0.0394	0.0373
20	13-Jul	0.2838	0.2484	0.0354	0.0940	0.0408
21	14-Jul	0.2931	0.2735	0.0196	0.0295	0.0440
22	15-Jul	0.3358	0.3002	0.0356	0.0045	0.0466
23	16-Jul	0.3436	0.3283	0.0153	0.0800	0.0485
24	17-Jul	0.3530	0.3577	-0.0047	0.0152	0.0494
25	18-Jul	0.3646	0.3882	-0.0236	0.0753	0.0494
26	19-Jul	0.3737	0.4196	-0.0459	0.0107	0.0485
27	20-Jul	0.4035	0.4517	-0.0482	0.0399	0.0467
28	21-Jul	0.4564	0.4842	-0.0277	0.0104	0.0441
29	22-Jul	0.4859	0.5168	-0.0309	0.1063	0.0409
30	23-Jul	0.5277	0.5492	-0.0216	0.0232	0.0374
31	24-Jul	0.5563	0.5813	-0.0250	0.0264	0.0337
32	25-Jul	0.6043	0.6127	-0.0083	0.0227	0.0299
33	26-Jul	0.6512	0.6432	0.0081	0.0228	0.0262
34	27-Jul	0.6572	0.6725	-0.0153	0.0229	0.0228
35	28-Jul	0.7038	0.7006	0.0033	0.0084	0.0196
36	29-Jul	0.7656	0.7272	0.0384	0.0094	0.0167
37	30-Jul	0.8311	0.7523	0.0788	0.0047	0.0142

Appendix A14.–Chemical and physical observations made in Upper Cook Inlet, Alaska, during the 2005 offshore test fish project.

Date	Sta	Air Temp ©	Water Temp (c)	Wind Vel. (knots)	Wind Dir	Tide Stage	Salinity (ppt)	Water Depth (f)	Secchi (m)
1-Jul	4	10	9.9	5	northwest	flood	30.9	28	5.0
	5	11	9.6	4	northwest	flood	31.1	40	7.0
	6	12	11.9	6	west	ebb	28.0	53	3.0
	6.5	13	11.9	4	southeast	ebb	27.8	45	4.0
	7	13	12.1	5	southwest	ebb	27.7	50	4.0
	8	12	11.7	5	southwest	ebb	28.6	31	3.0
2-Jul	8	10	11.2	9	south	ebb	28.9	30	3.0
	7	10	11.2	12	southwest	ebb	28.4	42	3.0
	6.5	11	11.6	12	southwest	ebb	27.8	44	3.0
	6	11	11.4	8	south	low	28.7	47	4.0
	5	11	10.4	5	south	flood	30.8	37	8.0
	4	11	10.0	5	southwest	flood	31.3	25	8.5
3-Jul	4	12	10.2	7	southwest	flood	31.1	26	6.0
	5	11	10.1	6	southwest	flood	31.3	34	7.5
	6	12	11.0	8	southwest	flood	29.8	47	4.0
	6.5	12	12.5	8	southwest	ebb	27.5	42	4.0
	7	13	12.2	9	south	ebb	27.9	45	4.0
	8	12	11.8	15	south	ebb	28.5	29	5.0
4-Jul	8	10	11.5	5	south	ebb	29.5	30	5.0
	7	11	11.3	5	south	ebb	28.8	40	3.0
	6.5	11	11.8	5	south	ebb	27.4	35	5.0
	6	14	12.2	5	south	low	26.7	41	3.0
	5	13	11.2	5	south	flood	29.7	36	6.0
	4	11	11.6	5	south	flood	31.1	20	6.0
5-Jul	4	15	10.7	2	south	flood	30.7	24	7.0
	5	13	10.4	2	south	flood	31.2	37	8.0
	6	13	10.3	2	south	flood	31.1	48	5.0
	6.5	15	12.8	2	south	flood	27.9	44	3.0
	7	14	13.0	2	south	ebb	27.9	40	4.5
	8	12	11.6	2	south	ebb	29.0	30	5.0
6-Jul	8	11	11.5	5	south	ebb	29.8	29	3.0
	7	12	11.5	5	south	ebb	28.6	44	2.5
	6.5	14	11.4	5	south	ebb	28.7	41	4.5
	6	14	10.8	2	south	ebb	29.8	44	4.5
	5	17	10.4	2	south	flood	30.9	36	5.5
	4	13	10.4	5	south	flood	31.3	26	7.0

