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Chinook and Sockeye Salmon Migration Patterns in Cook Inlet, 2013.

Report to the State of Alaska, Department of Fish and Game, Division of Commercial Fisheries

By Kintama Research Services Ltd.

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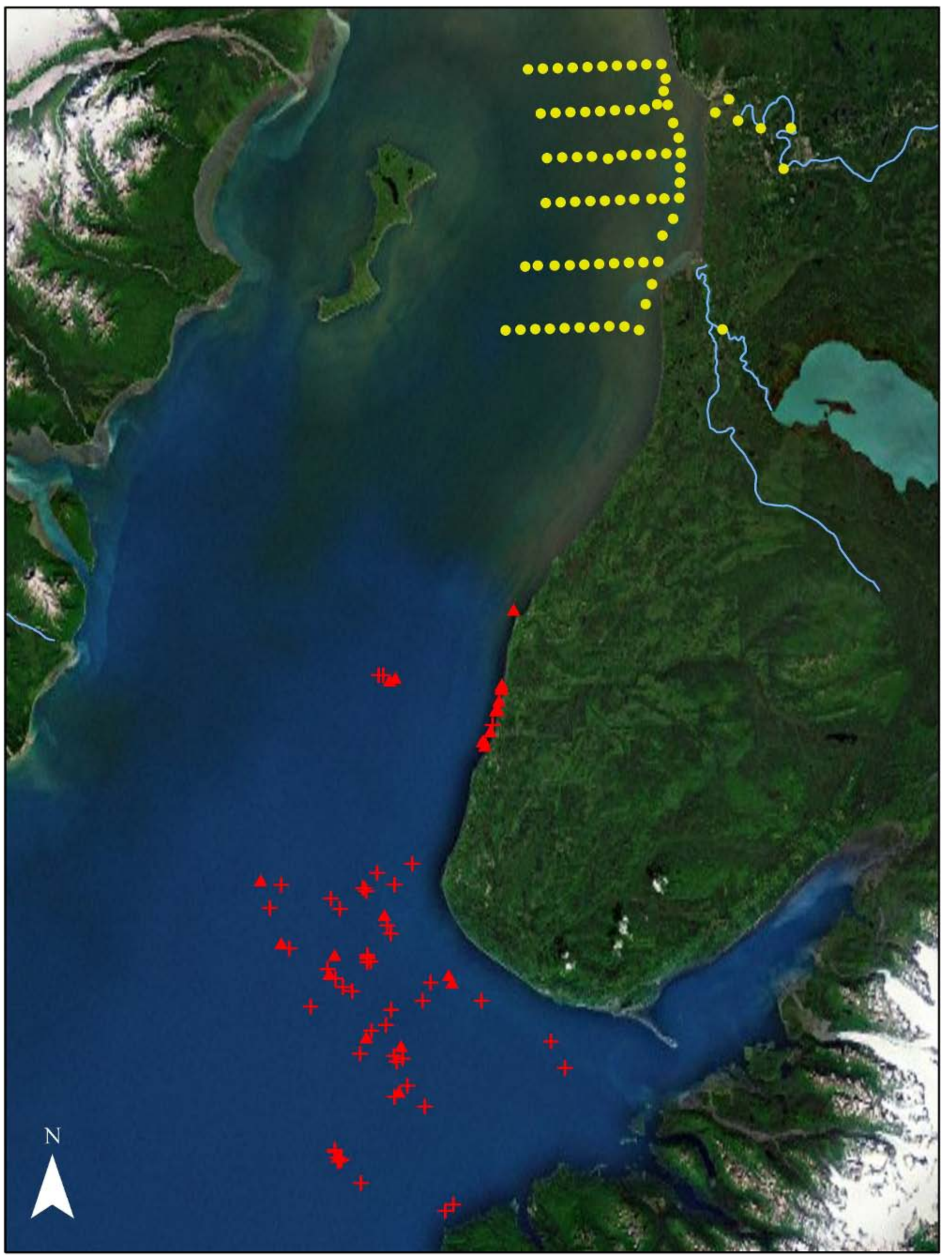

Location of the acoustic-tracking array (yellow dots) and the release sites of acoustic-tagged Chinook (red triangles) and sockeye (red crosses) salmon in Cook Inlet 2013.

Chinook and Sockeye Salmon Migration Patterns

in Cook Inlet, 2013.

Report to the State of Alaska, Department of Fish and Game, Division of Commercial Fisheries

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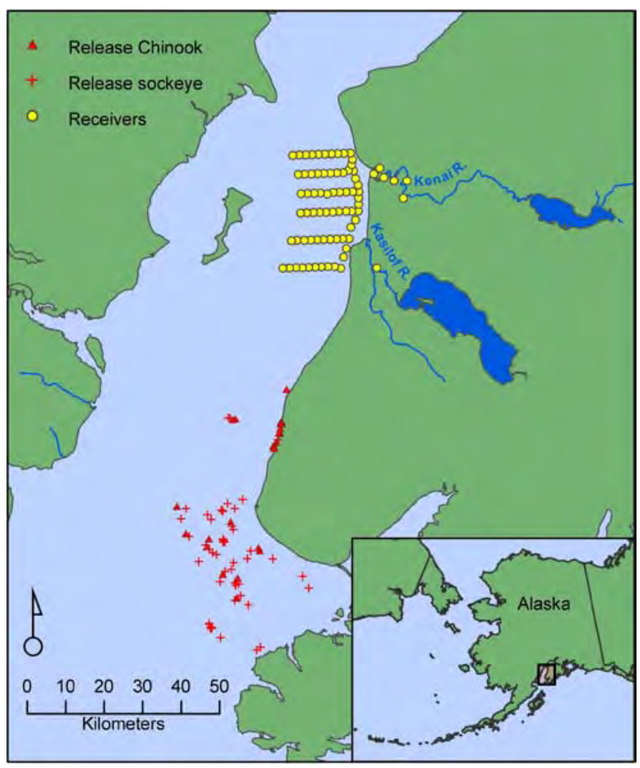
Summary

Introduction

Steadily worsening returns of Chinook salmon are occurring over a wide range of Alaskan rivers, including Cook Inlet's Kenai River Chinook population. The widespread nature of the decline suggests that the likely cause of the problem lies in the ocean—but with the marine phase of the life history poorly understood, questions of "where and when" significant declines are established remain unclear. The reduced productivity of Kenai River Chinook complicates attempts to manage the still productive sockeye stocks while ensuring escapement goals are achieved for both species. Because the sockeye fisheries also catch Chinook, an ability to identify biological differences between the two species that could potentially reduce Chinook catch when sockeye fisheries are underway would be useful in refining management strategies. The primary goal of this study was to identify species-specific differences in migration depth or other movement patterns for adult sockeye and late-run Kenai & Kasilof Chinook returning to spawn that could provide a stronger biological basis for management decisions.

Methods

To address these questions, a marine telemetry array consisting of 70 receivers was deployed in a sparse grid starting at the western (offshore) edge of the eastside set net (ESSN) fishery area and extending westward approximately 1/3rd of the way across Cook Inlet (Summary Figure 1). Additional receivers were placed in the Kasilof and Kenai Rivers to monitor the freshwater phase of the migration. Acoustic receivers record the unique serial number transmitted by each acoustically-tagged fish along with the date and time of the detection. All acoustic tags used in this study were equipped with a pressure sensor reporting fish depth at the



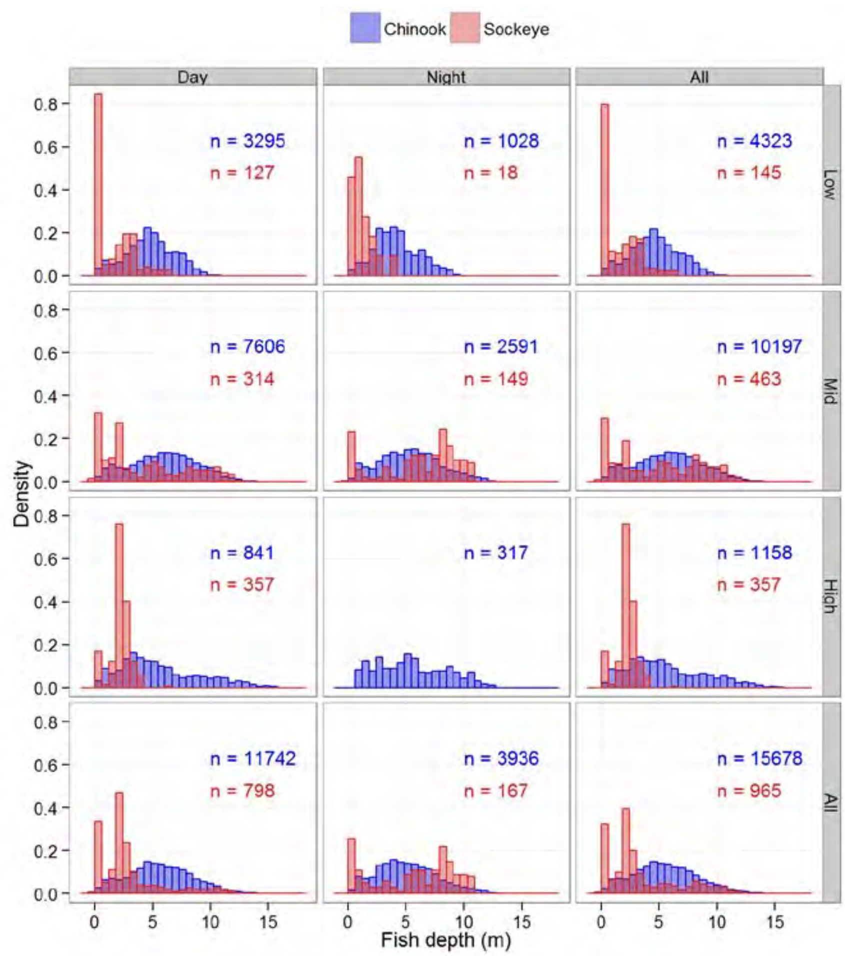
Summary Figure 1. Location of the acoustic telemetry array and release sites for tagged adult sockeye and Chinook salmon in Cook Inlet, 2013.

time of transmission. A total of 25 adult Chinook and 51 adult sockeye were caught in Lower Cook Inlet and tagged with paired external disc tags and internal acoustic tags. The fish were then released to continue their migration northwards over the acoustic array.

Key Results

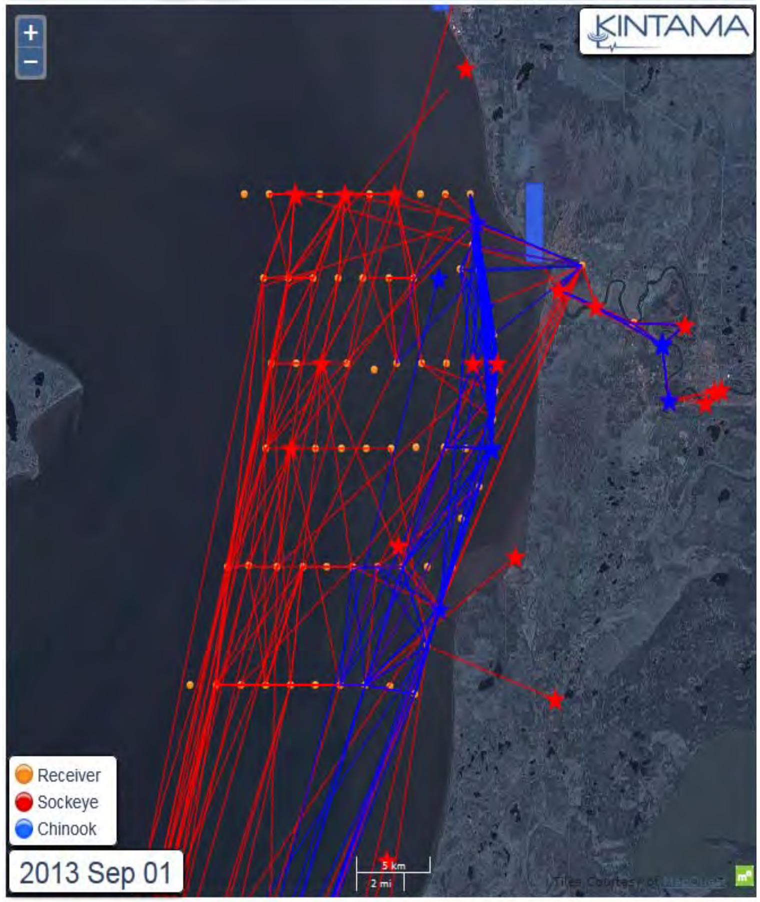
1) Establish the depth distributions of Chinook and sockeye salmon as they enter the ESSN fishing district.

The marine receivers recorded 16,608 depth measurements for Chinook and 3,389 depth measurements for sockeye. When depth data are restricted to those receivers sited just along the western boundary of the ESSN, the number of detections remains very similar for Chinook (15,678), but drops to only 965 for sockeye, reflecting the fact that most sockeye spent their time well offshore of the ESSN. The median depth of the sockeye and Chinook when calculated using data for the entire marine array was 1.21 m and 4.85 m, respectively; when restricted to receivers sited along the western boundary of the ESSN, these median depths were 1.82 m for sockeye and 4.85 m for Chinook. Although Chinook occasionally rose to near-surface waters, a clear difference in water column use was evident (Summary Figure 2).



Summary Figure 2. Distribution of migration depths of adult sockeye and Chinook salmon along the western edge of the ESSN fishing district in 2013.

2) Establish the differences in entry patterns of Chinook and sockeye salmon into the ESSN fishing district in relation to date, tide stage, and wind velocity.

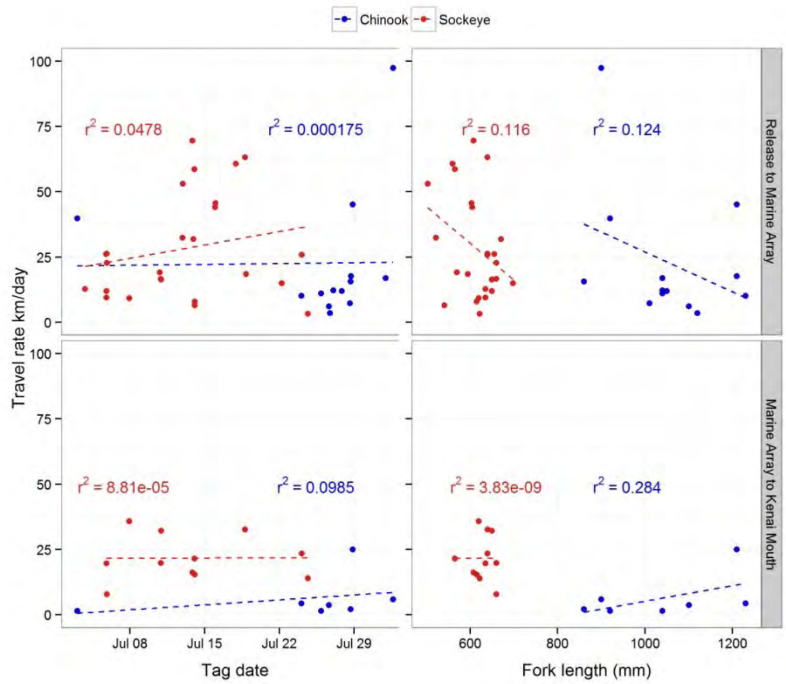


Summary Figure 3. Screen clip from the animation of the Cook Inlet project in 2013 showing the inshore distribution of Chinook relative to sockeye. Lines indicate the movement path of each fish as represented by detections on the acoustic array and tags recovered by the fishery. Stars indicate the last known location of each fish. The animation can be accessed at www. http://kintama.com/animator/CookInlet2013/. (The vertical blue bars on the animation show how tide height changes with time for locations within Cook Inlet).

Chinook and sockeye were found to have strikingly different marine behaviors, with Chinook repeatedly "patrolling" north-south almost exclusively along the western boundary of the ESSN, and sockeye found mainly farther offshore (Summary Figure 3). (An animation of the movements of the tagged salmon that can be dynamically zoomed, panned, and queried is available on the Kintama website: www. http://kintama.com/animator/CookInlet2013/). The observed behavior suggests that Chinook may spend a significant portion of their time within the ESSN and beyond the maximum detection range of the receivers. As receivers were not placed within the 1.5 nautical mile (2.5 km) wide ESSN, the length of time Chinook may spend in this area cannot be quantified at this time. No evidence was found that entry into the ESSN was strongly related to date, stage of the tide or wind.

3) Establish the differences in migration rates of Chinook and sockeye salmon in relation to tagging date and fish length.

There was no evidence that the migration rates of sockeye or Chinook were affected by either tagging date or fish length. Salt-water travel rates from 1) release to first detection on the marine array, and 2) from first detection on the marine array to river entry showed little relationship with release date or fish size in either species (r2<0.3; Summary Figure 4).



Summary Figure 4. Comparison of the effect of release data and fish length on the travel rate of Chinook and sockeye from (top) release to first detection on the marine array and (bottom) from the marine array to river entry.

4) Establish whether tidal fluctuations affect milling behavior of Chinook and sockeye salmon in the Kenai River estuary.

The majority of Chinook and sockeye initially entered the river and migrated upstream on either a flood or slack tide. At RKm 2 (Snug Harbor), only two fish had detections while the tide was ebbing significantly; one of these fish did not migrate upriver and the other logged only a single detection on a falling tide as it milled back and forth between the detection sites at RKm 2 and 4.5. At RKm 4.5, (Inlet Fish), neither species was recorded during ebbing tides. The influence of tide dropped by RKm 8.2 (Kenai Bridge), as 62% of Chinook and 81% of sockeye detections were recorded during flooding tides.

Only two fish showed evidence of milling in the Kenai River estuary. Fish 9484 moved back and forth three times between the two lowest receivers in the Kenai River; fish 9535 was detected once at the Kenai River mouth and then disappeared for 7 hours before being detected at the river mouth again and then proceeding upstream. Most of these upriver movements occurred during flooding tides. All other tagged salmon migrated directly up the Kenai River after river entry.

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1. **Methods**

1.1. Acoustic array

Acoustic-tagged salmon were detected by VEMCO VR2W acoustic receivers deployed in Central Cook Inlet, and in the Kenai and Kasilof rivers (Figure 1). In Cook Inlet, we deployed 70 receivers in early June in a sparse grid starting at the western (offshore) edge of the eastside set net (ESSN) fishery area and extending westward approximately 15 km or 1/3rd of the way across the channel. The grid consisted of a series of 6 east-west lines spaced ca. 5 km apart. We deployed 10 receivers in each line. We also sited 2 receivers midway between each line (for a total of 10 units) to provide greater resolution along the outer boundary of the ESSN fishing zone. We recovered and successfully uploaded 54 of these receivers Aug 27th-September 5th. Four of the remaining 16 receivers did not respond when polled and are considered lost. An additional 8 receivers did respond when polled (i.e., they were in their deployed position) but did not rise to the surface and were possibly held down by the strong tidal currents. The last 4 receivers were displaced by fishing activities or other causes and then returned to Kintama by members of the public. We downloaded these units and screened the detections to estimate the date and time they were pulled from their deployed positions (see section B.4).

To monitor the freshwater phase of the migration, we worked with ADF&G to deploy 11 receivers in the Kenai River between June 9th and July 2nd. Single receivers were installed at Snug Harbor and Inlet Fisheries (RKms 2 and 4); and paired receivers were installed at RKm 8.2 (the Kenai River Bridge), RKm 13.8 (lower Chinook sonar site), RKm 22.0 (upper Chinook sonar site), RKm 25.3 (Harry Gaines Fish Camp), and RKm 30.6 (sockeye sonar site). On June 19th, ADF&G deployed an additional 2 receivers in the Kasilof River at RKm 12.1 on the mountings for the ADF&G sonar. All freshwater deployments were successfully recovered and downloaded Aug 8th-24th.

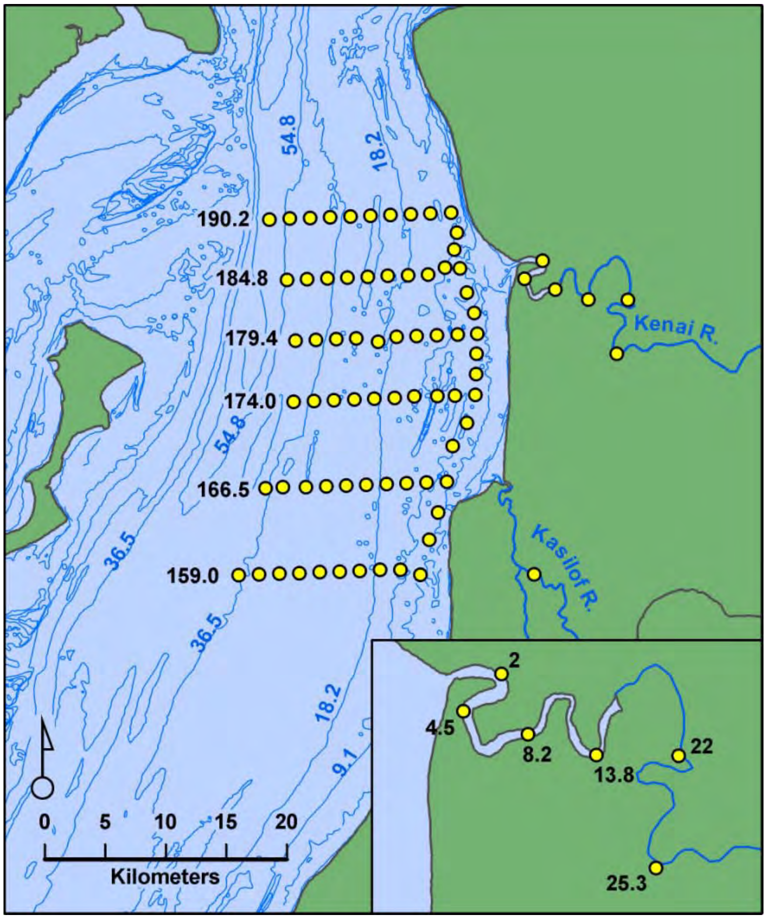

Figure 1. The acoustic array deployed in Cook Inlet and the Kenai and Kasilof rivers in 2013. Yellow circles represent individual acoustic receivers. Number labels to the left of east-west receiver lines are the distance in kilometers from the mouth of Cook Inlet. Inset: numbers beside receiver deployments are the river kilometer (RKm) from the mouth of the Kenai River. The receiver deployed in the Kasilof River was at RKm 12.1.

1.2. Tagging

1.2.1. Tagging procedure

Maturing Chinook and sockeye salmon were captured and tagged in southern Cook Inlet between July 1st and August 1st 2013. In order to obtain a representative sample of the Kenai River salmon, tags were applied approximately in proportion to the abundance of each species as the run entered Cook Inlet. Capture efforts were initially conducted with commercial troll gear and focused on offshore waters where it was thought that the majority of Kenai River Chinook likely migrate[1]. Because

[1] ADF&G (2013). Request For Proposal: Chinook and Sockeye Migration Patterns in Cook Inlet. Page 24.

the captures of tagged Chinook were very low offshore (see Results), we began capturing Chinook using sport troll gear in the inshore near Anchor Point in late July.

Salmon were tagged with paired external disc tags and internal acoustic tags. External tags were numbered orange Petersen disc tags; internal tags were VEMCO V16P-3H acoustic transmitters (16 mm diameter; 67 mm length; 26 g weight in air). The acoustic tags transmitted the unique ID code of the tag and the current depth. (These data along with the date and time of transmission are recorded by the acoustic receiver.) Both tag types were labeled “Return for Reward” in case of capture by the fishery. The disc tags were attached through the musculature below the dorsal fin. We implanted acoustic tags into the abdominal cavity of the first three sockeye using surgical techniques (July 1^{st} and 2^{nd}, 2013); however, we switched to using a gastric implantation technique for the remainder of the tagging (from July 2^{nd}) when we found that the surgical incision tended to gape. After tagging, each fish was measured, and a DNA tissue sample was taken from the axillary process of the pelvic fin. Fish were then released to the ocean close to their capture location (Figure 2).

Detailed handling and tagging methods are available in Appendix A.

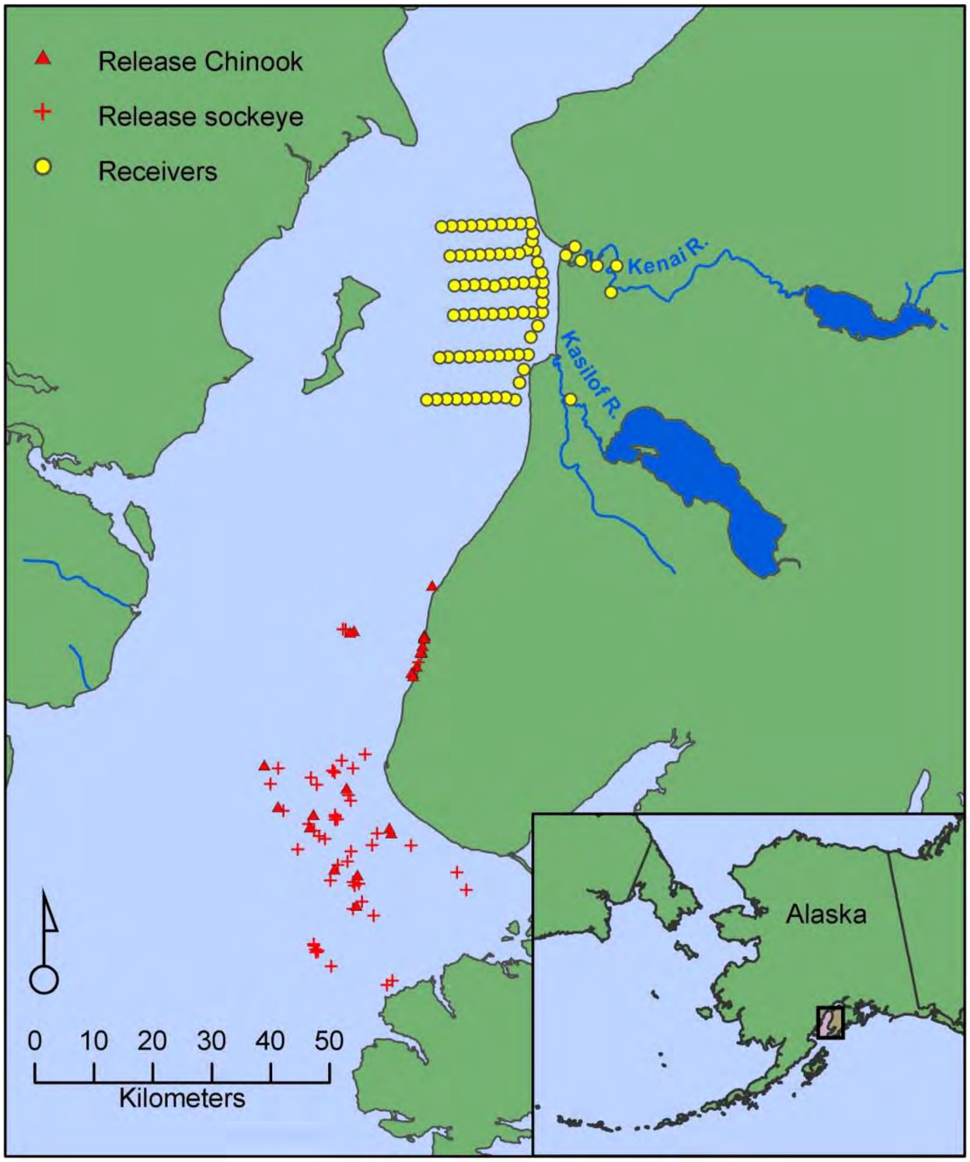

Figure 2. Location of release sites for tagged Chinook and sockeye relative to the telemetry array.

1.2.2. Sensor accuracy

In order to assess the accuracy of the pressure sensors in the acoustic tags, we deployed six tags previously returned from the fishery and eight receivers in Sproat Lake, B.C., between Oct 23rd and Dec 4th. Three tags were deployed at each of 5.2 or 3.0 m below the surface (close to the mean recorded depth of the Chinook and sockeye—see Results 2.5) on a taut mooring with all floatation placed sub-surface to reduce the risk of vandalism. Three major rainfall events occurring while this study was running increased the water level in the lake and thus the depth of the tags. A water level gauge[2] at the outflow of Sproat Lake (only a few km from the study site) indicated that water levels there changed by a maximum of 0.9 m and thus should be closely correlated to water level changes above the tags. To limit the effect of water level changes, we used only sensor transmissions on days where the water level at the gauge was within 0.25 m of its level on the day the tags were deployed (Oct 23rd). The results show that one depth sensor failed (although the tag continued transmitting; see Appendix B.6 for other failed sensors), and one tag stopped transmitting before the end of the study. Apparently the tag that stopped transmitting had not been turned off when originally recovered from the fishery and the programmed kill time of 150 days post-activation was exceeded during the lake deployment. The maximum average difference between the approximate deployed depth of the tags and the reported depth by the remaining sensors was 0.58 m. Because the tags were programmed to have a depth resolution of 0.6 m, this indicates that the tags were generally within 1 interval of true depth and that instrument errors were substantially smaller than the difference in species-specific mean depths measured in this study. There was also no indication that the accuracy of the tags' depth sensors changed over time.

Table 1. Comparison between the approximate depth (m) of VEMCO V16 tags deployed in Sproat Lake B.C. and the depth values reported by pressure sensors in the tags.

			Transmitted Depth (m)			
Deployed Depth (m)	**Tag**	**N**	**Mean**	**SE**	**SD**	**Difference between deployed and transmitted depths (m)**
5.2	9485	69583	4.75	0.004	0.95	-0.45
	9487	71519	4.83	0.004	1.17	-0.37
	9524	61921	5.21	0.004	0.95	0.01
3.0	9491	70389	3.04	0.002	0.59	0.04
	9499	50166	3.58	0.002	0.47	0.58

[2] Environment Canada hydrometric station 08HB008: http://www.wateroffice.ec.gc.ca/index_e.html

1.3. Data screening

The detections data are screened in various ways prior to analysis. Details on these screens are available in Appendix B.

1.4. Data analysis

For simplicity in the main report, analytical methods are described in Appendix C.

2. Results

2.1. Tagging

A total of 26 Chinook and 51 sockeye were tagged and released as part of the 2013 study. Tagging locations are shown in Figure 2. Because offshore Chinook catches were low using the commercial troller f/v West Bank (Figure 3), beginning on July 23rd Kintama (at its own cost) supplemented tagging efforts by chartering two sport fishing boats to troll in the very shallow waters (1.5-2.7 m; 5'-9') just off the beach north of Anchor Point, where most Kenai Chinook are known to be caught. (Offshore tagging operations were partially or completely shut down from 18-20 July because of bad weather; fishing near the beach then had to wait further before starting because the water was heavy with debris from the storm).

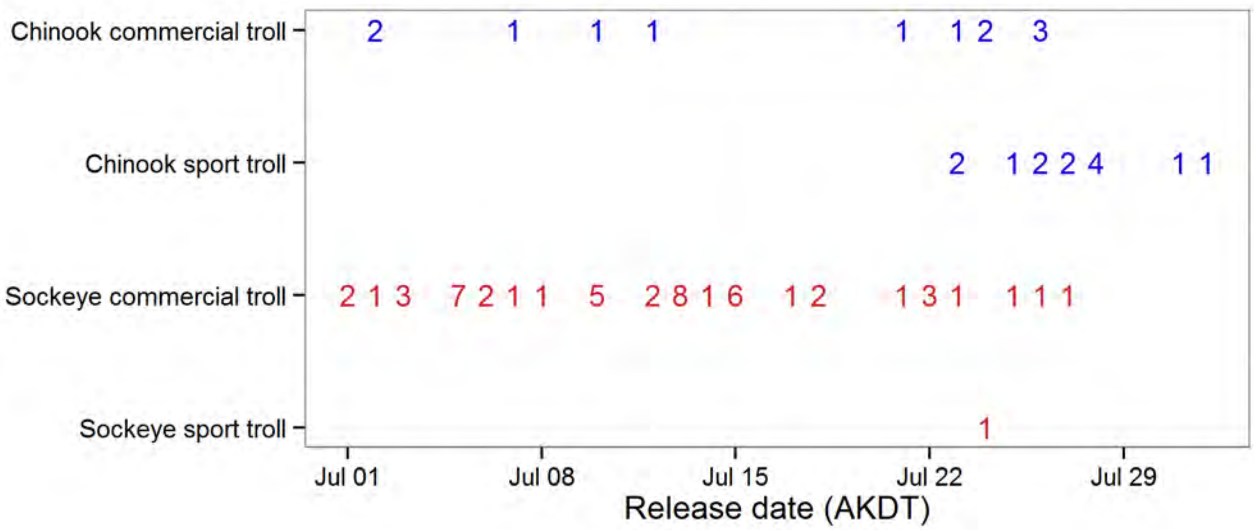

Figure 3. Number of acoustic-tagged, adult Chinook and sockeye grouped by capture method and capture/release date.

Capture depths varied by location for maturing Chinook (as well as immature "feeders"; Figure 4). Adult Chinook were consistently caught only on the bottom lures by the troller in maximum water depths of 30-35 m (100'-120') despite substantial proportions of the other lures on each troll line also being rigged for Chinook. (Each of the 6 troll wires was rigged with flashers and lures spaced approximately 2 fathoms apart; the total number of hooks fished therefore depended upon water depth, but was typically 4-6 vertically spaced lures/troll wire, yielding a total of 24-36 lures). In the inshore, maturing Chinook were captured at <5 m. Maturing sockeye were widely distributed in the water column offshore with most fish captured at water depths between 3.5-11 m. The single sockeye captured with the inshore sport gear was caught at ~2.5 m depth.

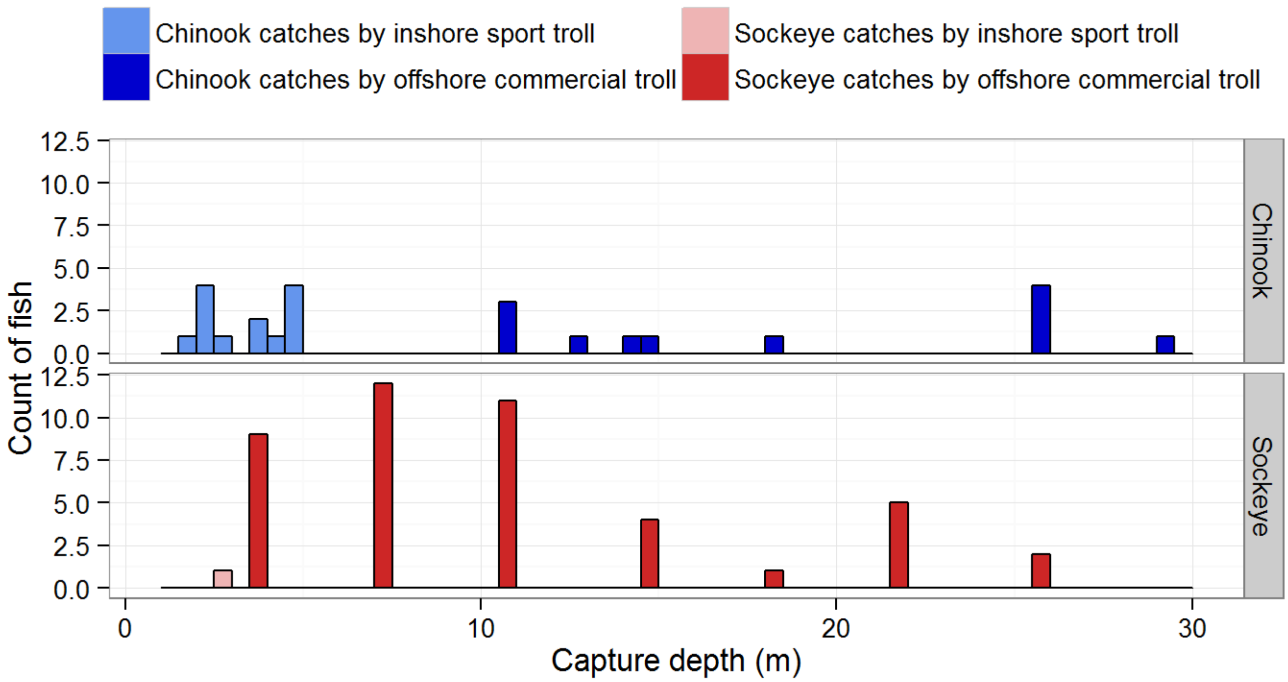

Figure 4. Capture depth by capture location (fishing method) for maturing Chinook and sockeye tagged in southern Cook Inlet 2013.

Although daily catch rates for maturing Chinook were low in the offshore region of southern Cook Inlet, maturing Chinook were likely widely distributed across at least the eastern and central parts of lower Cook Inlet, a region 40 nautical miles wide. The estimated run size of ca. 22,000 Kenai Chinook (17,000 escapement[3] + 5,000 harvest[4]) yields a migration density of 550 Kenai Chinook per mile per month, or a daily migration of ca. 18 Chinook crossing per linear mile across the Inlet. These low densities (plus the fact that Chinook would only typically bite just after the change to the ebb tide) strongly suggest that maturing Chinook are not just confined to the nearshore region off Anchor Point where most sports fishermen operate, but that they are difficult to catch in the offshore because they are thinly distributed near-bottom over a wide region.

Sockeye catch rates were also lower than the planned target of 70 adults, but for a different reason. Early catches using the offshore troll vessel were ample to provide the target of 70 sockeye for

[3] http://www.adfg.alaska.gov/sf/FishCounts/index.cfm?ADFG=main.kenaiChinook

[4] ADF&G reports a preliminary 2013 commercial Chinook harvest in lower Cook Inlet of 5,098 king salmon. www.adfg.alaska.gov/static/applications/dcfnewsrelease/371793118.pdf

tagging if these catch rates had continued, unfortunately, catches dropped to virtually nothing after 18 July (Figure 3).

Overall, there were four reasons for the shortfall in tagging numbers. We outline these issues here to document them and to suggest how the study design could be modified in future years.

1. The original direction in the RFP required tagging across lower Cook Inlet in order to ensure that salmon were tagged from all regions of Cook Inlet (in case salmon migrating through other parts of the inlet had different behaviors); this resulted in some fishing effort being expended in western or west-central Cook Inlet where few or no Chinook (and very little other animal life) was present. In general, we found the region farther to the west biologically unproductive (no birds or sea mammals seen at the surface, no sign of plankton or fish on the echo sounder, and no salmon catches when trolling).

2. It was challenging to tag fish in proportion to abundance because future catch rates were unknown. When sockeye were abundant early in July, we reserved substantial tag numbers for use later in the run; unfortunately, sockeye catches dropped sharply after mid-July, leaving us with insufficient numbers to meet the tagging goal.

3. Bad weather. Fishing was shut down (or terminated early during the day) several times because of storms.

4. The exposed nature of Cook Inlet and the poor bottom for secure anchoring made it necessary to steam for 2-3 hrs at the beginning and end of each day in order to find a safe anchorage (typically near Seldovia) on all but the most favorable weather days. Because the salmon were biting primarily near the turn to the ebb tide, potentially productive fishing time was often lost to the logistics of moving to and from the fishing ground.

In future years, additional fishing vessels could be used to increase the numbers of tagged salmon in the offshore. For sockeye, an additional offshore troller would be needed because of the limitations imposed by the timing of tides, poor weather, and the short periods that salmon actively fed each day. Additional fishing using one or more smaller boats fishing very near to shore off Anchor Point would yield substantial increases in catch for Chinook in a region where substantial proportions of the maturing Chinook appear to be returning to the Kenai River. Offshore, a second troller would also improve Chinook tagging rates because only the near-bottom troll hooks catch Chinook, and bottom lures were often rendered ineffective by halibut captures.

2.2. Technical performance

Detection efficiency on both the marine and freshwater components of the tracking array was 100%, with all tagged animals detected in the Kenai or Kasilof Rivers previously detected on one or more of the receivers forming the marine array, and all tagged animals detected on up-river receivers in the Kenai River previously detected on the lower river receivers[5]. It was not possible to evaluate detection efficiency of the two Kasilof River receivers deployed on opposite sides of the river at the ADF&G Didson site because no receivers were placed farther upstream, but their detection efficiency may have been poor; only one sockeye was detected (three detections) and on only one of the two receivers, despite the river being relatively narrow.

2.3. Detections

For both species, approximately 50% of tagged fish were detected on the marine array, and approximately 25% were detected entering the Kenai and Kasilof rivers (Table 2). We discuss these numbers further in section 2.11 Apparent survival. Because we released more sockeye than Chinook, these percentages mean that more sockeye were detected by the acoustic array. However, differences in the migration behavior of the two species resulted in far more detections for individual Chinook than sockeye (see section 2.4 Movements) and thus provided a stronger dataset per individual.

[5]This does not mean that every tagged fish was detected by every receiver when the fish were within the theoretical detection range.

Table 2. Detections recorded by the acoustic array deployed in Cook Inlet in 2013. First columns report the count of maturing Chinook and sockeye detected; second columns report the count of detections recorded for these fish. (A total of 25 tagged Chinook and 51 tagged sockeye were released in lower Cook Inlet).

		Number of Fish Detected[6]		Number of Detections	
		Chinook	Sockeye	Chinook	Sockeye
Entire Marine Array (includes ESSN Boundary)		13	27	18,232	3,422
ESSN Boundary		12	17	17,190	969
Kenai River	**RKm 2 Snug Harbor**	7	11	169	175
	RKm 4.5 Inlet Fish	7	10	207	176
	RKm 8.2 Bridge	7	9	304	368
	RKm 13.8 Lower King Sonar	5	9	35	301
	RKm 22 Upper King Sonar	3	7	10	13
	RKm 25.3 Gaines Dock	7	9	386	71
	RKm 30.6 Sockeye Sonar	3	7	28	73
Kasilof R.	**RKm 12.1 Sockeye Sonar**	0	1	0	3

2.4. Movements

Animation of the detection data (http://kintama.com/animator/CookInlet2013/) revealed major differences in the pattern of movement of the two species, with tagged Chinook migrating almost exclusively as close to shore as our instrumentation was deployed (the western offshore boundary of the ESSN), and then repeatedly "patrolling" north and south along the offshore boundary for up to 20 days before river entry (Figure 5; Figure 6; Figure 7). In contrast, the marine distribution of tagged sockeye was much broader in the eastern third of Cook Inlet (where instrumentation was emplaced). Sockeye migrated primarily offshore and then moved rapidly past the western boundary of the ESSN fishing district with all but one sockeye present near the ESSN boundary for one day or less before entering the Kenai River. In general, both species were detected evenly along the ESSN boundary (Figure 6), although more Chinook were detected at the receivers 6.5 and 10 km south from the Kenai River, which some individual Chinook used as the southern limit before turning around and swimming north again while milling near the river mouth.

[6] Totals include several fish that were not included in the assessment of migration depth: 2 Chinook and 1 sockeye with faulty depth sensors; and 1 sockeye that was detected entering the Kasilof River. The sockeye with the faulty depth sensor was detected on the outer array before being recovered in the fishery near Kodiak Island.

A lack of receivers within the first 1.5 nautical miles (2.7 km) of the eastern shore of Cook Inlet, where the ESSN operates, is a limitation in the observational power of the 2013 array design for Chinook because the majority of Chinook detections are from receivers sited along the outer edge of the ESSN. This suggests that undetected Chinook may simply have remained farther inshore, beyond the range of our instrumentation (a maximum of roughly 700 m). Similarly, the limited western extent of the marine sub-arrays likely prevented complete detection of sockeye, which were more abundant on the offshore half of the marine array.