-continued-

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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	12	10.5	4	south	low	31.1	24	5.5
	5	13	10.5	4	south	flood	30.9	36	6.0
	6	13	10.8	4	south	flood	29.7	46	3.5
	6.5	12	12.4	4	south	flood	29.5	44	3.5
	7	13	11.6	8	south	flood	28.8	46	2.5
	8	13	11.5	8	south	ebb	29.2	29	2.0
8-Jul	8	11	11.4	10	southwest	high	29.0	32	2.5
	7	11	11.4	15	southwest	ebb	29.0	45	2.5
	6.5	12	11.6	15	southwest	ebb	28.8	44	2.5
	6	13	11.2	15	southwest	ebb	29.2	46	2.0
	5	14	12.1	10	south	ebb	28.6	33	5.0
	4	12	10.8	5	south	ebb	30.9	24	6.0
9-Jul	4	14	10.6	1	south	ebb	31.4	24	7.5
	5	17	13.3	1	south	ebb	28.4	35	4.5
	6	16	11.7	1	south	ebb	29.0	46	4.0
	6.5	15	12.6	3	south	flood	30.6	45	4.5
	7	15	13.0	9	south	flood	27.9	49	4.0
	8	15	12.0	4	south	flood	28.0	31	2.0
10-Jul	8	12	11.6	25	southwest	flood	28.9	31	2.0
	7	12	11.6	15	southwest	ebb	28.9	45	4.0
	6.5	12	11.6	15	southwest	ebb	29.0	44	3.0
	6	12	11.6	20	southeast	ebb	29.2	48	4.0
	5[a]	-	-	-	-	-	-	-	-
	4[a]	-	-	-	-	-	-	-	-
11-Jul	4	13	10.9	7	southwest	ebb	30.3	24	3.5
	5	14	11.6	9	west	ebb	29.3	35	4.0
	6	13	11.6	9	south	ebb	29.3	47	4.0
	6.5	12	12.7	9	south	ebb	28.3	41	3.5
	7	12	12.4	9	south	flood	28.2	45	3.0
	8	12	12.2	10	south	flood	28.8	29	4.0
12-Jul	8	11	11.6	2	southeast	high	29.1	32	3.5
	7	11	11.6	2	southeast	high	29.3	46	2.5
	6.5	12	12.9	8	southeast	ebb	28.8	46	3.5
	6	12	11.8	8	southeast	ebb	29.1	45	4.0
	5	12	12.1	2	southeast	flood	28.6	35	4.0
	4	12	12.3	2	southeast	ebb	28.7	24	4.0

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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	10.2	11	northeast	ebb	31.5	25	8.5
	5	13	11.6	7	northeast	ebb	29.7	37	4.0
	6	12	11.9	12	north	ebb	29.5	44	3.5
	6.5	13	11.6	8	northeast	ebb	27.9	43	4.5
	7	14	12.1	1	northwest	low	29.3	43	3.5
	8	13	12.3	8	northwest	low	28.8	26	3.5
14-Jul	8	13	12.4	8	northwest	low	28.0	30	3.0
	7	13	11.3	8	northwest	flood	29.9	42	5.2
	6.5	12	11.1	6	northwest	flood	30.5	45	6.0
	6	14	11.5	6	northwest	flood	30.1	46	7.0
	5	18	10.1	1	east	ebb	31.5	38	7.5
	4	19	10.4	3	northwest	high	31.5	24	10.0
15-Jul	4	12	10.6	9	southwest	ebb	31.6	25	10.0
	5	12	11.1	8	southwest	flood	31.6	37	6.0
	6	14	13.5	12	south	flood	26.5	48	2.5
	6.5	17	13.3	9	south	flood	29.5	43	2.5
	7	15	13.8	12	south	ebb	26.2	45	4.5
	8	15	13.5	13	south	ebb	26.7	26	4.0
16-Jul	8	13	13.1	12	northeast	flood	26.1	29	3.5
	7	13	13.8	13	northeast	flood	25.5	46	3.5
	6.5	13	12.7	15	north	flood	27.8	44	4.0
	6	12	10.1	15	north	high	31.4	49	7.0
	5	13	10.3	12	north	high	31.4	37	7.0
	4	12	10.3	11	northeast	high	31.5	24	9.5
17-Jul	4	15	10.4	4	southwest	flood	31.5	25	9.0
	5	13	10.3	5	south	flood	31.5	37	8.5
	6	13	12.4	7	southwest	flood	28.2	48	6.5
	6.5	13	13.5	11	southwest	flood	25.7	44	4.5
	7	14	14.5	8	southwest	high	26.2	46	4.5
	8	14	12.8	7	south	high	27.3	27	4.5
18-Jul	8	14	13.2	6	south	ebb	26.6	29	4.5
	7	15	13.5	5	south	ebb	26.6	42	4.5
	6.5	15	12.6	4	south	ebb	27.6	43	7.0
	6	12	11.1	5	south	low	30.5	46	8.5
	5	12	10.6	4	southeast	low	31.1	48	8.5
	4	16	10.5	2	south	low	31.3	36	10.0