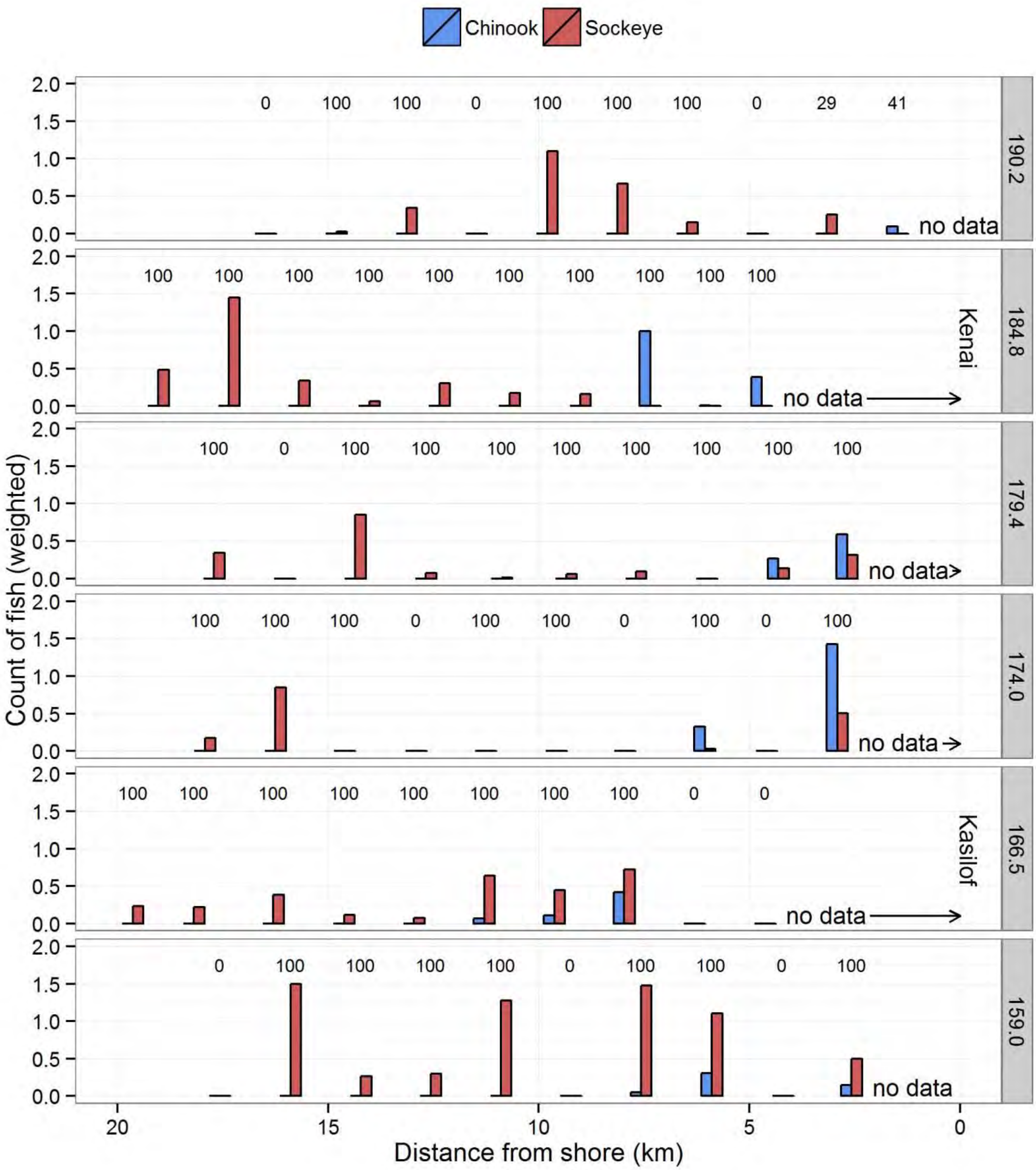

Figure 5. Distribution of adult sockeye and Chinook salmon migrating over the marine array. If a fish was detected at more than one receiver, a proportion was allocated to the receiver, e.g., if an ID code was detected on two receivers, each receiver was assigned a value of 0.5. The values above the bars indicate the proportion of time that the receiver was operational during the season. "No data" indicates the extent of the inshore region (within the ESSN) lacking instrumentation.

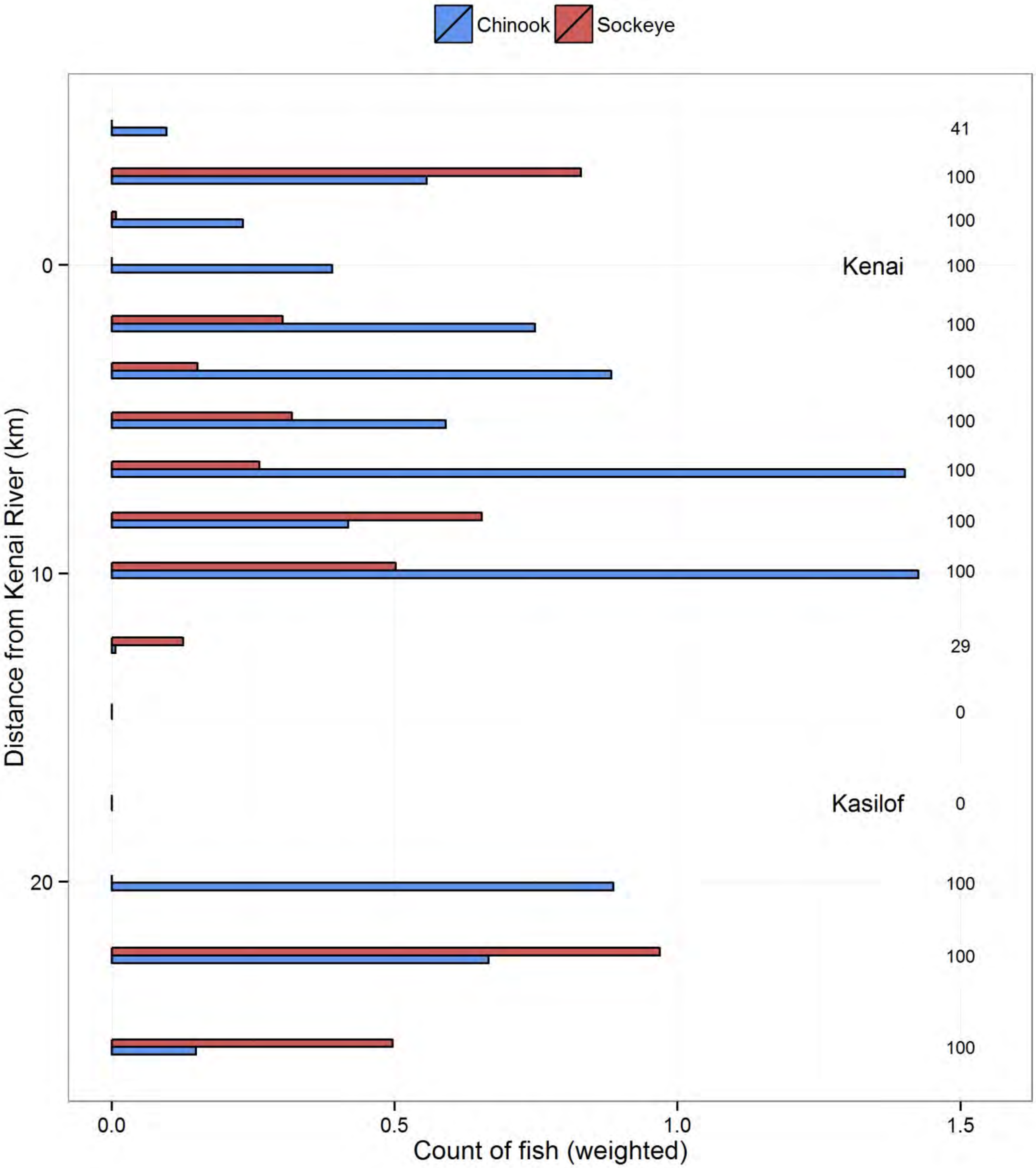

Figure 6. Distribution of adult sockeye and Chinook salmon as they migrated over the north-south row of acoustic receivers bordering the western edge of the ESSN fishery in Cook Inlet 2013. If a fish was detected at more than one receiver, a proportion was allocated to the receiver, e.g., if an ID code was detected on two receivers, each receiver was assigned a value of 0.5. The values to the right of the bars indicate the proportion of time that the receiver was operational during the season.

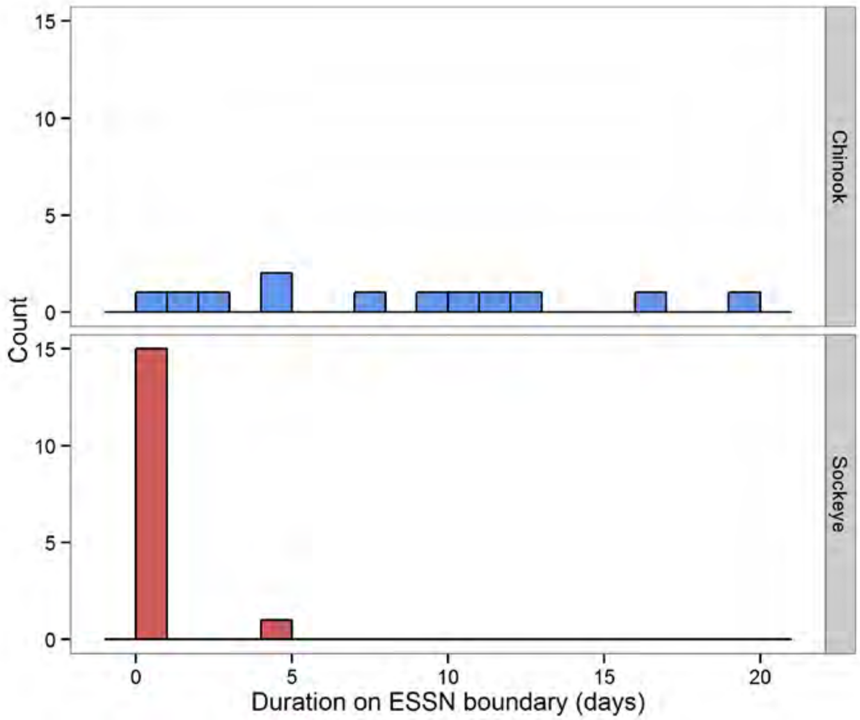

Figure 7. Time between first and last detection (duration) of adult sockeye and Chinook salmon on the north-south row of acoustic receivers bordering the western edge of the ESSN fishing district.

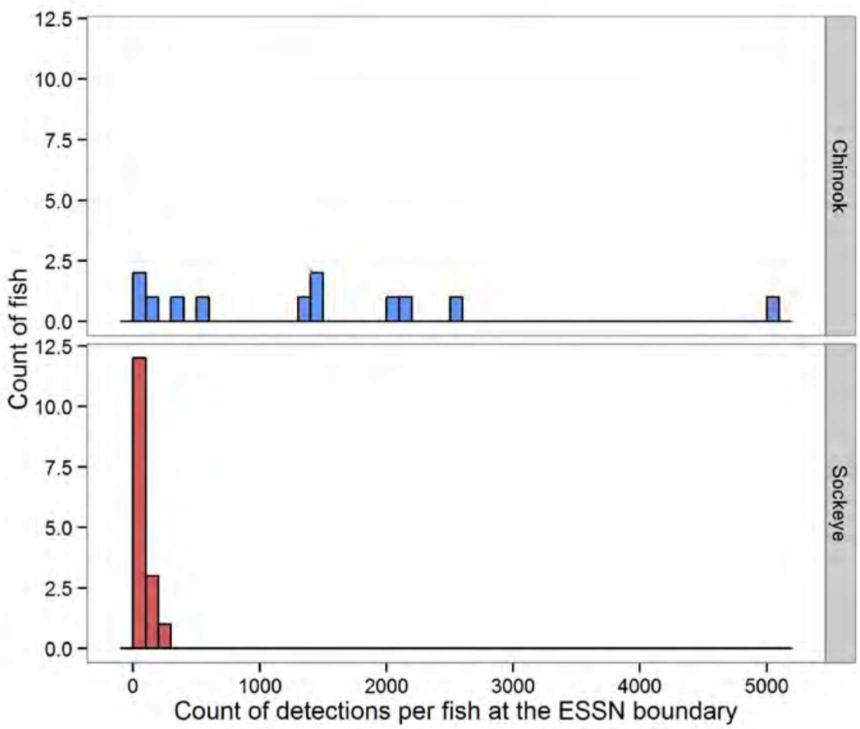

Figure 8. Distribution of the number of detections recorded for individual adult sockeye and Chinook salmon on the north-south row of acoustic receivers bordering the western edge of the ESSN fishing district.

2.5. Depth distributions near the ESSN

Chinook and sockeye detected on the receivers sited along the offshore boundary of the ESSN showed significant differences in the depth of migration. At the boundary, the receivers recorded a total of 15,678 depth measurements for 10 individual Chinook, and 965 depth measurements for 16 individual sockeye. The median depths were 4.8 and 1.8 m respectively, a 3 m difference. Over the broader area represented by the marine array as a whole, the receivers recorded 16,608 depth measurements for 11 individual Chinook and 3,389 depth measurements for 25 individual sockeye. The large increase in the number of detections for sockeye relative to the count along the ESSN boundary reflects their mostly offshore distribution. The Chinook migrated closer to shore and were mainly detected along the ESSN boundary. Despite their distribution over deeper offshore water, the median depth for sockeye over the full marine array was slightly shallower than along the ESSN boundary (1.2 m); the median depth for Chinook was unchanged (4.8 m).

To better assess the amount of time tagged Chinook and sockeye spent at each depth along the western boundary of the ESSN, we calculated the relative depth distribution using all observations collected over the receivers forming the ESSN boundary (Figure 9) after excluding the data from three failed depth sensors (Appendix B). We then calculated the proportion of the total detections that occurred between the surface and different maximum depths (the cumulative depth distribution), as this measurement reflects the proportion of time each species spends near the surface (Figure 10).

These summaries show that sockeye spent 50% of their time in the top 1.8 m (6’) of the water column, while Chinook spent only ca. 12% of their time at such shallow depths (Table 3). For both species, depth in the water column bore little relationship to bottom depth (Figure 11).

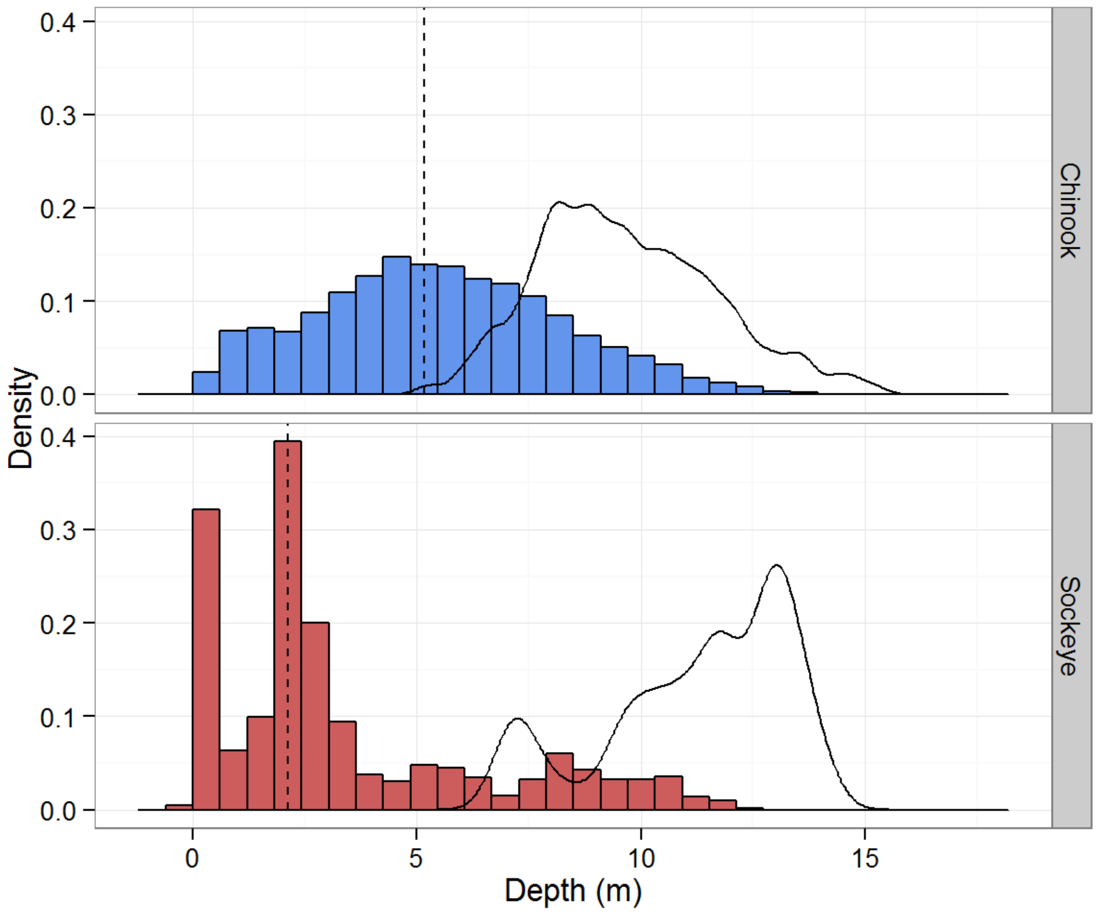

Figure 9. Depth distribution (m) of adult sockeye and Chinook salmon migrating over the row of acoustic receivers bordering the western edge of the ESSN fishing district. Colored bars indicate the depth distributions of acoustic-tagged fish. Black lines indicate the distribution of seafloor bottom depths at the time (i.e. adjusted for tide level) and location (i.e. receiver site) each fish was detected. Distributions were calculated using all depth measurements pooled by species. Vertical dashed lines indicate the median depth.

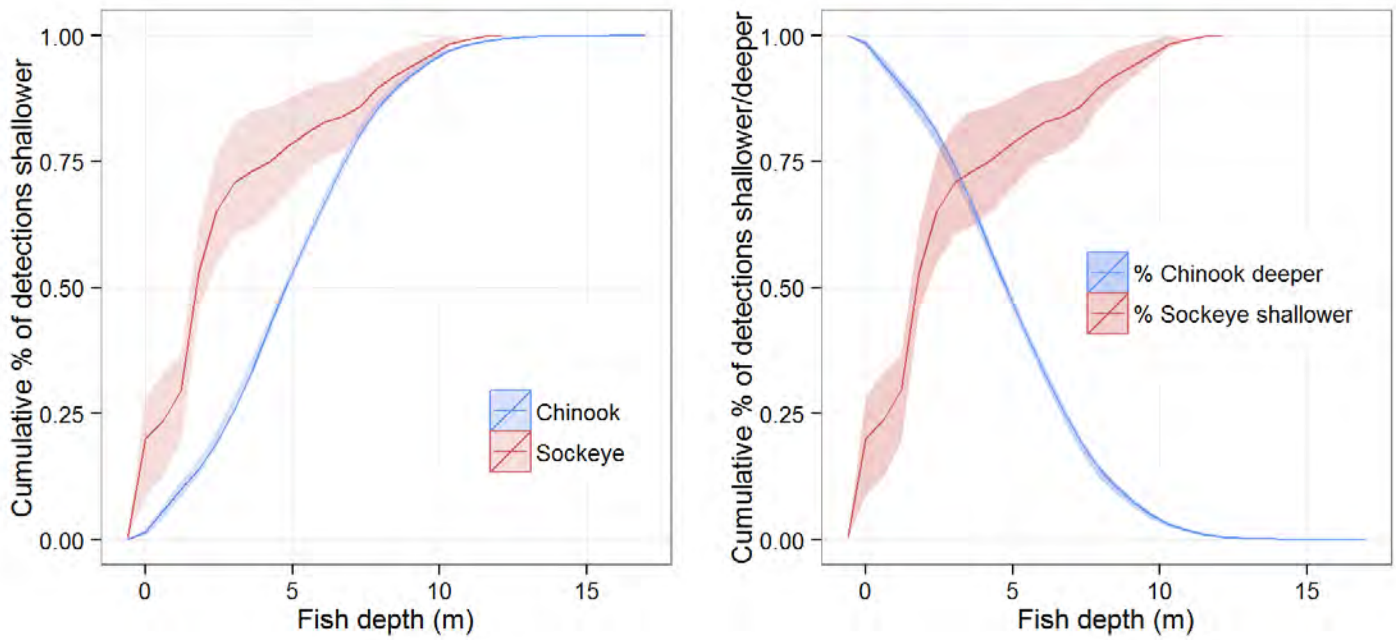

Figure 10. (Left) Cumulative depth distribution of tagged sockeye (red) and Chinook (blue) near the ESSN. (Right) The same data, but showing for Chinook the proportion of time Chinook spent deeper than a given depth. The lines show the jackknifed mean and the shaded areas span the minimum and maximum of the jackknifed replicates (see Appendix C Data Analysis).

Table 3. Cumulative depth distribution of tagged sockeye and Chinook near the western boundary of the ESSN fishing district.

Depth (m)	Cumulative percent of detections shallower	
	Chinook	Sockeye
1	6%	24%
2	14%	54%
3	19%	66%
4	34%	74%
5	51%	78%
6	59%	81%
7	74%	84%
8	86%	90%
9	89%	92%
10	95%	96%

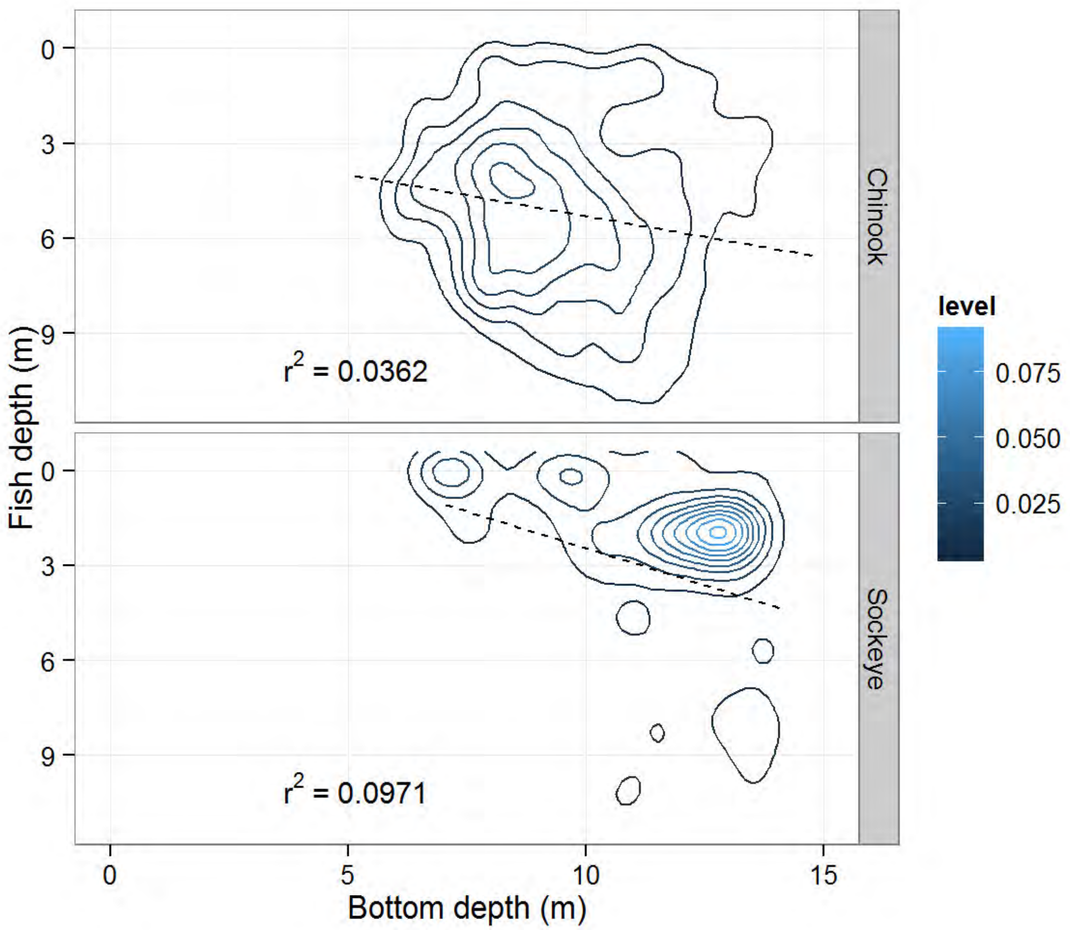

Figure 11. Depth distribution (m) of adult sockeye and Chinook salmon relative to seafloor bottom depth (m) near the ESSN fishing district. Seafloor bottom depths are specific to the time (i.e. adjusted for tide level) and location (i.e. receiver site) each fish was detected. Distributions were calculated using all depth measurements pooled by species.

As a final step, we examined the relationship between the fork length and migration depth near the ESSN (Figure 12). There was no evidence that fork length influenced migration depth for either species.

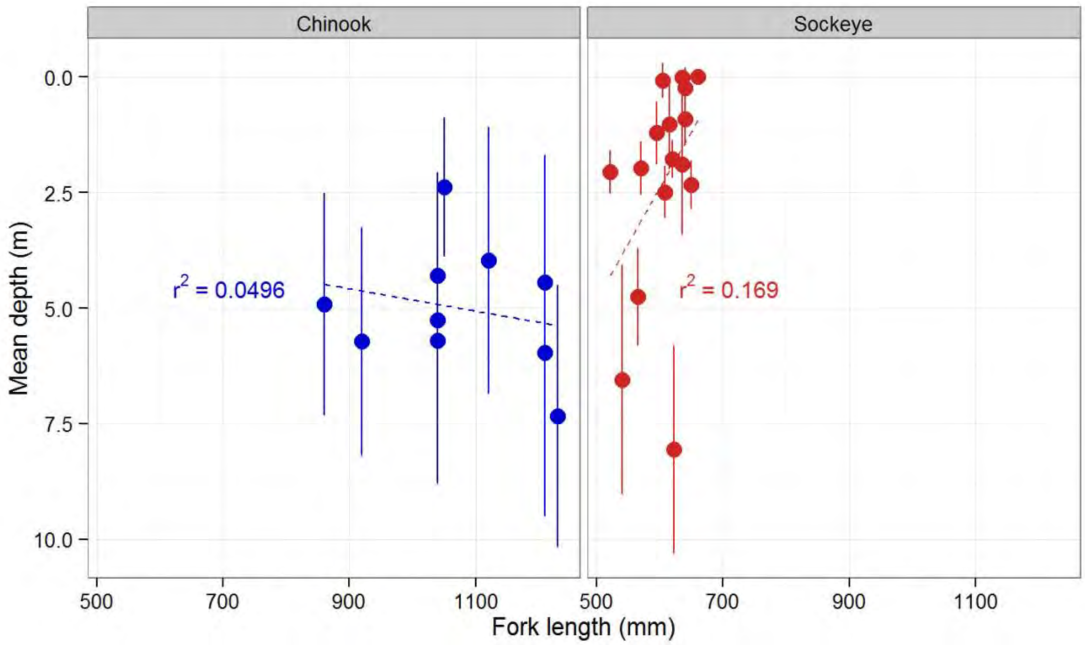

Figure 12. Mean migration depth (m) relative to fork length (mm) for individual Chinook and sockeye adult salmon near the ESSN fishing district. Error bars show the standard deviation of the mean.

Appendix D provides supplementary figures and tables as well as a supporting analysis focused on the depth distribution for each tagged individual.

2.6. Effect of tides and time of day on depth distributions near the ESSN

To examine the effect of time of day and tidal stage on migration depth (and to look for possible interactions between tide and light level) we compared the depth distribution of Chinook and sockeye using trellis plots, where the rows divide the available depth data by the stage of the tide[7] at the time depth was recorded, and the columns divide the data by day or night[8]. We used a density histogram to

[7] We defined 'high' tides as those ≥ the 80^{th} percentile of tide heights predicted for the Kenai River mouth during the interval the tagged fish were migrating over the marine array, and 'low' tides as those≤ the 20^{th} percentile of tide heights during this same interval (see Appendix C).
[8] We defined 'day' as the interval between sunrise and sunset, and 'night' as the interval between sunset and sunrise (see Appendix C).

show the relative distribution of the detections for each species (Figure 13). Then to more simply assess the proportion of time sockeye spent shallower than a given depth versus the proportion of time Chinook spent deeper than a given depth, we plotted the Chinook cumulative depth distribution (CDD) as its complement (1-CDD; Figure 14).

The difference between the median depth of the two species (vertical lines) provides a useful measure of the depth separation possible at different times of day or stages of the tide. At night, the difference in median depth was reduced because the sockeye moved deeper while Chinook moved slightly (average 0.8 m) towards the surface. Although the depth distribution of sockeye in the offshore region of the array was similar to the sockeye depth distribution near the western boundary of the ESSN, data for the latter are quite limited and considerable caution should be used in interpreting the effect of the tides on depth. Additionally, the number of detections recorded during mid-tide may not accurately reflect the occurrence of tagged fish near the ESSN boundary because the detection range of the receivers is expected to drop when the tidal currents are strong; it is not known if this effect applies equally over all depths. Perhaps the most confident conclusion is that during daylight hours different stages of the tides appeared to have at best only a minor effect on the depth difference between Chinook and sockeye.

Some circumstantial evidence that Chinook spent much of their time in shallower waters within the ESSN comes from an assessment of the number of tag detections collected by the nearshore array receivers at different stages of the tide (Figure E-4). Fewer Chinook detections were recorded at high tides than at low tides. This suggests that the Chinook moved farther inshore on the rising tide and away from the receivers, thus decreasing the opportunity to detect them at the western edge of the ESSN where the receivers were sited. In contrast, sockeye detections were few (reflecting their presence primarily offshore), but slightly greater at high tides, perhaps suggesting that during high tides they staged near the ESSN prior to their migration into the river. (We show in the next section that there is clear evidence that both species entered the river on either flood tides or slack water).

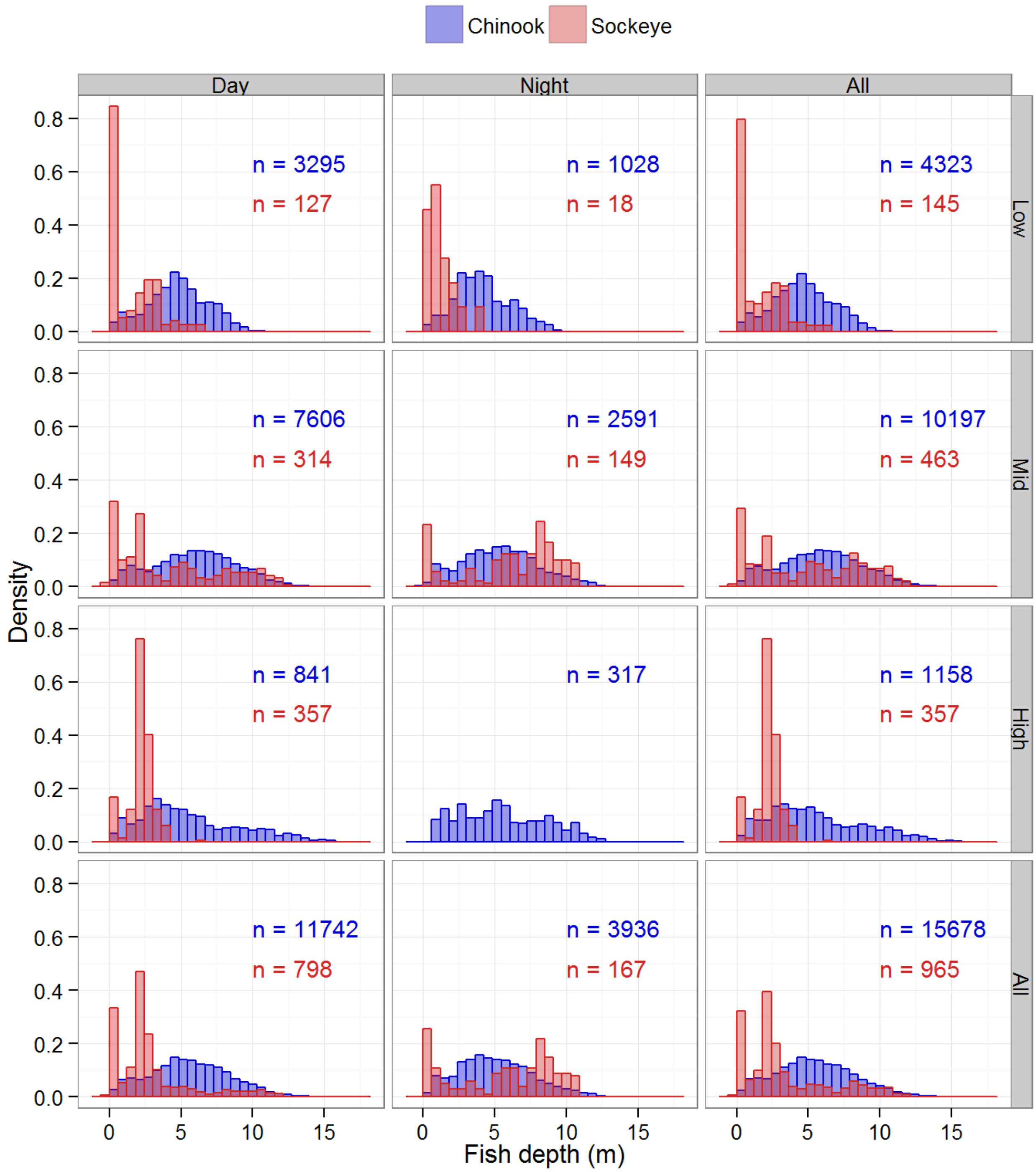

Figure 13. Depth distributions (m) of adult sockeye and Chinook salmon along the western edge of the ESSN fishing zone; n: sample size.

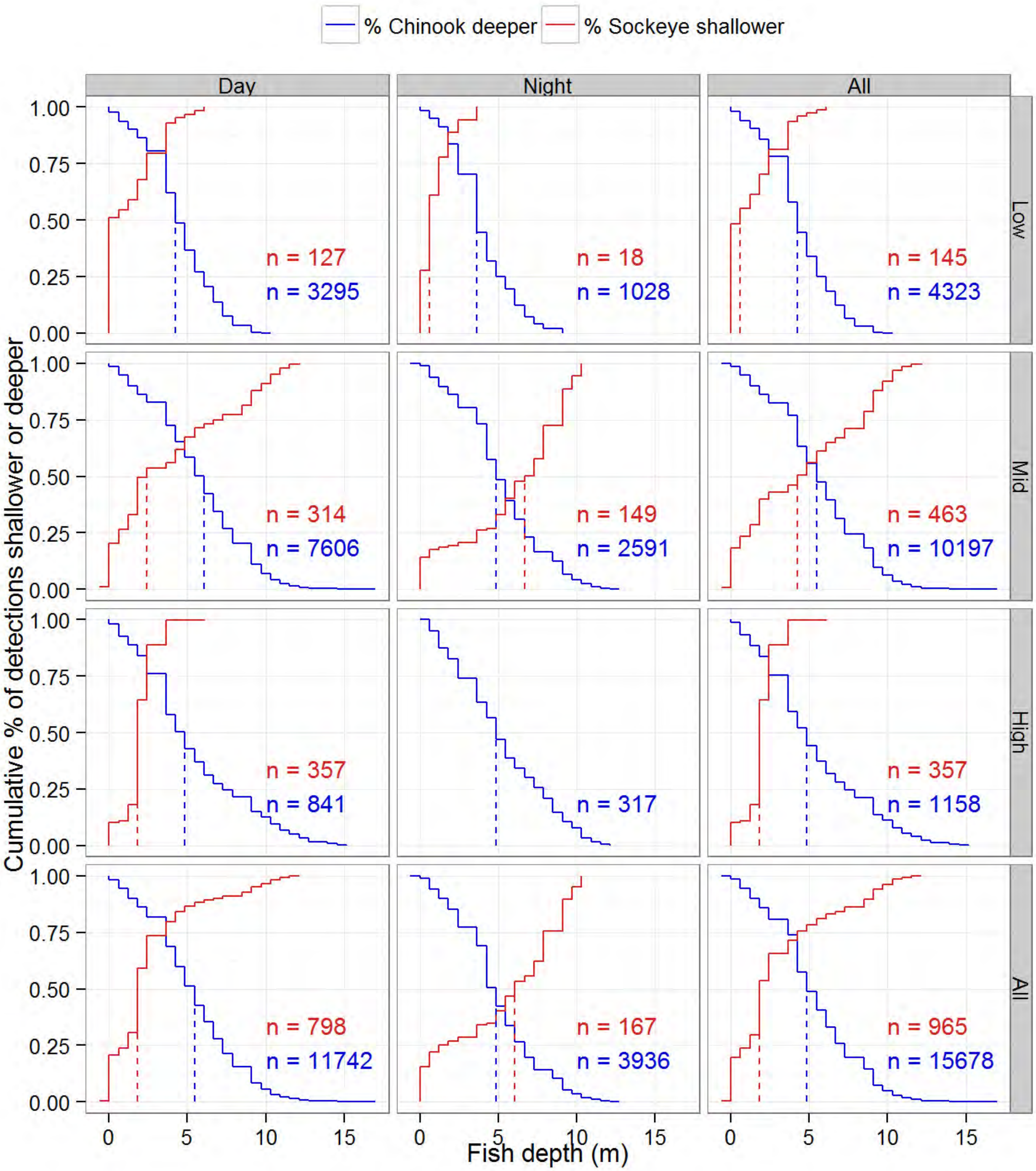

Figure 14. Cumulative depth distributions (m) of adult sockeye and Chinook along the western edge of the ESSN fishing district; n: sample size. Distributions show the proportion of time sockeye spent shallower than a given depth and the proportion of time Chinook spent deeper than a given depth. The vertical lines show the median depths.

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2.7. *Entry patterns into the ESSN and Kenai River in relation to time of day, tide stage, and wind velocity*

There was little evidence that entry into the ESSN was strongly related to date, stage of the tide or wind. For river entry, the majority of Chinook and sockeye initially entered the Kenai River and migrated upstream on either a flood tide or slack water (Table 4). At RKm 2 (Snug Harbor), 74% of Chinook detections and 78% of sockeye detections were recorded as the tide was rising. Of the remaining detections at this site most were recorded at slack water or on a tide that was still ebbing, but nearly slack (classed as Ebbing in Table 4). Only 14 detections (of 2 individuals) were recorded at RKm 2 while the tide was falling significantly; one of these fish did not migrate upriver and the other logged only a single detection on a falling tide as it milled back and forth between the detection sites at RKm 2 and 4.5. At the next site upstream (RKm 4.5, Inlet Fish), no detections of either species were recorded during ebbing tides. The influence of tide dropped somewhat by RKm 8.2 (the Kenai Bridge), as 62% of Chinook detections and 81% of sockeye detections were recorded during flooding tides, suggesting that both species took advantage of tidal conditions primarily to move past the river mouth as quickly as possible and then continued migrating upriver irrespective of the stage of the tide once past the river mouth.

Appendix E provides figures that present the environmental conditions during entry to the ESSN.

Table 4. Number of detections (number of individual fish in brackets) recorded at the detection sites in the lower Kenai River during different tidal stages. Ebb, slack, and flood tides were defined based on whether the tide height predicted for the Kenai River mouth was lower, equal, or higher than in the preceding half hour, respectively.

	Site	RKm	Ebbing	Flooding	Slack
Chinook	Snug Harbor	2	2 (2)	125 (6)	42 (1)
	Inlet Fish	4.5	0	186 (6)	21 (1)
	Kenai Bridge	8.2	114 (3)	190 (6)	0
Total			**116 (5)**	**501 (18)**	**63 (2)**
Sockeye	Snug Harbor	2	38 (4)	137 (8)	0
	Inlet Fish	4.5	0	176 (10)	0
	Kenai Bridge	8.2	71 (2)	297 (7)	0
Total			**109 (6)**	**610 (25)**	**0**

2.8. Migration rates

Travel rates were slow in the ocean, sped up on river entry, and then gradually slowed again as the fish migrated upriver (Figure 15). Marine travel rates reflect milling behavior; the fish travelled an unknown distance further than the straight line distance used to calculate the travel rates. The extensive milling the Chinook displayed before entry to the Kenai River reduced their travel rate both relative to sockeye and to the other migration segments. As well, travel rates were somewhat slower for Chinook than sockeye between release and arrival at the marine array, indicating that Chinook may have also milled more along southern areas of the ESSN fishery. Both species moved from the array directly into the Kenai River mouth, although Chinook made this transition more rapidly. Once in the river, almost all fish migrated directly upstream without evidence of milling. At upriver sites, the influence of river current may have contributed to reduced travel rates.

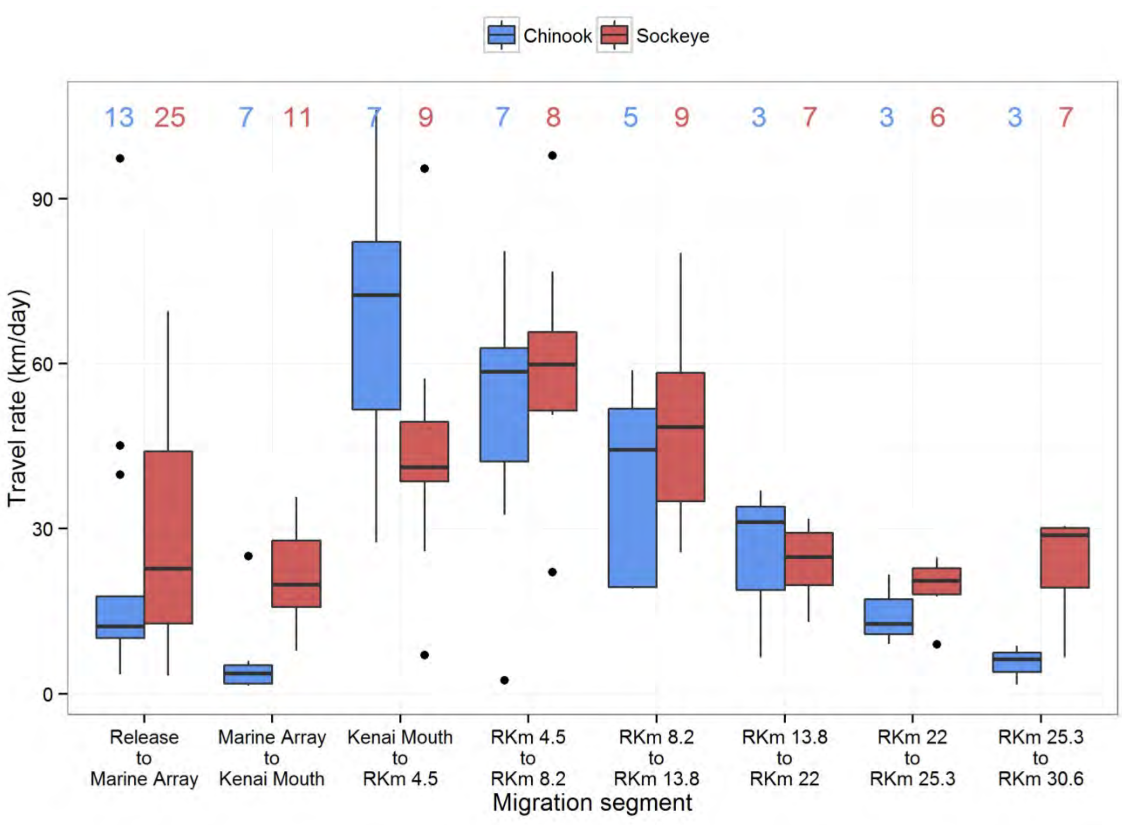

Figure 15. Travel rates (km/day) of tagged adult sockeye and Chinook salmon during different phases of the migration.

Travel rates from release to arrival at the marine array and from the marine array to freshwater entry of both sockeye and Chinook showed little relationship with release date or fish size (Figure 16). One possible exception was that a few (4 of 5) sockeye tagged mid-month may have travelled more quickly between release and arrival at the southern-most line of marine receivers (line 159; circle symbols in top left corner of Figure 16; $r^{\wedge 2}=0.52$). To increase sample size and further assess this possible relationship, we also plotted travel rates for those fish first detected on more northerly regions of the marine array (instead of only those detected on the southern line); however, once these fish were included there is little evidence that the time of tagging or fish size had a substantial influence on subsequent travel rate. Similarly, there was no evidence that once either species reached the marine array that their subsequent entry into freshwater was related to tagging date or fish size.

Appendix F provides supplementary figures and tables on travel times and rates.

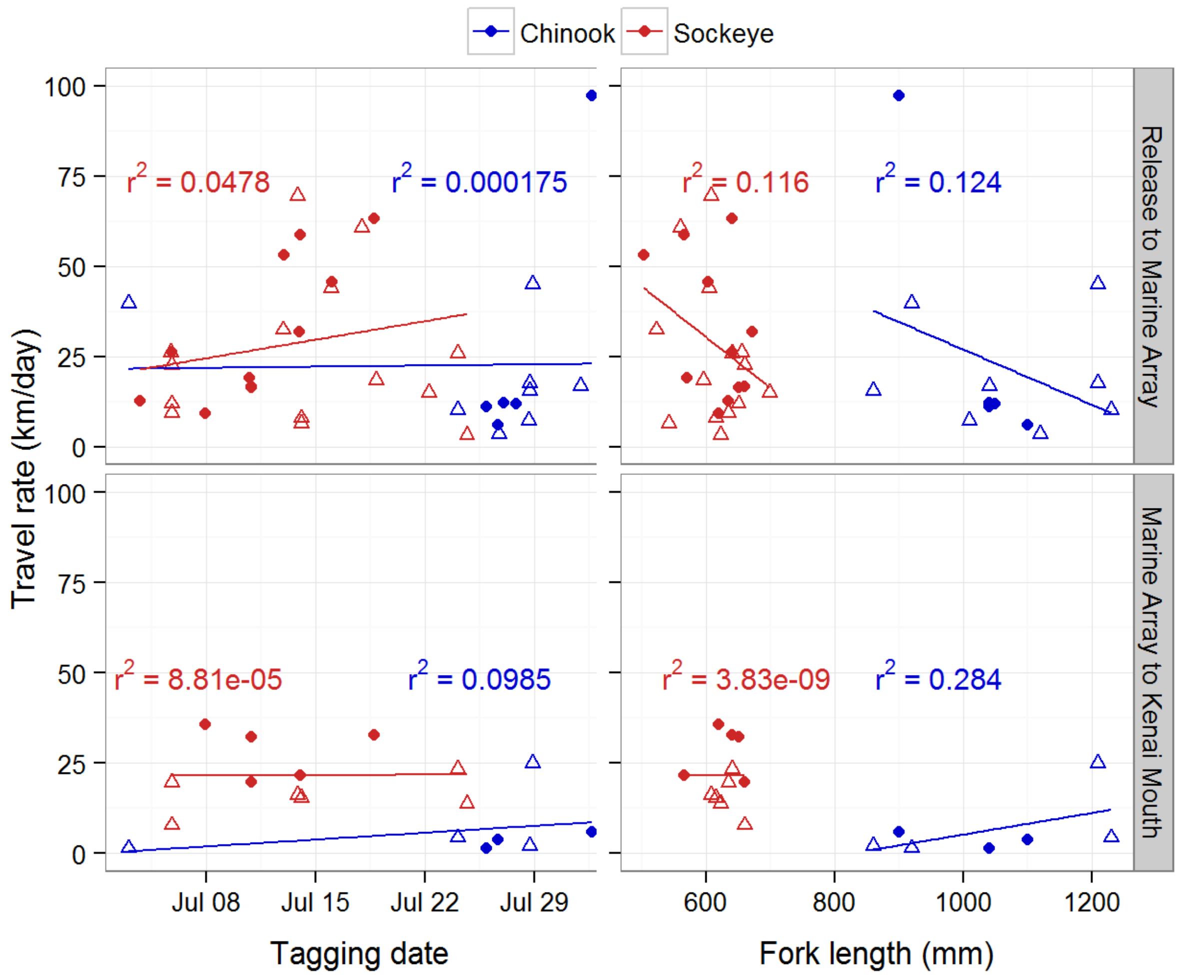

Figure 16. Marine travel rates (km/day) for adult sockeye and Chinook in relation to tagging date and fork length (mm). Rates were calculated for two migration segments:(top) between release and arrival at the marine array, and (bottom) from first arrival at the marine array until entry into the Kenai River (river kilometer 2). Circles show fish first detected on the most southern line of receivers in the marine array (line 159); triangles show fish first detected on any other marine line. The r-squared values were calculated across all rate estimates for each species in each segment.