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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)
19-Jul	4	14	10.7	1	northwest	flood	31.4	25	7.0
	5	13	10.3	2	southwest	flood	31.5	38	8.0
	6	13	12.6	3	southwest	flood	28.2	25	7.0
	6.5	14	12.6	3	southwest	high	27.8	42	6.0
	7	13	13.1	3	southwest	high	26.6	45	3.5
	8	14	12.7	4	southwest	ebb	27.3	30	4.5
20-Jul	8	14	11.9	4	south	ebb	28.3	29	4.5
	7	15	12.9	2	west	ebb	26.7	42	3.5
	6.5	12	11.5	4	southeast	low	29.5	42	6.0
	6	15	10.6	3	southeast	flood	31.1	47	10.0
	5	14	10.4	1	southwest	flood	31.5	38	9.0
	4	14	10.4	4	southwest	flood	31.6	26	12.5
21-Jul	4	14	10.8	14	south	ebb	31.3	22	6.5
	5	12	10.6	11	south	flood	31.3	35	5.5
	6	12	10.7	6	south	flood	30.6	45	5.5
	6.5	13	11.0	3	south	flood	30.3	42	5.0
	7	13	11.5	4	south	flood	29.7	46	5.5
	8	13	11.7	6	south	flood	29.4	32	3.5
22-Jul	8	13	11.7	4	southwest	high	28.8	33	2.5
	7	14	12.0	8	southwest	ebb	28.5	46	2.5
	6.5	18	12.0	1	south	ebb	28.8	42	3.5
	6	15	11.7	3	southeast	ebb	29.9	44	5.0
	5	18	11.4	1	south	low	31.1	35	9.0
	4	11	12.7	4	southeast	flood	31.2	23	7.2
23-Jul	4	13	10.8	2	southwest	ebb	31.5	22	7.0
	5	13	11.0	2	southwest	ebb	31.1	34	7.0
	6	13	11.5	4	southwest	low	32.0	46	2.0
	6.5	15	11.5	4	southwest	low	30.1	43	3.0
	7	13	11.7	6	southwest	flood	30.2	46	4.5
	8	13	11.2	5	southwest	flood	30.2	33	3.0
24-Jul	8	14	11.2	5	north	flood	30.0	33	3.0
	7	12	11.2	4	southeast	high	30.2	43	4.0
	6.5	13	11.2	5	north	ebb	30.3	42	4.0
	6	13	11.5	7	north	ebb	30.0	44	3.0
	5	12	11.5	9	north	ebb	31.1	34	5.0
	4	12	11.1	16	north	low	31.2	23	6.0

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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	12	10.5	14	northwest	ebb	31.4	23	6.5
	5	12	11.2	16	northwest	ebb	30.8	35	5.0
	6	12	11.6	16	northwest	ebb	30.2	47	4.5
	6.5	14	11.8	2	northeast	flood	29.9	43	5.4
	7	12	12.0	3	east	flood	29.7	46	2.5
	8	14	12.0	1	south	flood	29.6	28	3.0
26-Jul	8	14	12.0	6	northwest	flood	29.1	30	2.0
	7	12	11.5	6	north	flood	30.2	47	3.5
	6.5	12	11.7	7	north	high	30.8	44	5.5
	6	11	10.9	7	east	ebb	31.1	49	7.5
	5	12	12.0	4	north	ebb	31.5	35	4.5
	4	15	11.1	4	northwest	ebb	30.2	23	6.5
27-Jul	4	10	12.6	4	north	ebb	31.4	24	9.0
	5	12	11.4	12	northwest	ebb	30.6	36	5.0
	6	13	12.9	12	west	low	28.9	48	2.5
	6.5	13	12.9	15	northwest	ebb	28.6	43	3.5
	7	14	12.9	14	west	flood	28.7	46	3.5
	8	12	14.4	13	northwest	flood	29.0	28	2.5
28-Jul	8	13	12.8	5	southwest	low	28.2	31	3.0
	7	12	12.5	8	southeast	flood	29.0	45	3.0
	6.5	12	11.6	9	southeast	flood	30.2	44	5.0
	6	13	10.8	8	southeast	flood	30.1	48	8.0
	5	11	10.5	6	east	flood	32.3	37	11.0
	4	15	12.3	10	east	ebb	30.3	25	12.0
29-Jul	4	11	10.3	2	south	flood	31.4	26	9.5
	5	11	10.4	2	south	flood	31.0	37	11.5
	6	12	13.5	6	south	high	27.0	43	3.5
	6.5	13	13.5	8	southwest	ebb	27.1	43	4.0
	7	14	13.5	9	southeast	ebb	27.4	45	3.5
	8	13	13.0	9	southwest	ebb	26.3	28	2.8
30-Jul	8	13	12.9	15	southwest	ebb	28.2	30	2.8
	7	13	13.2	17	southwest	ebb	26.9	45	3.5
	6.5	12	13.2	17	southeast	ebb	26.8	43	3.0
	6	11	12.9	19	southeast	ebb	28.5	50	3.0
	5	12	13.4	18	south	flood	27.6	35	4.0
	4	13	12.8	20	southeast	flood	28.8	24	4.5