2.9. Effect of tides on milling behavior in the estuary

Most tagged salmon migrated directly up the Kenai River after river entry; only two showed evidence of milling in the Kenai River estuary (Figure 17). Fish 9484 (a Chinook) was detected moving back and forth three times between the two lowest receivers in the Kenai River; fish 9535 (a sockeye) was detected once at the Kenai River mouth and then disappeared for 7 hours before being detected at the river mouth again and then proceeding upstream. These movements appear to be coordinated with tides; however, the sample size is small. All other tagged salmon migrated directly up the Kenai River after river entry.

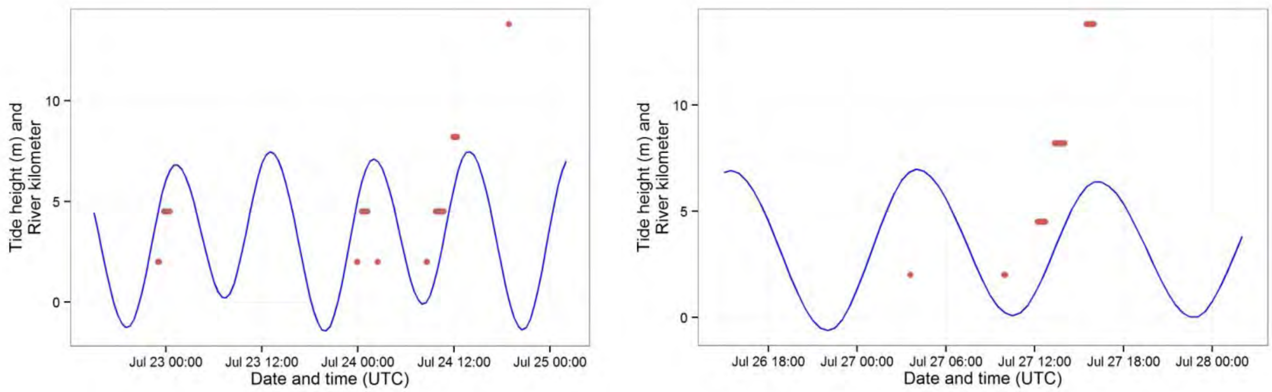

Figure 17. Detections of the two fish that milled in the Kenai River estuary displayed with tide height (m) as estimated at the Kenai River mouth. Red dots represent detections recorded at four sites in the Kenai River; blue lines indicate tide height; tag 9484 is on the left and tag 9535 is on the right. Note the y-axis represents both tide height (m) and location of detection sites by river kilometer.

2.10.DNA analysis

Tissues samples were collected from 25 Chinook and 50 sockeye salmon that received an acoustic tag. Mixed stock analyses (MSA) were conducted for the Chinook using a baseline for Upper Cook Inlet Chinook salmon similar to that reported in Barclay et al. (2012). MSA results for Chinook were inconclusive, likely due to the small sample size and the presence of fish in the sample from populations not present in the baseline. (DNA analysis of sockeye tissue samples was not complete at the date of writing). The acoustic tagging results suggested that some Chinook salmon tagged in the offshore area of Cook Inlet may not have been from Upper Cook Inlet populations. Out of the 12 Chinook tagged offshore, 8 were never detected by the acoustic array and 2 of these tagged Chinook were later reported caught in areas outside of Upper Cook Inlet (Jakolof Bay and Columbia River). Conversely, out of 13 fish caught and tagged in the nearshore off Anchor Point, 11 were later relocated in Upper Cook Inlet. Because the genetics results were equivocal, it is not possible to confidently exclude from the analyses Chinook that were not from Cook Inlet populations.

2.11. Apparent survival

Fish not detected by the marine array do not necessarily die. Properly designed telemetry arrays measure what is technically referred to as "*apparent survival*", or the progressive disappearance of tagged fish after release as they migrate over elements of the tracking array. For simplicity, we refer to this as "*survival*"; however, "*apparent survival*" is more accurate because several factors can reduce the number of tagged salmon in addition to mortality. In the present study, these factors are (i) sockeye and Chinook from stocks not originating from the Kenai or Kasilof Rivers which were tagged but would never migrate to these rivers[9]; (ii) tag loss from extrusion (in surgically implanted individuals) or regurgitation (in individuals whose tag was inserted in the stomach); iii) incomplete detection by the receiver array; (iv) tag failure; and, (v) mortality occurring as a result of tagging (fish capture, handling, tagging or release procedures).

Just over half the tagged Chinook and sockeye released in southern Cook Inlet were detected on the marine array (Figure 18; Figure 19; Table 2; Table 5). Half of the animals detected on the marine array were then detected entering the Kenai or Kasilof Rivers, providing an overall apparent survival to river entry of 25%. Within the Kenai River, where multiple sets of receivers allowed us to track the upstream movements of the tagged salmon, all 7 Chinook detected entering the Kenai River mouth were detected as high up as RKm 25 (River Mile 15; Harry Gaines' Fish Camp), so had excellent in-river survival[10]. The sockeye also had good in-river survival, with 9 of the 12[11] fish (75%) initially reaching the Kenai River mouth detected at RKm 25.

[9] We partially addressed this concern by removing fish from the apparent survival calculations (n=2 Chinook; n=2 sockeye) that were recovered south of the release site (see Appendix B); however, we could only remove individuals whose tags were returned.

[10] Only three of these 7 Chinook were subsequently detected at the final detection site, the ADF&G Didson sonar site at RKm 30.6 (mile 18). The number of detections of each of the tagged animals was lower than at the preceding detection site (Harry Gaines), suggesting that harmonic coupling of the electronics with the Didson sonar may have reduced the sensitivity of the receivers.

[11] One additional sockeye was detected in the Kasilof River.

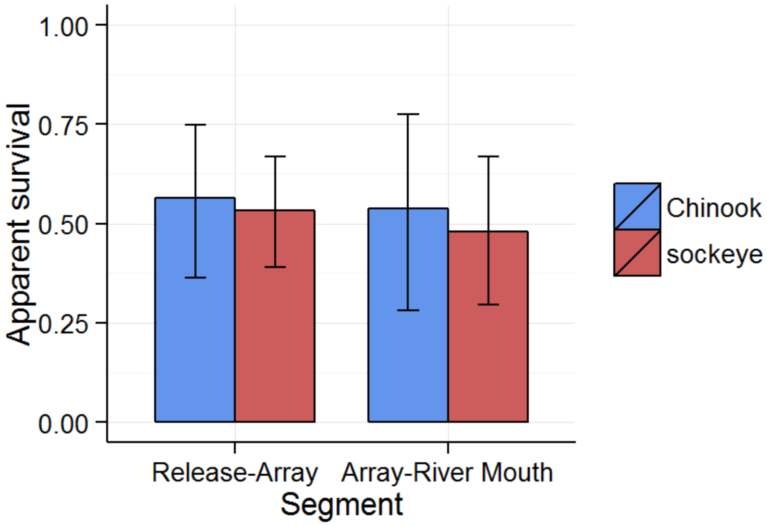

Figure 18. Apparent survival of acoustic tagged Chinook and sockeye between release and arrival on the marine array, and from the arrival on the array until entry into the Kenai River mouth. Error bars are 95% confidence intervals. Survival rates calculated using standard Cormack-Jolly-Seber methods in R. We excluded fish recovered by the fishery south of the release site from these calculations as well as one sockeye detected in the Kasilof River because the detection efficiency of the Kasilof receivers is unknown.

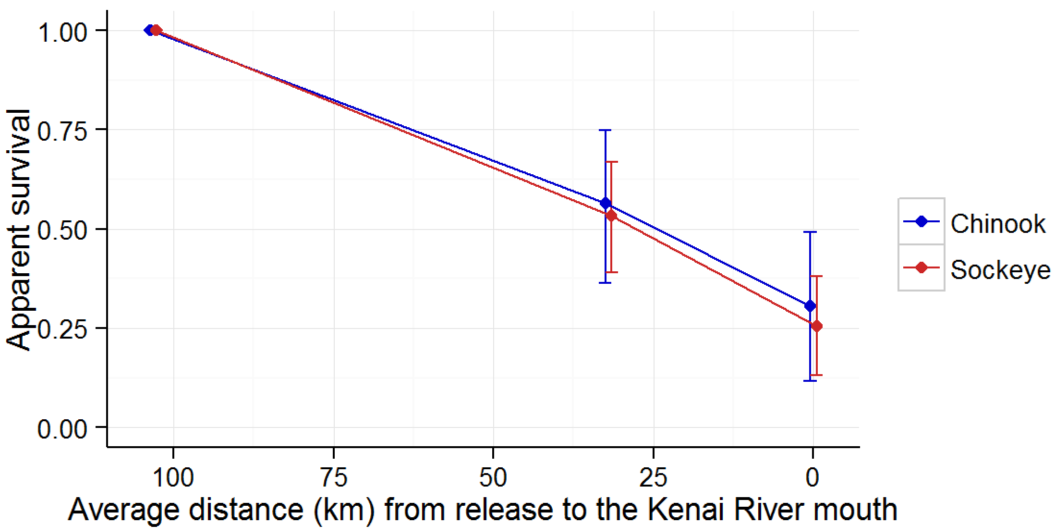

Figure 19. Apparent marine survival for acoustic tagged Chinook and sockeye by distance from release. The points represent apparent survival at release; between release and arrival at the marine array; and between release and arrival at the Kenai River mouth. Error bars are 95% confidence intervals. Survival rates calculated using standard Cormack-Jolly-Seber methods in R. We excluded fish recovered in fisheries south of the release site from these calculations as well as one sockeye detected in the Kasilof River because the detection efficiency of the Kasilof receivers is unknown. Distance from the Kenai River mouth was calculated for each fish for the shortest in-water path and then averaged across all fish (see section C Data Analysis).

Table 5. Apparent survival over the marine and freshwater components of the array (standard error in brackets). We excluded from these calculations fish recovered by the fishery south of the release site and the sockeye that was detected in the Kasilof River because the detection efficiency of the Kasilof receivers is unknown12. Numbers detected at each detection site are available in Table 2. N=sample size.

Species	N Released	N for Survival[13]	Release to Marine Array[14]	Marine Array to Kenai R. Mouth[15]	Release to Kenai R. Mouth
Chinook	25	23	57% (10%)	54% (14%)	30% (10%)
Sockeye	51	47	53% (7%)	48% (10%)	26% (6%)

Although apparent survivals in the ocean appear low post-release (see Discussion), they were higher for Chinook captured and tagged in shallow waters near Anchor Point (46% survival to the Kenai R mouth), than for Chinook tagged offshore (10%[16] to the Kenai R mouth; Figure 20). Chinook released inshore had a shorter distance to travel to the Kenai River mouth (average of 73 km versus 102 for the offshore fishery), but survivals for the inshore fish were still higher when scaled by distance (inshore: 90% survival/km; offshore: 80% survival/km). However, sample sizes were small when subdivided by capture site.

[12] Kasilof River had two receivers placed at the Didson Sonar site, and detected only 1 tagged salmon (3 detections total), suggesting that detection data for the Kasilof River may be poor.

[13] We excluded fish recovered by the fishery south of the release site from these calculations (see Appendix B). We also excluded one sockeye detected in the Kasilof River because the detection efficiency of the Kasilof receivers is unknown.

[14] Detection efficiency of the marine sub-arrays was perfect; no tagged salmon were detected on the freshwater (river) array without first being detected on the marine array.

[15] Detection efficiency of the Kenai River freshwater sub-array was also perfect; at most Kenai River receiver sites no tagged salmon were detected upstream that were not first detected on the downstream sites.

[16] Excludes two Chinook caught and tagged in offshore Cook Inlet that were later recovered by the fishery south of the release site: 1 recovered in the Columbia River; 1 recovered from Seldovia.

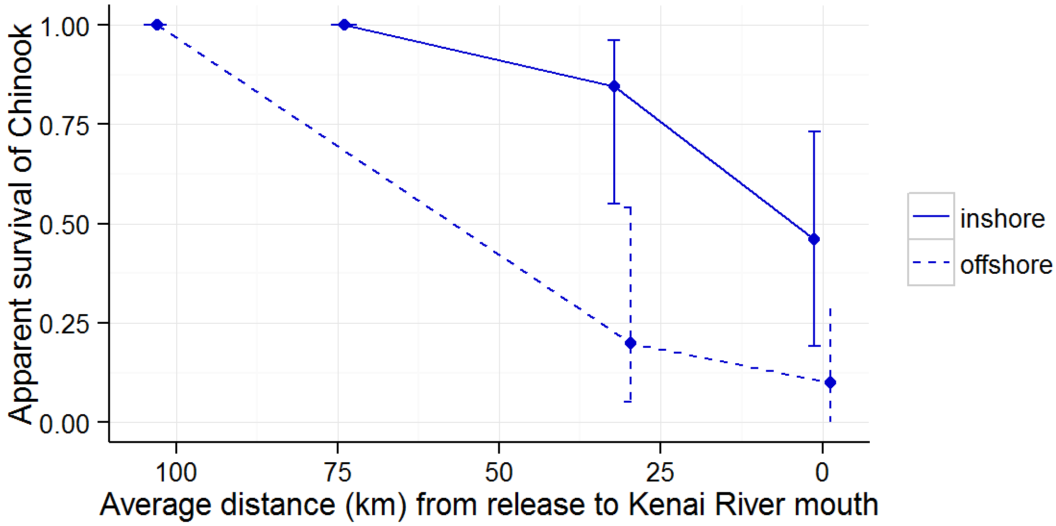

Figure 20. Apparent marine survival for Chinook captured and tagged in southern Cook Inlet either offshore or inshore near Anchor Point. Points represent apparent survival at release; between release and arrival at the marine array; and between release and until arrival at the Kenai River mouth. Error bars are 95% confidence intervals. Apparent survival rates calculated using standard Cormack-Jolly-Seber methods in R. We excluded fish recovered by the fishery south of the release site from these calculations. Distance from the Kenai River mouth was calculated for each fish for the shortest in-water path and then averaged across all fish by capture location (see section C, Data Analysis).

3. Discussion

The technical aspects of the 2013 Cook Inlet telemetry study were generally successful; the marine array detected 100% of the tagged sockeye and Chinook that were subsequently recorded entering the Kenai or Kasilof Rivers, and most freshwater receivers in the Kenai River also detected 100% of all tagged animals migrating upstream. These results were probably due to the tag programming chosen, which partially compensated for the sparse grid of ocean receivers (1.5 km spacing). A few simultaneous detections of a tagged animal on adjacent receivers demonstrated that this specialized programming allowed detection ranges≥700 m when circumstances were favorable. Only one pair of receivers was placed in the Kasilof at the ADF&G Didson SONAR site, precluding assessment of performance, but performance may have been poor; just one sockeye was detected (3 times) and by only one of the two paired receivers. Local conditions can degrade sound transmission and it seems likely that mounting some of the tracking receivers on the ADFG Didson sonars may have degraded performance of the receiver. If the study is to be repeated, it would be useful to place a foam sleeve around the receivers to dampen possible resonant coupling.

The major identified limitations on the 2013 results are the small number of salmon tagged and the lack of reliable genetic assignment from the DNA samples collected. Although the number of tagged salmon was substantially lower than the target of 70 tagged adults per species, the large number of depth measurements collected for these tagged fish provided enough information to calculate reasonable depth distributions for Chinook and sockeye in the ocean. The near perfect detection efficiency of both the marine and Kenai River sub-arrays also gives high statistical confidence in the proportions of tagged fish first reaching the areas covered by the marine array, and then entering the Kenai River.

A novel result stemming from the present study was the detailed information on the behaviour and distribution of Chinook in the ocean, especially the repeated north-south marine movements of Chinook recorded in the nearshore prior to river entry. In contrast to Chinook, tagged sockeye were distributed further offshore and transited rapidly through the ESSN to reach the river. Both species then migrated directly through the river mouth at high speeds (primarily on flood tides or at slack water) before slowing down again upriver. The timing and speed of river entry may have evolved to allow the fish to avoid predators congregating at the choke point formed by the river mouth.

Migration depths were surprisingly shallow at the ESSN boundary for both species (median depth for sockeye: 1.8 m; Chinook: 4.8 m), as well as over the entire marine array (median depth sockeye: 1.2 m; Chinook: 4.8 m). The similarity in the depth distributions across these two zones is most interesting for sockeye because the majority of sockeye detections were recorded away from the ESSN boundary in deeper water (while most Chinook were detected along the ESSN).

In general, the Chinook migrated ~3 m deeper than the sockeye and were deeper in the water column than sockeye under all tidal conditions and particularly during daylight hours. For both species, depth in the water column bore little relationship to bottom depth. These results apply primarily to approximately the outer 500 m of the ESSN region, where most Chinook were detected and where receivers could effectively monitor tagged salmon.

Prior to the start of our study, the expectation was that essentially all maturing Chinook tagged in 2013 would return to the Kenai River, similar to 2012. Consistent with that view, no tagged Chinook were detected in the Kasilof River. However, even after excluding two Chinook captured to the south of the array in Jakolof Bay (southern Cook Inlet) and the lower Columbia River, the low apparent Chinook survival rate of 30% (7/23) between release and Kenai River entry is surprising, but close to the sockeye apparent survival rate of 26% (12/47; Figure 21)[17]. Both species had high in-river survival: all Chinook and the majority of sockeye (9 of 12 entering the Kenai) were subsequently detected well upstream. The three apparent sockeye losses are consistent with several sockeye tags being returned from fishermen fishing within the river.

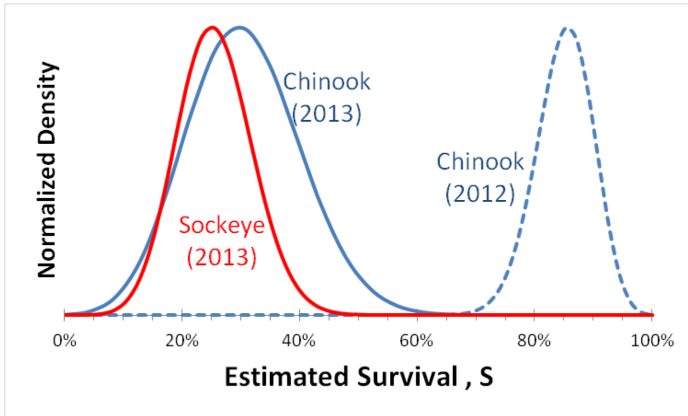

Figure 21. Probability density functions showing apparent survival from release near Anchor Point to river entry for Chinook in 2012 (dashed blue; ADFG study) & 2013 (solid blue) and sockeye in 2013 (red).

The x-axis shows survival and the y-axis shows relative density. Note that sockeye and Chinook survival were very similar in 2013. Calculations assume perfect detection of all surviving tagged adults reaching freshwater, which may not be true in 2012. The effect of poorer in-river detection would be to increase survival in 2012 but also widen the statistical uncertainty as to the true survival.

The 2013 apparent survival rates from release to river entry based on 23 tagged Chinook[18] can be compared with the reported 2012 results when ADF&G tagged and released 49 radio-tagged and 5 acoustic-tagged Chinook near Anchor Point[19]. In total, 87% of the radio-tagged and 60% of the acoustic-tagged adult Chinook were detected in either the Kenai or Kasilof Rivers, yielding a minimum 2012 combined survival estimate to river entry of 85% (SE=9.7%)[20], or a 95% confidence interval of 75%-95%. This is far higher than our apparent survival rate for Chinook of 30% (SE=9.6%), despite

[17] Sockeye survival increases to 27% (13/48) if the fish detected in the Kasilof River is included.
[18] 25 Chinook were tagged, but one tagged Chinook was reported caught in the lower Columbia River and a second was caught in Jakolof Bay south of the release site. A complete 2013 survival estimate for Kenai & Kasilof River Chinook would require excluding other tagged Chinook not from these two river systems but is not possible because of problems with the DNA analysis.
[19] ADF&G (2012). Chinook Salmon Migration Patterns in Upper Cook Inlet-- Summary of First-Year Pilot Study acoustic tag study. Unpublished Report. 4 pp.
[20] (49*87% + 5*60%)/(49+5)=85%. An approximate 95% confidence interval on this value can be calculated as twice the standard error on this proportion, or $\pm 2*(S(1-S)/N)^{0.5}$, or ±9.7%.

apparently perfect detection on the array and perfect in-river survival over the Kenai receivers during upstream migration.

The cause of the large difference between the 2012 and 2013 Chinook survival estimates is unclear. It seems unlikely that the lower survivals in 2013 were an artifact of the tagging procedure because fish were not noticeably affected by tagging in either year. Also, if Kintama's tagging protocols were at fault (as opposed to the methods used in 2012), we would expect that sockeye marine survival would be substantially lower than Chinook (since the sockeye are targeted by the commercial fishery), and that in-river survival of tagged Kenai River Chinook would be less than 100% (assuming tagging effects persist). Neither effect was observed.

Other possible explanations for the poor apparent marine survival rates are poor performance of the single detection site in the Kasilof River, and higher-than-expected tagging of maturing Chinook ultimately migrating to rivers other than the Kenai. Unfortunately, given problems with the Chinook DNA analysis in 2013, it is not possible to distinguish between these factors at the time of writing.

There is evidence that Chinook tagged farther offshore in Cook Inlet may have included a greater proportion of non-Cook Inlet origin Chinook. Apparent survival to the marine array was 85% for inshore releases and only 16% for offshore releases, while survival for both release zones was close to 50% between arriving at the array and Kenai River entry. Although some of this difference can possibly be accounted for by the shorter average migration distance of the inshore releases to the marine array (43 km vs 72 km), the large difference in apparent survival after release suggests that at least some offshore tagged Chinook were destined for other rivers. This conclusion is further supported by the fact that two Chinook tagged offshore were subsequently recovered from southern Cook Inlet (Jakolof Bay) or entirely outside Cook Inlet (Columbia River). A broader array would be needed to address these issues, both by identifying the movement of tagged salmon into other parts of Cook Inlet (or their emigration out of Cook Inlet entirely), and by measuring the post-release survival of tagged salmon just before they reached the ESSN.

4. Future Work

The magnitude of the disappearance of the tagged Chinook and sockeye suggests that a more extensive telemetry array would be a valuable addition to the study design. Telemetry lines stretching eastward into the ESSN and westward fully across Cook Inlet would better allow identification of Chinook and sockeye movements north of the tagging site. In addition, a telemetry line situated just south of the ESSN would be useful for evaluating whether there was poor post-release survival prior to reaching the main marine telemetry array to the north. Finally, without reliable genetic results to identify Kenai River Chinook, a southern sub-array sited somewhere near the Barren Islands to monitor the exit from Cook Inlet of tagged animals migrating to other regions of the coast would be useful, but costly.

In future years, fish capture protocols should also be modified to focus on tagging fish in those areas and times where they are most abundant, in order to increase the number of tagged salmon released. The capture rates achieved in 2013 suggest that two or more vessels would be required in the offshore Cook Inlet area plus at least one small boat fishing the very nearshore off Anchor Point. Post-season, the behavior of tagged salmon from different tagging groups could then be compared to try to identify possible differences in behavior between different tagging groups and areas.

Finally, the expansion of acoustic arrays around Alaska would allow a much broader look at survival of Chinook during all phases of their marine life history, and allow a quantitative assessment of when and where the poor survival affecting many Alaskan Chinook stocks is occurring in the ocean. Such data will be critical to moving beyond speculation as to the causes of the current decline in adult returns of Chinook to many of Alaska's rivers. A large-scale Alaskan telemetry array would also have broad utility to many of Alaska's other valuable fisheries.

5. Acknowledgements

We thank ADF&G staff, particularly Mr Mark Willette, for support and advice during this study, and particularly for agreeing to mount acoustic receivers at their Kenai & Kasilof sonar sites—this allowed us to deploy substantially more tracking receivers in freshwater than would otherwise be the case. We thank Captain Dave Beam (Cordova; Montague Marine Research, LLC), Casey Pape, and other crew for their able assistance in deploying and recovering the marine array, Mr Ritchie Davis

(Juneau; F/V West Bank) for his incredible skills and assistance trolling for Chinook, and Mr Steve Walli (Anchor Point) and Dan Calhoun (Homer) for their agreement and great willingness to assist on very short notice with additional nearshore sportfish trolling to supplement the number of tagged Chinook when contacted in the middle of July. Without all of you this study would not have been successful.

6. Appendices

A. Fish Handling and Tagging Methods

A.1. Summary statistics

A.1.1. Total salmon tagged

Maturing Chinook: 25
Maturing Sockeye: 51

A.1.2. Fishing effort

Total fishing effort:	317.25 hours.
Full Fishing:	28 June-02 August 2013
Minimal Fishing:	July 18 – due to weather
No Fishing:	July 09, 19, 20 – due to weather

A.2. Tagging operations

Most fishing for adult salmon used a 53’ commercial troller, F/V West Bank, but from July 23rd- August 2nd, two smaller sport fishing boats were also hired to help increase catch rates of maturing Chinook by fishing in very shallow waters along the beach off Anchor Point. Fish were captured using commercial or sport troll gear.

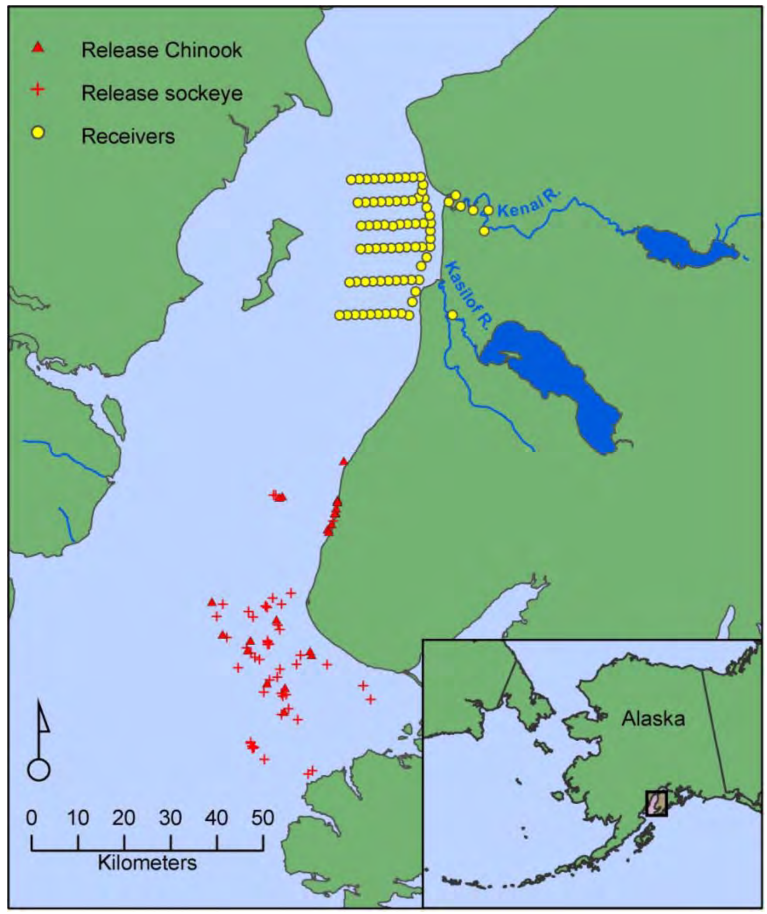

Figure A-1. **Map showing 2013 study. Red triangles show release locations; yellow dots show the location of telemetry receivers.**

Two tagging tanks were set up with independent power and controls for the recirculating pumps and aeration systems. A light sedative dose of an approved fisheries anesthetic (AQUI-S® 20E[21]) was put in the tank water to produce an average AQUI-S® 20E working concentration of 104.4 ppm for Chinook and 128.6 ppm for sockeye[22]. Because the adult Chinook and sockeye were found to be quite docile in the tagging sling once they were inverted and a hood covered their eyes, a decision was made in late July that the use of AQUI-S® 20E was unnecessary for most gastric tagging of sockeye and Chinook[23] (Table A-1). Finally, artificial fish slime (Vidalife) was introduced into the tank water and spread over tagging surfaces that would come in contact with the fish to minimize damage to the mucous layer.

We implanted acoustic tags into the abdominal cavity of the first three sockeye using surgical techniques on June 1st and 2nd, 2013 (Table A-2). However, the surgical incision tended to gape, probably due to pressure from the developing gonads on the abdominal wall. As a result, we switched to using a gastric implantation technique starting July 2nd for the majority of Chinook and sockeye that were tagged, N=25 and N=48 respectively.

Sockeye and smaller Chinook were lifted directly from the water into the tagging tank, while larger Chinook were netted and transferred using a long-handled landing net. Fish were quickly and carefully positioned upside-down in a neoprene sling. A rubber mouthpiece was then inserted into the mouth to irrigate the gills with recirculating oxygenated water. A neoprene hood was placed over the head eyes to help calm the fish. The acoustic tag was placed into a flexible PVC tube, which was inserted through the mouth and esophagus into the stomach. A plunger inside the tube was depressed to dislodge the tag, placing it in the stomach. DNA tissue samples (5-10 mm clipped from the axillary process of the pelvic fin) were then collected from every acoustically tagged salmon except one sockeye (July 10th, 2013), placed into individually labeled vials with ethanol, and given to ADF&G staff for analysis. Finally, paired numbered Petersen disc tags stating "*Return for Reward*" and listing Kintama's toll-free telephone number and email address were attached to both sides of the back using a nickel pin

[21] AQUI-S® 20E is approved under the Investigational New Animal Drug (INAD) program run by the Aquatic Animal Drug Approval Partnership (AADAP) Program.
[22] The three sockeye with tags surgically implanted were anesthetized with a heavier dose (Table A-2).
[23] Some informal experiments using incidentally-caught coho demonstrated that coho were much less docile, and strongly fought being turned on their backs and hooded; it is likely that AQUI-S® 20E would be required if a future study included coho.

run through the back musculature and between the fin rays approximately 2/3rds back from the leading edge of the dorsal fin.

Nine of the first 11 sockeye and the first two Chinook tagged were released directly into the ocean immediately following the procedure (Figure A-1; Figure A-2; Table A-3). Part way through tagging operations on July 5th, a decision was made to implement a revival tank, where fish were held in fresh, flow-through seawater until recovery from the anesthetic. Prior to, and certainly after the implementation of the revival tank, tagged fish were lively and swimming actively at the time of release.

Procedure times are summarized in Table A-4 and Table A-5, with individual times listed Table A-8.

A.3. Tagging results

A variety of data were recorded throughout the procedure:

- Date and time of capture, as well as capture coordinates.
- Capture depth (if available; Table A-5).
- Fork length (FL), and mid-eye fork length (MEFL) (Figure A-3; Table A-5).
- Sex (if determinable with confidence). Chinook: 2 male, 8 female, 15 undetermined; sockeye: 10 male, 4 female, 37 undetermined.
- Time of induction (capture time), time out of induction (Table A-8).

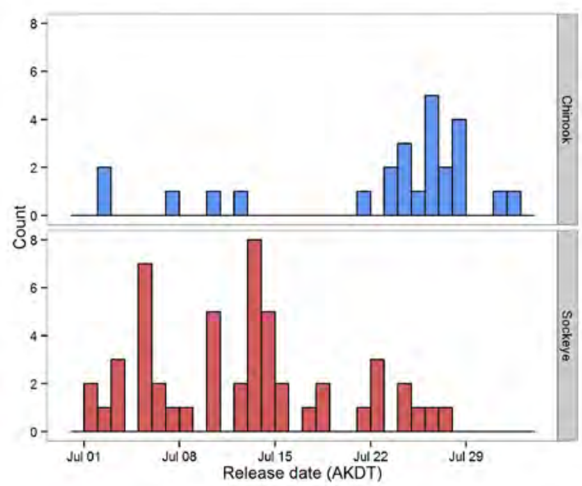

Figure A-2. Daily count of tagged Chinook and sockeye released between July 1st and August 2nd (start and end of tagging operations).

- Date and time of release, and release coordinates (Table A-3). Table A-5 provides a summary of ‘handling times’.
- Water quality in the tagging tank at the time of tagging (Table A-6).
- Observations on fish condition and disposition were also recorded if merited;
  - not fully revived (after the first few immediate releases, the revival tank was implemented as previously documented),
  - bleeding slightly from mouth (N=8; as a result of capture on fishing tackle),
  - evidence of old injuries (N=4) or fresh injury (N=1); assessed as non-detrimental to fish health and survival after tagging)

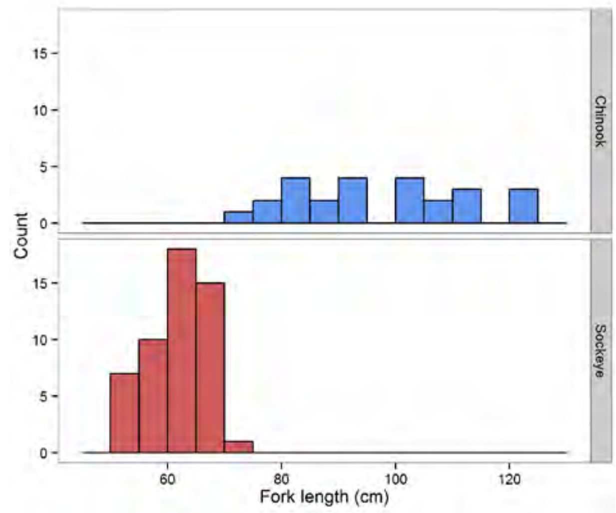

Figure A-3. **Fork length frequency histogram of tagged salmon.**

A.4. Bycatch

All bycatch was released at the side of the boat, as quickly as possible, taking care to minimize harm. Daily bycatch by species is summarized in Table A-9.

A.5. Tables

Table A-1. AQUI-S® 20E use.

	Chinook	Sockeye
Tagged with Sedative	19	47
Tagged without Sedative	6	4

Table A-2. Concentration of AQUI-S® 20E and handling particulars of the first 3 heavily anesthetized sockeye, into each of which an acoustic tag was surgically implanted.

	Duration (minutes)		
Anesthetic Concentration (ppm)	Induction	Recovery	Handling
888.9	11	209	220
733.3	12	0	12
888.9	12	87	99

Table A-3. Release locations (decimal degrees) and release date/time (AKDT)

Species	Release Latitude	Release Longitude	Local Release Date/Time
SOCKEYE	59.77399	-152.19007	01-Jul-2013 14:19
SOCKEYE	59.65341	-151.91340	01-Jul-2013 19:46
SOCKEYE	59.70971	-152.17808	02-Jul-2013 13:18
CHINOOK	59.77957	-152.23172	02-Jul-2013 17:08
CHINOOK	59.71572	-152.19422	02-Jul-2013 20:43
SOCKEYE	59.66951	-152.07198	03-Jul-2013 10:44
SOCKEYE	59.67838	-152.08681	03-Jul-2013 10:56
SOCKEYE	59.68822	-152.10248	03-Jul-2013 11:08
SOCKEYE	59.50614	-152.09827	05-Jul-2013 10:26
SOCKEYE	59.50376	-152.09778	05-Jul-2013 10:34
SOCKEYE	59.49800	-152.09290	05-Jul-2013 11:06
SOCKEYE	59.49597	-152.08532	05-Jul-2013 11:21
SOCKEYE	59.49523	-152.08655	05-Jul-2013 11:28
SOCKEYE	59.49397	-152.09120	05-Jul-2013 11:45
SOCKEYE	59.47181	-152.04746	05-Jul-2013 11:58
SOCKEYE	59.44116	-151.88194	06-Jul-2013 10:23
SOCKEYE	59.44745	-151.86515	06-Jul-2013 11:48
CHINOOK	59.74093	-151.98556	07-Jul-2013 11:18
SOCKEYE	59.79151	-151.92558	07-Jul-2013 14:16
SOCKEYE	59.77083	-151.96306	08-Jul-2013 16:16
CHINOOK	59.67132	-151.85438	10-Jul-2013 05:32
SOCKEYE	59.67115	-151.89633	10-Jul-2013 11:00
SOCKEYE	59.76512	-152.01951	10-Jul-2013 13:12
SOCKEYE	59.76854	-152.02620	10-Jul-2013 13:21
SOCKEYE	59.76817	-152.02383	10-Jul-2013 14:00
SOCKEYE	59.78338	-151.99673	10-Jul-2013 15:43
SOCKEYE	59.72186	-151.97336	12-Jul-2013 14:19
SOCKEYE	59.73019	-151.97955	12-Jul-2013 15:07
CHINOOK	59.67849	-151.85985	12-Jul-2013 23:23
SOCKEYE	59.64513	-151.97743	13-Jul-2013 12:34
SOCKEYE	59.64708	-151.98191	13-Jul-2013 12:44
SOCKEYE	59.69360	-152.02285	13-Jul-2013 14:44
SOCKEYE	59.69773	-152.02120	13-Jul-2013 17:12
SOCKEYE	59.69901	-152.02160	13-Jul-2013 17:27
SOCKEYE	59.70024	-152.02174	13-Jul-2013 17:41
SOCKEYE	59.70086	-152.02190	13-Jul-2013 17:49
SOCKEYE	59.69456	-152.01520	13-Jul-2013 18:28
SOCKEYE	59.75092	-152.21450	14-Jul-2013 11:51
SOCKEYE	59.75887	-152.09126	15-Jul-2013 12:25
SOCKEYE	59.66518	-152.05407	15-Jul-2013 13:49
SOCKEYE	59.59287	-151.96909	15-Jul-2013 15:25
SOCKEYE	59.59875	-151.97447	15-Jul-2013 15:50
SOCKEYE	59.55765	-151.97587	15-Jul-2013 16:34
SOCKEYE	59.54676	-151.91550	15-Jul-2013 17:43
SOCKEYE	59.58101	-151.63357	17-Jul-2013 14:16
SOCKEYE	59.65140	-151.79595	18-Jul-2013 10:19
SOCKEYE	59.60821	-151.65944	18-Jul-2013 12:44
SOCKEYE	59.62489	-152.01774	21-Jul-2013 21:11
CHINOOK	59.56298	-151.96630	21-Jul-2013 21:23
SOCKEYE	59.56849	-151.94892	22-Jul-2013 10:56
SOCKEYE	59.60200	-152.04226	22-Jul-2013 12:10
SOCKEYE	59.65070	-152.13770	22-Jul-2013 13:40
CHINOOK	59.60880	-151.96013	23-Jul-2013 16:45
CHINOOK	59.94458	-151.74363	23-Jul-2013 17:13
CHINOOK	59.94313	-151.74547	23-Jul-2013 17:37
SOCKEYE	59.98168	-151.97270	23-Jul-2013 18:10
SOCKEYE	59.92820	-151.75502	24-Jul-2013 07:58
CHINOOK	59.97932	-151.94828	24-Jul-2013 20:24
CHINOOK	59.97683	-151.96000	24-Jul-2013 20:40
SOCKEYE	59.62993	-151.98845	25-Jul-2013 13:30
CHINOOK	59.92222	-151.76035	25-Jul-2013 13:36
CHINOOK	59.70253	-152.08776	25-Jul-2013 17:05
CHINOOK	59.96465	-151.73493	26-Jul-2013 07:07
CHINOOK	59.95310	-151.74058	26-Jul-2013 09:20
SOCKEYE	59.59583	-151.95705	26-Jul-2013 12:08
CHINOOK	59.61868	-152.02890	26-Jul-2013 13:45
CHINOOK	59.68367	-152.09950	26-Jul-2013 15:12
SOCKEYE	59.74802	-152.07430	26-Jul-2013 16:05
CHINOOK	59.91293	-151.77321	27-Jul-2013 12:28
CHINOOK	59.96924	-151.73386	27-Jul-2013 17:36
CHINOOK	59.94375	-151.74746	28-Jul-2013 06:50
CHINOOK	59.96784	-151.73506	28-Jul-2013 08:12
CHINOOK	59.96543	-151.73484	28-Jul-2013 08:43
CHINOOK	59.91269	-151.77712	28-Jul-2013 12:35
CHINOOK	59.90810	-151.77218	31-Jul-2013 14:55
CHINOOK	60.04397	-151.70480	01-Aug-2013 07:40

Table A-4. Handling times of tagged fish that were released immediately after the tagging procedure without a recovery interval. Times reported in mm:ss.

		Chinook	Sockeye	Species Combined
Count of Tagged Fish (N)		6	9	15
After Sedation	Average	11:00	10:53	10:56
	Minimum	06:00	05:00	
	Maximum	13:00	17:00	
Count of Tagged Fish (N)		6	4	10
No Sedation	Average	10:30	07:00	09:06
	Minimum	07:00	05:00	
	Maximum	20:00	10:00	

Table A-5. The duration of each stage of the tagging procedure, broken down by species, and troll method. Times reported in mm:ss

		Chinook			Sockeye			Species Combined		
		Commercial	Sport	Combined	Commercial	Sport	Combined	Commercial	Sport	Combined
Count of Fish Tagged (N)		7	12	19	43	1	44	50	13	63
Induction Duration	Average	06:43	08:55	**08:04**	07:59	05:00	**07:55**	07:48	08:37	**07:58**
	Minimum	04:00	04:00		03:00	N/A		03:00	04:00	
	Maximum	10:00	13:00		25:00	N/A		25:00	13:00	
Recovery Duration	Average	04:43	02:45	**03:28**	06:25	03:00	**06:20**	06:11	02:46	**05:31**
	Minimum	00:00	00:00		00:00	N/A		00:00	00:00	
	Maximum	11:00	07:00		34:00	N/A		34:00	07:00	
Handling Duration	Average	11:26	11:40	**11:35**	14:24	08:00	**14:15**	13:16	11:23	**13:27**
	Minimum	06:00	05:00		05:00	N/A		05:00	05:00	
	Maximum	17:00	18:00		40:00	N/A		40:00	18:00	

*Excluding fish tagged without using anesthetic; excluding first 3 surgically implanted sockeye.

Table A-6. Water quality conditions during tagging.

		Chinook	Sockeye
Sedative Concentration (ppm)*	Average	104.4	128.6
	Minimum	66.7	88.3
	Maximum	183.3	133.3
Water Temp (°C)	Average	11.8	9.3
	Minimum	9.0	6.5
	Maximum	15.0	11.5
Dissolved Oxygen (ppm)	Average	11.5	10.6
	Minimum	9.0	8.2
	Maximum	12.3	12.6

***Excluding the first 3 sockeye surgically implanted using a heavy sedative dose. Also excludes fish tagged without sedative (Chinook, N=19; Sockeye, N=44).**

Table A-7. Capture statistics by the capture vessel/method. All fish caught using the sport fishing vessels were captured in shallow, nearshore waters. Capture depth of sockeye caught by commercial troll calculated on N=44.

		Chinook			Sockeye		
		Commercial	Sport	Combined	Commercial	Sport	Combined
Count of Tagged Fish (N)		12	13	25	50	1	51
FL (mm)	Average	853	1075	968	612	622	612
	Minimum	700	860		503	N/A	
	Maximum	1040	1230		710	N/A	
MEFL (mm)	Average	764.6	960.8	866.6	561	565	561.2
	Minimum	620	790		456	N/A	
	Maximum	940	1040		650	N/A	
Capture Depth (m)	Average	18.7	3.5	10.8	10.9	2.7	10.7
	Minimum	11	1.8		3.7	N/A	
	Maximum	29.3	4.9		25.6	N/A	

Table A-8. Induction, recovery, and retention durations for tagged individuals. Times reported in h:mm.