Appendix A15.–Yearly mean values of physical observations made during the 1995–2005 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	1996	12.8	9.4	7.4	E	31.5	24.6	7.9
	1997	13.7	9.5	8.9	SE	31.6	24.6	6.2
	1998	12.5	9.7	9.7	SE	31.0	24.4	9.5
	1999	13.1	9.6	10.6	SE	31.4	24.3	7.6
	2000	13.8	9.7	10.0	SE	31.5	23.5	10.0
	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
Avg		12.9	9.8	9.6	SE	31.4	24.0	8.1
5	1996	12.8	9.4	8.6	NE	31.3	36.3	6.3
	1997	13.7	9.9	10.1	SE	31.3	36.8	5.2
	1998	12.8	9.8	9.8	SE	31.1	35.2	8.5
	1999	13.4	10.0	12.9	SE	30.6	38.9	6.2
	2000	13.5	10.1	11.8	SE	30.7	35.9	7.1
	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
Avg		13.0	10.1	10.4	SE	30.9	36.1	6.6
6.5	1996	13.2	10.3	8.4	E	30.5	42.9	3.2
	1997	13.9	10.7	9.4	E	29.6	43.4	3.2
	1998	12.7	10.5	7.7	SE	29.5	43.3	3.5
	1999	13.4	10.5	13.0	SE	29.7	43.2	3.5
	2000	13.6	10.8	13.0	S	29.7	42.9	3.7
	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
Avg		13.1	10.9	10.9	SE	29.6	42.7	3.6
7	1996	12.7	10.4	10.7	SE	30.3	44.9	3.4
	1997	14.0	10.9	10.3	SE	30.2	44.8	2.9
	1998	12.3	10.7	8.4	SE	29.1	44.3	3.0
	1999	13.3	10.6	13.0	S	29.5	42.7	2.9
	2000	13.1	10.9	13.6	S	29.4	43.3	3.0
	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
Avg		12.9	11.0	10.8	SE	29.3	44.1	3.1

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Sta	Year	Air Temp (c)	Water Temp (c)	Wind Vel. (knots)	Wind Dir	Salinity (ppt)	Water Depth (f)	Secchi (m)
6	1996	12.4	10.2	9.7	E	30.6	47.1	4.2
	1997	13.8	10.5	11.1	SE	30.8	45.9	3.7
	1998	12.4	10.3	10.9	S	30.0	46.1	4.7
	1999	13.5	10.3	12.5	SE	29.8	44.4	4.3
	2000	13.5	10.6	11.1	SE	29.9	45.4	4.9
	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
Avg		12.9	10.6	10.8	SE	30.1	45.9	4.5

Sta	Year	Air Temp (c)	Water Temp (c)	Wind Vel. (knots)	Wind Dir	Salinity (ppt)	Water Depth (f)	Secchi (m)
8	1996	12.2	10.4	9.3	SE	30.3	29.9	2.7
	1997	13.7	11.1	9.6	SE	30.1	30.1	2.6
	1998	12.5	10.7	9.1	S	29.1	29.3	2.8
	1999	13.6	10.5	11.8	SE	30.0	25.9	2.6
	2000	13.2	11.0	14.0	S	29.5	29.1	2.6
	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
Avg		12.8	11.0	10.3	S	29.4	29.0	2.8

Appendix A16.–Yearly mean values for selected chemical and physical variables collected during the offshore test fish project, 1979–2005.

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	14.3	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	13.1	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
1992–2004 Avg	12.9	10.4	9.7	29.4	4.9
2005	13.0	11.7	7.1	29.4	5.0