Species	Induction Duration	Recovery Duration	Overall Handling Duration	Species	Induction Duration	Recovery Duration	Overall Handling Duration
SOCKEYE	0:11	3:29	3:40	SOCKEYE	0:25	0:05	0:30
SOCKEYE	0:12	0:00	0:12	SOCKEYE	0:08	0:26	0:34
SOCKEYE	0:12	1:27	1:39	SOCKEYE	0:06	0:07	0:13
CHINOOK	0:11	0:00	0:11	SOCKEYE	0:05	0:05	0:10
CHINOOK	0:06	0:00	0:06	SOCKEYE	0:08	0:04	0:12
SOCKEYE	0:05	0:00	0:05	SOCKEYE	0:07	0:12	0:19
SOCKEYE	0:11	0:00	0:11	SOCKEYE	0:04	0:10	0:14
SOCKEYE	0:09	0:00	0:09	SOCKEYE	0:10	0:09	0:19
SOCKEYE	0:08	0:00	0:08	SOCKEYE	0:05	0:08	0:13
SOCKEYE	0:16	0:00	0:16	SOCKEYE	0:12	0:09	0:21
SOCKEYE	0:06	0:00	0:06	CHINOOK	0:04	0:03	0:07
SOCKEYE	0:14	0:00	0:14	SOCKEYE	0:05	0:16	0:21
SOCKEYE	0:17	0:00	0:17	SOCKEYE	0:04	0:08	0:12
SOCKEYE	0:06	0:06	0:12	SOCKEYE	0:06	0:04	0:10
SOCKEYE	0:10	0:05	0:15	CHINOOK	0:04	0:11	0:15
SOCKEYE	0:06	0:02	0:08	CHINOOK	0:13	0:05	0:18
SOCKEYE	0:08	0:02	0:10	CHINOOK	0:10	0:07	0:17
CHINOOK	0:06	0:03	0:09	SOCKEYE	N/A	0:00	0:10
SOCKEYE	0:05	0:04	0:09	SOCKEYE	0:05	0:03	0:08
SOCKEYE	0:08	0:04	0:12	CHINOOK	N/A	0:00	0:09
CHINOOK	0:10	0:07	0:17	CHINOOK	N/A	0:00	0:08
SOCKEYE	0:10	0:04	0:14	SOCKEYE	N/A	0:00	0:05
SOCKEYE	0:08	0:04	0:12	CHINOOK	0:10	0:06	0:16
SOCKEYE	0:07	0:05	0:12	CHINOOK	N/A	0:00	0:10
SOCKEYE	0:07	0:03	0:10	CHINOOK	0:06	0:03	0:09
SOCKEYE	0:05	0:05	0:10	CHINOOK	0:06	0:05	0:11
SOCKEYE	0:12	0:03	0:15	SOCKEYE	N/A	0:00	0:08
SOCKEYE	0:05	0:12	0:17	CHINOOK	N/A	0:00	0:09
CHINOOK	0:06	0:09	0:15	CHINOOK	N/A	0:00	0:07
SOCKEYE	0:08	0:07	0:15	SOCKEYE	N/A	0:00	0:05
SOCKEYE	0:09	0:05	0:14	CHINOOK	0:04	0:01	0:05
SOCKEYE	0:06	0:03	0:09	CHINOOK	0:05	0:01	0:06
SOCKEYE	0:03	0:03	0:06	CHINOOK	0:04	0:05	0:09
SOCKEYE	0:04	0:05	0:09	CHINOOK	0:13	0:00	0:13
SOCKEYE	0:09	0:08	0:17	CHINOOK	0:13	0:00	0:13
SOCKEYE	0:06	0:34	0:40	CHINOOK	0:13	0:00	0:13
SOCKEYE	0:06	0:17	0:23	CHINOOK	N/A	0:00	0:20
SOCKEYE	0:04	0:12	0:16	CHINOOK	0:10	0:00	0:10

N/A in the 'Induction Duration' column indicates that NO anesthetic (AQUI-S® 20E) was used

Table A-9. Bycatch recorded and released.

	SPECIES													
	SOCKEYE (UNTAGGED)	SOCKEYE (UNFIT)	IMMATURE CHINOOK	MATURE CHK <400mm	COHO	PINK	CHUM	HALIBUT	PACIFIC COD	WALLEYE POLLOCK	DOLLY VARDON	IRISH LORD	GREENLING	VESSEL
29-Jun-13			1						2	3				F/V WEST BANK
30-Jun-13	1	1				1		21						F/V WEST BANK
01-Jul-13	1	2						9						F/V WEST BANK
02-Jul-13	3					2		30						F/V WEST BANK
03-Jul-13	2	1				1	1	17						F/V WEST BANK
04-Jul-13						1		19		1	1			F/V WEST BANK
05-Jul-13	7	3	3		5	17	6	18						F/V WEST BANK
06-Jul-13	2		4		6	5		1	3	5				F/V WEST BANK
07-Jul-13			2			1		18	1	2				F/V WEST BANK
08-Jul-13			2		2	1		13						F/V WEST BANK
09-Jul-13														F/V WEST BANK
10-Jul-13	1	1	1		7	9		27	5		1			F/V WEST BANK
11-Jul-13								4						F/V WEST BANK
12-Jul-13		2	1		1	2		10	2					F/V WEST BANK
13-Jul-13	11	1	2					23						F/V WEST BANK
14-Jul-13						5	3	3						F/V WEST BANK
15-Jul-13		7			2	14	3	22		3				F/V WEST BANK
16-Jul-13														F/V WEST BANK
17-Jul-13			2			2	4			4				F/V WEST BANK
18-Jul-13		2			2	5		3		2				F/V WEST BANK
19-Jul-13														F/V WEST BANK
20-Jul-13														F/V WEST BANK
21-Jul-13					1	21		15		5	1			F/V WEST BANK
22-Jul-13			2			17	2							F/V WEST BANK
23-Jul-13		2	1		4	60		9				1		COMBINED (ALL 3 VESSELS)
24-Jul-13			3		2	20		3			1	1	1	COMBINED (ALL 3 VESSELS)
25-Jul-13			1		2	15	1	11	1		1			COMBINED (ALL 3 VESSELS)
26-Jul-13			1		2	12		12		1				COMBINED (ALL 3 VESSELS)
27-Jul-13			2		3			12					1	COMBINED (ALL 3 VESSELS)
28-Jul-13						1		14						COMBINED (ALL 3 VESSELS)
29-Jul-13														M/V REFLECTIONS & SERENITY
30-Jul-13														M/V REFLECTIONS & SERENITY
31-Jul-13														M/V REFLECTIONS & SERENITY
01-Aug-13														M/V REFLECTIONS & SERENITY
02-Aug-13														M/V REFLECTIONS & SERENITY
TOTALS	**28**	**22**	**28**	**0**	**39**	**212**	**20**	**314**	**14**	**26**	**5**	**2**	**2**	

B. Detections Data Screening

Prior to analysis, we screen the data to identify 1) false detections; 2) single transmissions that were recorded on more than one receiver; 3) the date of displacement for receivers that were pulled from position (likely by fishing activities) and returned to us by the public; and 4) fish that were likely not of Kenai River origin.

B.1. Clock-drift correction

VEMCO submerged receivers rely on crystal oscillators to keep track of time. Due to manufacturing variations, the frequency of the crystal oscillators varies slightly between receivers. Over time, the clock drifts and loses or gains time. A receiver may drift up to 4 seconds per day. Some of the time drift is due to changes in temperature, however, the majority of the drift is due to the variations in the oscillator. Therefore, the drift is highly linear and can be corrected (http://vemco.com/wp-content/uploads/2013/10/vue_manual.pdf).

We corrected the receivers for clock drift using the automatic correction function in VEMCO's VUE software.

B.2. False detection screening

We identified and excluded any detection likely to be false (as a result of aliasing or tag collisions) using the First and Second Acceptance Criteria recommended by VEMCO (Pincock 2008; see http://www.vemco.com/pdf/false_detections.pdf) with a modification to the Second Criteria. Detections met the first criteria if there was at least one short interval (<0.5 hour) between successive detections of an ID code on a receiver and if there were more short intervals (<0.5 hour) between detections than long ones (>0.5 hour). Detections not meeting the first criteria were then examined individually (second criteria) to determine if they were supported by detections on other sub-arrays in a temporally logical sequence (including release) along the migratory path and if they were recorded when the probability of collision between multiple tags was low (i.e., at times when there was a silent interval of >5 minutes on at least one side of the detection in question). VEMCO acoustic tags generally have a very low false positive rate: we identified four of 24573 detections as false.

B.3. Duplicate detections

The VEMCO V16 acoustic tags we used in the Cook Inlet study in 2013 are powerful and a single transmission was occasionally detected by more than one receiver. We removed these duplicates from the marine detections.

We used the following criteria to identify duplicate detections:

1) the tag numbers must match;
2) the depth measurements must match;
3) the receiver serial numbers must be different; and
4) the detections must be recorded within the minimum transmission interval of the tag (<15 s).

This screen identified 205 duplicate detections.

B.4. Last date of valid detection screening

When receivers are accidentally displaced from their deployment position (usually by fishing activity), they are sometimes returned to Kintama by members of the public. We are usually able to download the data from these units; however, we do not always know the date and time they were displaced. Fishing crews are often able to provide dates when units were caught in their nets, providing us with accurate displacement dates, but receivers found floating or washed ashore may have been displaced much earlier.

When the date of displacement is not available, we estimate it by comparing the date and time of each tag ID logged with the date and time of the same tag ID on neighboring units that remained in position throughout the study period. The last date with a difference of less than one hour between tag detections on neighboring receivers is accepted as the last date of valid detection, and otherwise valid detections recorded for later dates are excluded from any analysis that is sensitive to receiver position. This process can only be used for receivers that have data (empty units cannot be screened) and that have neighboring units that also recorded detections.

In 2013, there were 4 receivers returned to Kintama by members of the public. From these, we identified 35 detections of 4 individual fish as being recorded after the receiver was displaced.

B.5. Stock of origin screening

This study focuses on Chinook and sockeye from the Kenai and Kasilof rivers; however, fish were captured at sea and we do not know the stock of origin. Tissue samples were collected from each acoustic-tagged fish for genetic stock analysis, but results were not conclusive for Chinook, and were not yet available for sockeye at the time of writing. Prior to the start of our study, it was assumed that most fish captured in lower Cook Inlet in 2013 would return to the Kenai or Kasilof rivers, similar to 2012. However, there is now some evidence that fish from other stocks were included in our sample (see Discussion). These fish were unlikely to be detected by the acoustic array and would appear to be mortalities.

To partially address this concern, we removed fish from the analyses (n=2 Chinook; n=3 sockeye) that were recovered south of the release site; however, we could only remove individuals whose tags were returned in the fishery. To further focus the results on the Kenai River, we also removed the one sockeye that was detected in the Kasilof River. Removal of the Kasilof sockeye was particularly important for the survival analysis because the detection probability of the single detection site in the Kasilof River was unknown.

We removed 6 fish:

1) 1 Chinook caught in the Columbia River;
2) 1 Chinook caught near Seldovia;
3) 1 sockeye caught near Seldovia;
4) 1 sockeye caught near Kodiak Island;
5) 1 sockeye caught in Kachemak Bay; and
6) 1 sockeye caught in the Kasilof River.

B.6. Failed depth sensors

All depth measurements for three tags read 2.5 m above the water surface, indicating that the pressure sensors were broken:

1) 9563 was a Chinook detected 1529 times between Aug 2nd and 9th;

2) 9572 was a Chinook detected 95 times between Aug 2nd and 6th; and

3) 9501 was a sockeye detected 15 times over 1.5 hours on July 19th.

Acoustic tag 9501 was returned by the fishery and VEMCO confirmed that the sensor had failed. We removed all three of these fish from the depth analysis.

VEMCO reports that the pressure sensors used in this study are their most reliable model and they have had no previous failures reported from the field. That we had 3 of these sensors fail out of 76 tags (39 with detections) is a cause for concern. Both Kintama and VEMCO are running various assessments using additional tags. In particular, Kintama has deployed multiple tags at the mean migration depths of the Chinook and sockeye measured in this study to evaluate their accuracy and precision. These results were not complete at the time this report was prepared.

C. Data Analysis

C.1. Distribution on marine array

To identify possible migratory pathways within Cook Inlet, we plotted the number of fish that were detected at each receiver on each of the six east-west lines deployed in the marine array. We also assessed the distribution of fish detected entering the ESSN by plotting fish counts at each receiver along the eastern boundary of the marine array. Because individual fish are usually heard at more than one receiver on a line, we allocated a proportion of each fish to each of the receivers on which it was detected (i.e., if a fish was heard once at each of three positions, each unit was allocated 0.33 of a fish).

C.2. Vertical distributions on entry to the ESSN fishing district

We assessed the vertical distributions of Chinook and sockeye on entry to the ESSN and in relation to daylight and stage of tide. Entry to the ESSN was represented by all detections recorded on the north-south line of receivers bounding the western edge of the ESSN district (and the eastern edge of the marine array). Note that fish detected at this boundary may not actually be 'entering' the ESSN at the detection site; they may be anywhere within detection range of these receivers (~700 m) either inside or outside the ESSN fishing district.

We classified detections as occurring during day or night using the sunrise and sunset times specific to the day they were recorded. Sunrise/sunset times were obtained for at the Kenai Municipal Airport using the calculator provided by Horizon Network Security (http://www.cmpsolv.com/cgi-bin/sunset?page=bob&exper=new97&loctype=City&loc=Kenai%2C+AK&date=28%2F06%2F2013&tz=Zulu&tzcustom=&q=d2&aviation=yes&astro=yes&colors=white&datefmt=3). We defined 'day' as the interval between sunrise and sunset, and 'night' as the interval between sunset and sunrise.

We obtained estimates of tide level at the Kenai River Mouth from Nobeltec software Tides and Currents Professional version 3.5.107. The tidal data were for the interval between July 1st and August 20th which corresponds to the release of the first acoustic-tagged fish and the last detection on the marine array. They were reported with a 30 minute resolution and relative to the Mean Lower Low Water datum. Each detection was associated with the tide level predicted closest to the time the detection was recorded. We defined 'low' tides as tides ≤ the 20th percentile of tide heights (≤ 1.4 m), ‘high’ tides as tides $\geq$ the 80th percentile of tide heights ($\geq$ 5.4 m), and intermediate tides as tides between the 20th and 80th percentiles.

Because the number of depth measurements varied by individual fish, there was the possibility that unique behaviour by one or a few individuals who were detected frequently could bias the results. Accordingly, we present the depth distributions data for each species in two ways: 1) with depth transmissions as the unit of replication, and 2) with individual fish as the unit of replication. In the first approach, we simply summarized all the depth transmissions by species regardless from which fish they originated. In the second approach, we allocated a proportion of each fish to each of its depth transmissions (i.e., if a fish was detected 100 times, each detection was weighted as 0.01). Thus, the total number of detections for each individual summed to one. Using the fish as the unit of replication in this manner reduced the influence of individuals with high detection counts, but in exchange, individuals for which we have little information were weighted the same as those whose depth distributions are well known.

To further investigate the influence of individual animals on the cumulative depth distributions, we calculated the jackknife distribution for the *m* fish of each species that were detected by resampling the data *m* times while successively leaving out all the detections from one individual fish. We then calculated the mean, minimum, and maximum values at each depth across these resampled cumulative distributions.

There was little difference in results between the methods where the unit of replication was 1) the detection, or 2) the fish. For simplicity, the main report body presents results based on detections. Results based on individual fish are included in Appendix D.

C.3. Entry patterns into the ESSN fishing district in relation to time of day, tide stage, and wind velocity

We assessed if entry of tagged Chinook and sockeye to the ESSN was related to time of day, tide stage, or wind velocity (wind speed and direction). We did not assess if entry to the ESSN was related to date (as specified in the RFP) because date was confounded by release timing after tagging (Figure E-1) and, therefore, reflects both run-timing and our fishing schedule rather than a variable that can be used to inform fishery management.

Entry to the ESSN was represented by all detections recorded on the north-south line of receivers bounding the western edge of the ESSN district (and the eastern edge of the marine array). Note that fish detected at this boundary may not actually be ‘entering’ the ESSN at the detection site; they may be anywhere within detection range of these receivers (~700 m) either inside or outside the ESSN fishing district.

Sources for sunrise/sunset times and tide levels are provided in section C.2. We defined ‘day’ as the interval between sunrise and sunset, and ‘night’ as the interval between sunset and sunrise. We defined ‘low’ tides as tides ≤ the 20th percentile of tide heights (≤ 1.4 m), ‘high’ tides as tides ≥ the 80th percentile of tide heights (≥ 5.4 m), and intermediate tides as tides between the 20th and 80th percentiles. We further defined ebb, slack, and flood tides defied based on whether the tide height predicted for the Kenai River mouth was lower, equal, or higher than in the preceding half hour, respectively (tides were predicted at ½ hour intervals).

We used hourly wind speed and direction measurements for the NOAA meteorological station at Nikiski (Station number: 09455760) to represent wind conditions at the western boundary of the ESSN fishing district (http://tidesandcurrents.noaa.gov/met.html?id=9455760). Each detection was associated with the wind speed and direction measurements recorded closest to the time the detection was recorded.

Because the number of detections varied by individual fish, there was the possibility that unique behaviour by one or a few individuals who were detected frequently could bias the results. Accordingly, we assessed entry to the ESSN for each species in two ways: 1) with each detection the unit of replication, and 2) with individual fish as the unit of replication. In the first approach, we simply summarized (by species) the environmental conditions occurring when each detection was recorded regardless of the fish from which it originated. In the second approach, we allocated a proportion of each fish to each of its detections (i.e., if a fish was detected 100 times, the environmental conditions occurring when the detection was recorded were weighted as 0.01). Thus, the total number of detections for each individual summed to one. Using the fish as the unit of replication in this manner reduced the influence of individuals with high detection counts, but in exchange, individuals for which we have little information were weighted the same as those whose depth distributions are well known.

There was little difference in results between the methods where the unit of replication was 1) the detection, or 2) the fish. Results from both methods are included in Appendix E.

C.4. Travel times and rates

Travel time (days) was calculated for each fish from release until first detection on the marine array, from this first detection on the marine array until arrival at the Kenai River Mouth at RKm 2 (Snug Harbor), and from arrival at one detection site until arrival at the next for all sites in the Kenai River (RKms 2, 4.5, 8.2, 13.8, 22, 25.3, and 30.6). These estimates could only be made for fish detected at both detection sites bracketing the segment in question. Arrival was defined as the first detection at each detection site.

Travel rate was calculated for each fish as follows:

$$Travel\ rate = \frac{Distance}{Travel\ time}.$$

For this equation, distance was measured for each fish along the shortest route in water. We present travel rates in both kilometers/day and body lengths/second (BL/sec). We used fork length at tagging as the body length measure.

C.5. Migration rates in relation to tagging date and fish length

Travel rates were calculated as described in section C.4. Fish length (fork length) and tag date were recorded at time of tagging.

C.6. Milling behavior of Chinook and sockeye salmon in the Kenai River estuary in relation to tidal fluctuations

We used the three detection sites at or below the Kenai River Bridge (RKms 2, 4.5, and 8.2) to investigate the influence of tidal fluctuations on milling behaviour in the Kenai River estuary. Estimates of tide level at the Kenai River Mouth were from Nobeltec software Tides and Currents Professional version 3.5.107. These data were reported with a 30 minute resolution and relative to the Mean Lower Low Water datum. We defined ‘milling’ in the following ways:

1. a gap in the detection sequence at a single detection site of >1 hour; or
2. detection at a detection site upstream followed by detection at a site downstream.

For each fish that displayed milling behaviour, we plotted its detection sequence overlaid with the time series of tide levels.

C.7. Survival analysis

Estimates of survival and detection probabilities were calculated using the Cormack-Jolly-Seber[24] (CJS) model for live-recaptured animals implemented with Program MARK (White and Burnham 1999) through the R[25] package RMark[26]. This model estimates survival (ϕ) and detection probabilities (p) within a likelihood framework.

The survival estimates are termed “apparent survival” and represent the joint probability of migration to the Kenai River and survival through each segment of the array. Any fish that did not migrate to the Kenai River were counted as mortalities. For simplicity, we have abbreviated “apparent survival” as “survival”.

We estimated survival for acoustic-tagged Chinook and sockeye in two segments of their migration: 1) between release and arrival at the marine acoustic array at line 159.0 (Figure 1), and 2) from there until arrival at the Kenai River mouth. Fish were considered to have survived to reach line 159 if they were detected anywhere on the marine array. They were then considered to have survived to reach the Kenai River Mouth if they were detected at either of the receivers deployed at RKms 2 or 4. Detections upstream were used to estimate the detection probability at the River Mouth.

The method of using the entire marine array to represent detection at line 159 has the potential to bias the survival estimates if fish swam over a portion of the marine array undetected and died before reaching the river mouth. In this case, the mortality would appear to have occurred between release and line 159 rather than in the next segment over the marine array. We used a more complex CJS model[27] to

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[24] 1) Cormack RM (1964) Estimates of survival from the sighting of marked animals. Biometrika 51:429-438
2) Jolly GM (1965) Explicit estimates from capture-recapture data with both death and immigration- Stochastic model. Biometrika 52:225-247
3) Seber GAF (1965) A note on the multiple recapture census. Biometrika 52:249-259

[25] R Core Team (2013). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL http://www.R-project.org/.

[26] Laake, J.L. (2013). RMark: An R Interface for Analysis of Capture-Recapture Data with MARK. AFSC Processed Rep 2013-01, 25p. Alaska Fish. Sci. Cent., NOAA, Natl. Mar. Fish. Serv., 7600 Sand Point Way NE, Seattle WA 98115.

[27] We added a digit to the capture history sequence by dividing the marine array into 2 segments: 1) line 159 represented arrival at the marine acoustic array because it formed the southern edge of the grid; and 2) the rest of the marine receivers

investigate this possible source of bias: the survival estimates for Chinook were unchanged and the survival estimates for sockeye were increased by only 3% which is well within 1 standard error.

We estimated cumulative survival from release to the Kenai River mouth as the product of the two segment estimates. Because detection probability was 100% at the River mouth (i.e., all fish detected upstream were also detected at the Mouth), we calculated the standard error of the cumulative survival estimates as the standard error of a proportion[28].

$$Standard\ error = \sqrt{\frac{Survival(1 - Survival)}{Number\ released}}.$$

were combined and used to boost the number of fish detected beyond line 159. Given the study design, this method provided the largest possible sample size to estimate detection probability and survival to line 159.

[28] When detection probability is 100%, the CJS model returns the same results as the following expression:

$$Survival = \frac{Number\ detected}{Number\ released}$$

D. Sections 2.5 Depth distributions near the ESSN; and 2.6 Effect of tides and time of day on depth distributions near the ESSN–Supplementary

Because the number of depth measurements varied by individual fish, it was possible that unique behavior by one or a few individuals who were detected frequently could bias the results. To investigate this prospect, we present the depth distributions data for each species in two ways: 1) with depth transmissions as the unit of replication, and 2) with individual fish as the unit of replication. In the first approach, we summarized all the depth transmissions by species regardless from which fish they originated. In the second approach, we allocated a proportion of each fish to each of its depth transmissions (i.e., if a fish was detected 100 times, each depth measurement was weighted as 0.01). Because the results were similar between the two methods, we reported only the results based on detections in the main report body. This appendix presents the results based on individual fish.

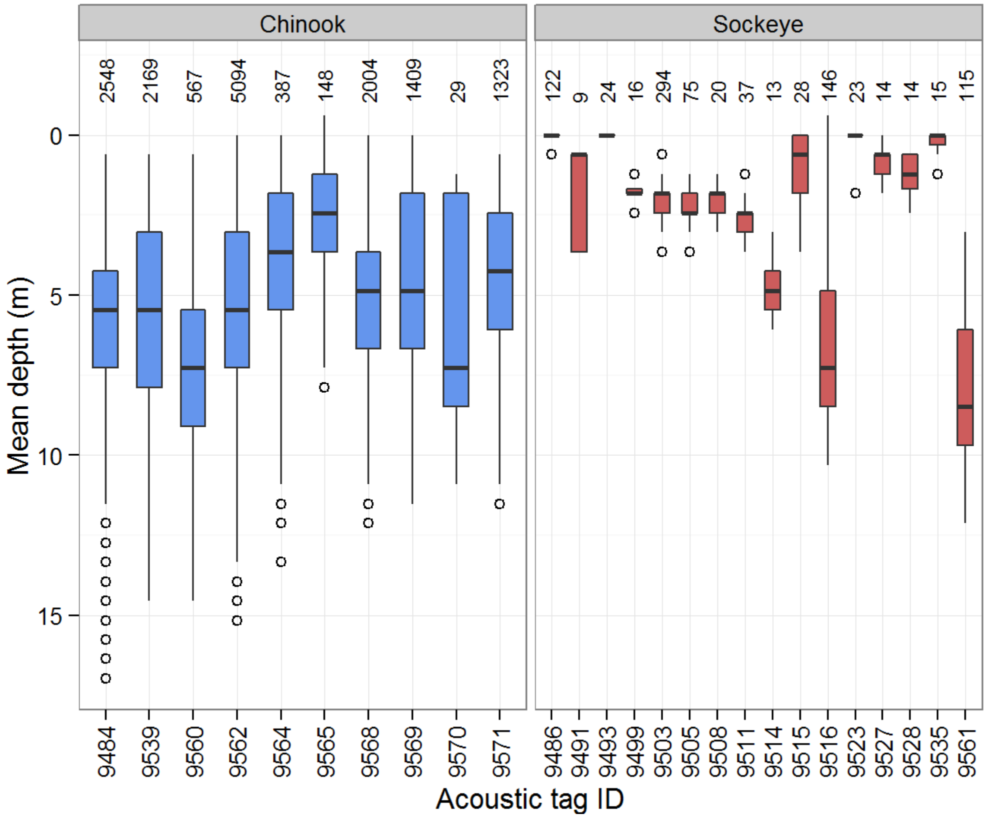

Figure D-1. Depth distribution (m) of individual adult sockeye and Chinook salmon migrating over the row of acoustic receivers bordering the western edge of the ESSN fishery. Numbers along the top of the plots are the sample size. The top and bottom of each box are the 25th and 75th percentiles, the central band is the median, and the whiskers extend to the minimum and maximum values exclusive of outliers which are shown as circles.

KINTAMA

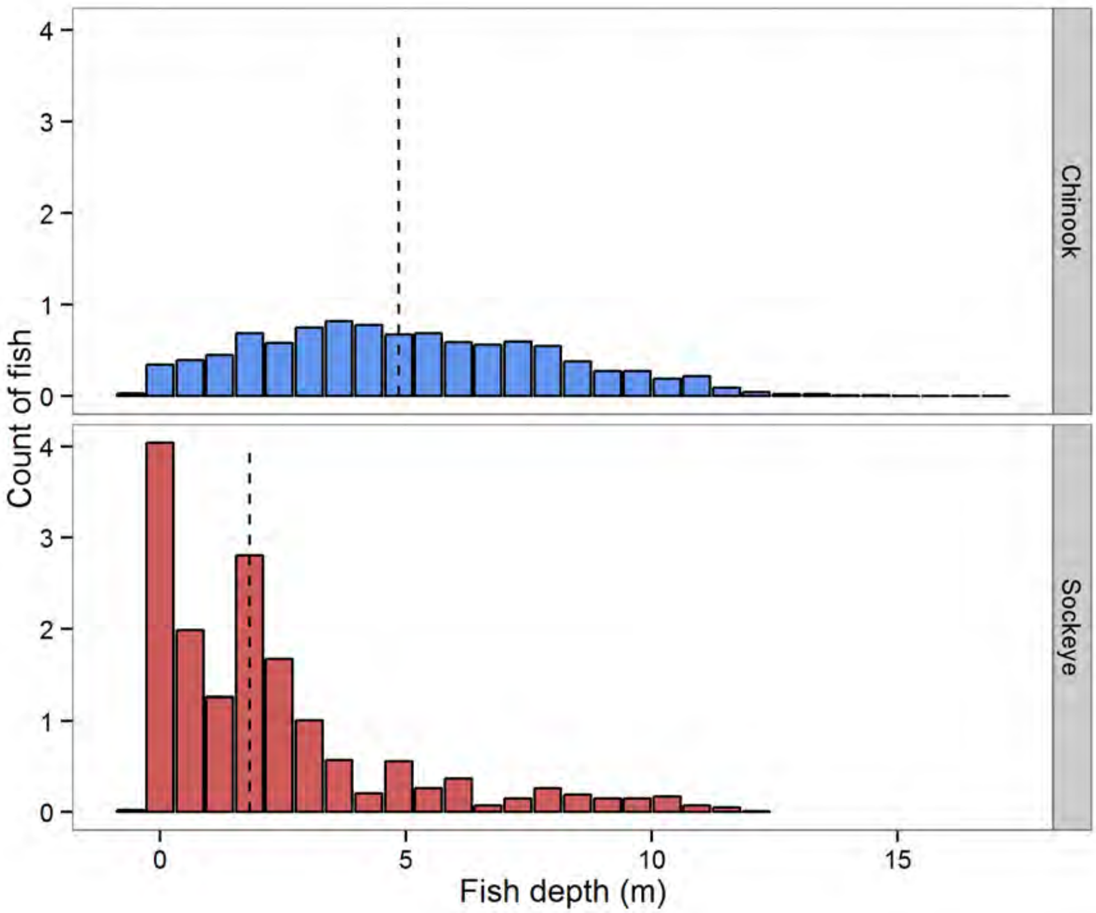

Figure D-2. Depth distribution (m) of adult sockeye and Chinook salmon migrating over the row of acoustic receivers bordering the western edge of the ESSN fishery. Distributions were calculated by weighting each depth measurement by the number of depth measurements recorded by each individual fish (i.e., if a fish was detected 100 times, each depth measurement was weighted as 0.01). The vertical lines show the median depth.

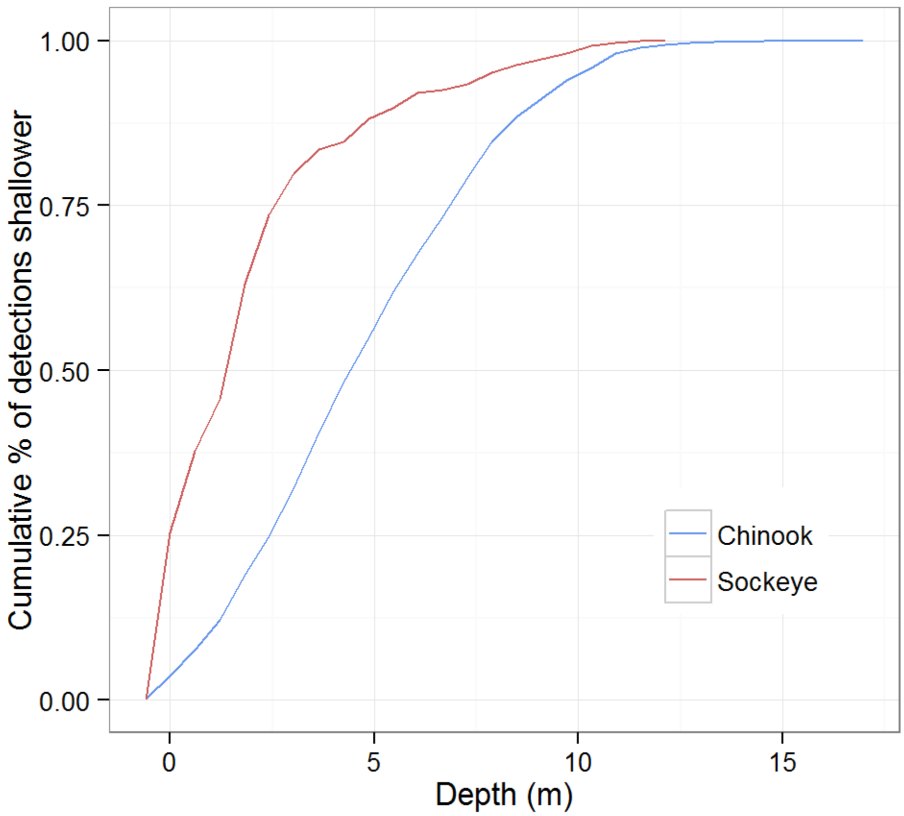

Figure D-3. Cumulative depth distribution of tagged sockeye (red) and Chinook (blue) near the western boundary of the ESSN. Distributions were calculated by weighting each depth measurement by the number of depth measurements recorded by each individual fish (i.e., if a fish was detected 100 times, each depth measurement was weighted as 0.01).

Table D-1. Cumulative depth distribution of tagged sockeye and Chinook near the western boundary of the ESSN fishing district. Distributions were calculated by weighting each depth measurement by the number of depth measurements recorded by each individual fish (i.e., if a fish was detected 100 times, each depth measurement was weighted as 0.01).

Depth (m)	Cumulative percent of detections shallower	
	Chinook	Sockeye
1	8%	38%
2	19%	63%
3	25%	74%
4	41%	83%
5	55%	88%
6	62%	90%
7	73%	93%
8	85%	95%
9	89%	96%
10	94%	98%

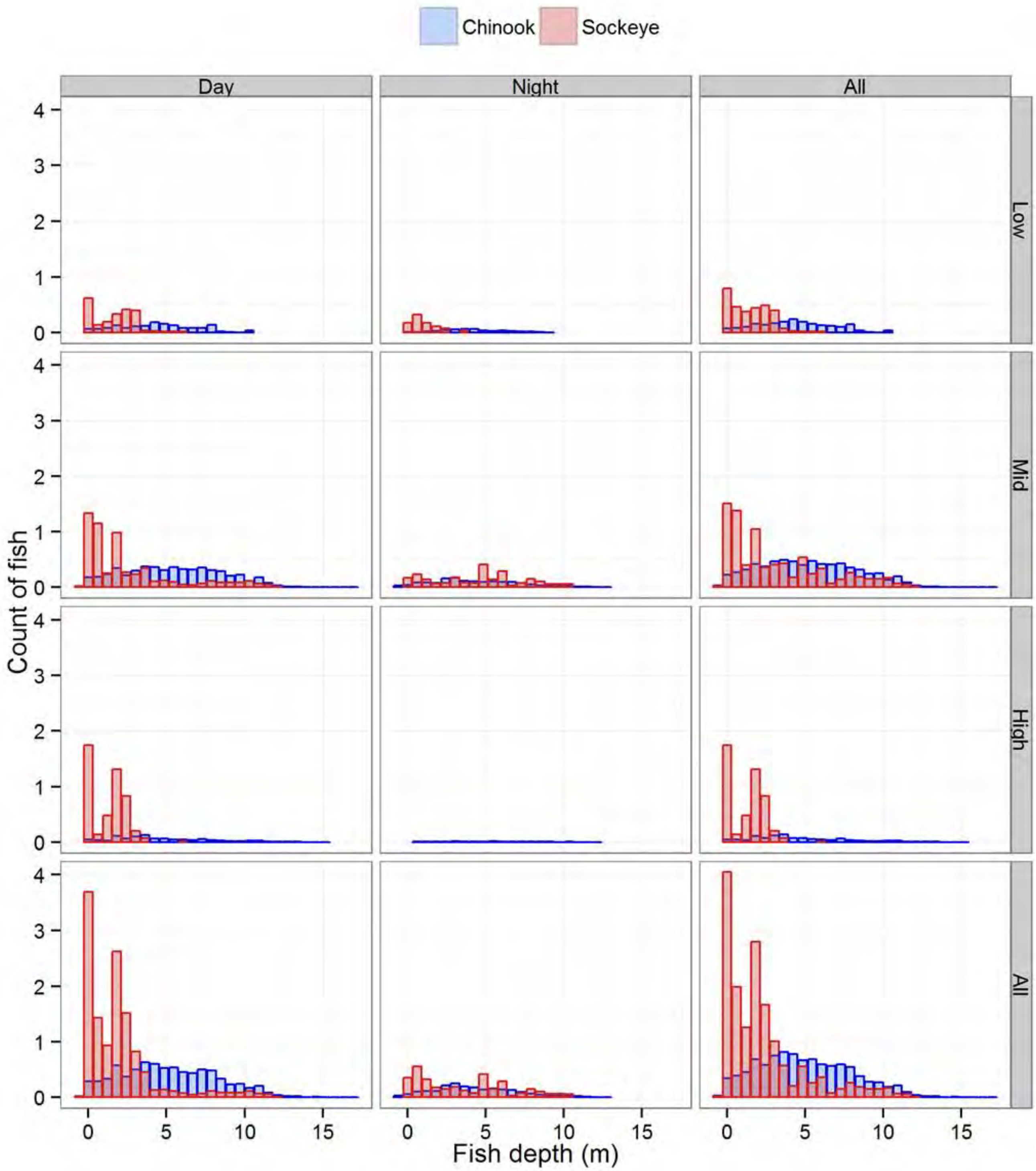

Figure D-4. Depth distributions (m) histograms of adult sockeye and Chinook salmon along the western edge of the ESSN fishing zone. Distributions were calculated by weighting each depth measurement by the number of depth measurements recorded by each individual fish (i.e., if a fish was detected 100 times, each depth measurement was weighted as 0.01).

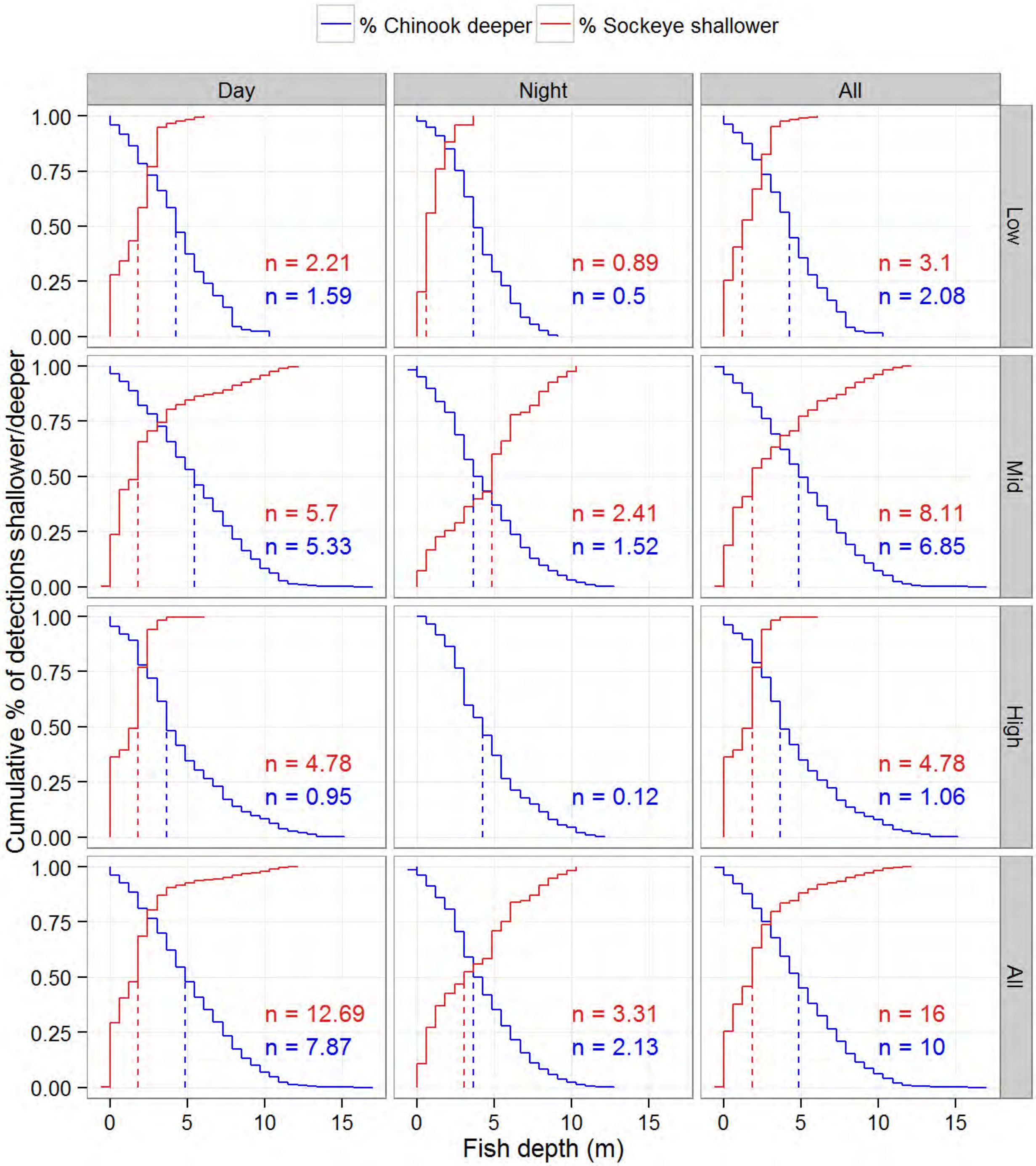

Figure D-5. Cumulative depth distributions (m) of adult sockeye and Chinook along the western edge of the ESSN fishing district; n: sample size. Distributions show the proportion of time sockeye spent shallower than a given depth and the proportion of time Chinook spent deeper than a given depth. Distributions were calculated by weighting each depth measurement by the number of depth measurements recorded by each individual fish (i.e., if a fish was detected 100 times, each depth measurement was weighted as 0.01).

E. Section 2.7 Entry patterns into the ESSN and Kenai River in relation to time of day, tide stage, and wind velocity—Supplementary

This appendix presents supplementary figures for the investigation into the effects of environmental conditions on entry to the ESSN fishing district. “Entry” to the ESSN was represented by all detections by all detections recorded on the north-south line of receivers bounding the western edge of the ESSN district (and the eastern edge of the marine array). Note that fish detected at this boundary may not actually be ‘entering’ the ESSN at the detection site; they may be anywhere within detection range of these receivers (~700 m) either inside or outside the ESSN fishing district.

Several of the figures in this appendix are presented twice using 1) the detection as the unit of replication and 2) the fish as the unit of replication. In the first approach, we simply summarized the environmental conditions by species when each detection was recorded. In the second approach, we allocated a proportion of each fish to each of its depth transmissions (i.e., if a fish was detected 100 times, the environmental condition when each detection was recorded were weighted as 0.01). Thus, the total number of detections for each individual summed to one. Using the fish as the unit of replication in this manner reduced the influence of individuals with high detection counts, but in exchange, individuals for which we have little information were weighted the same as those whose distributions are well known.

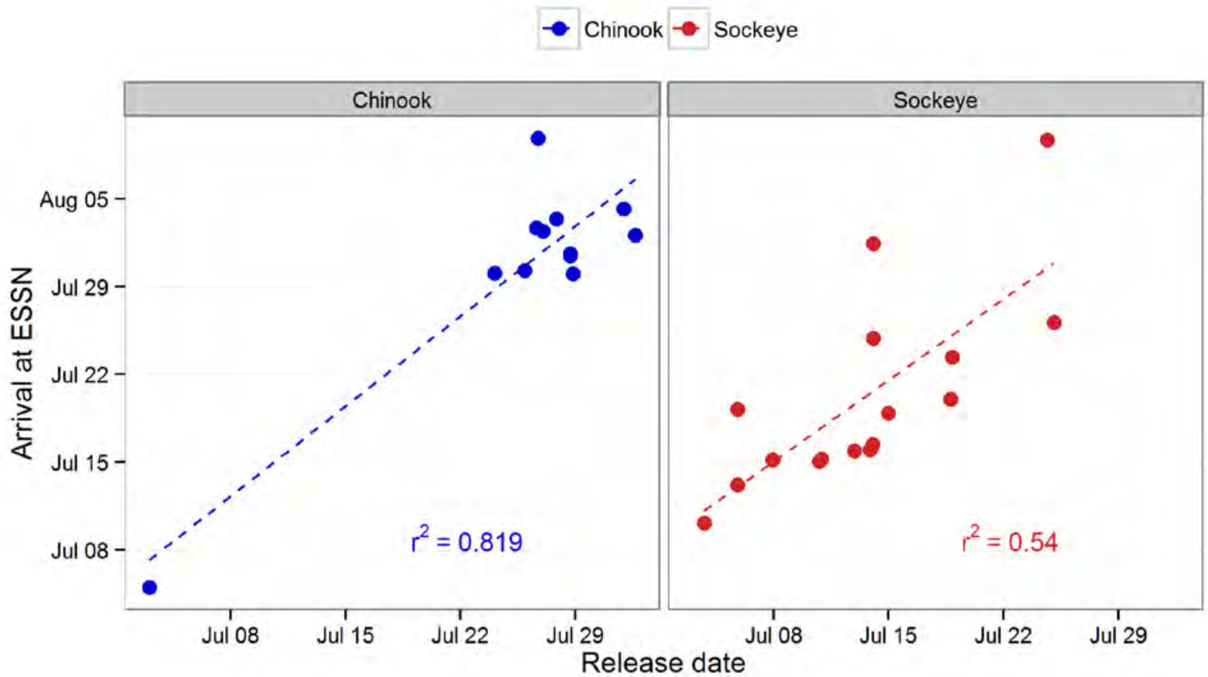

Figure E-1. Relationship between release date and arrival of tagged adult sockeye and Chinook salmon at the western boundary of the ESSN fishing district.

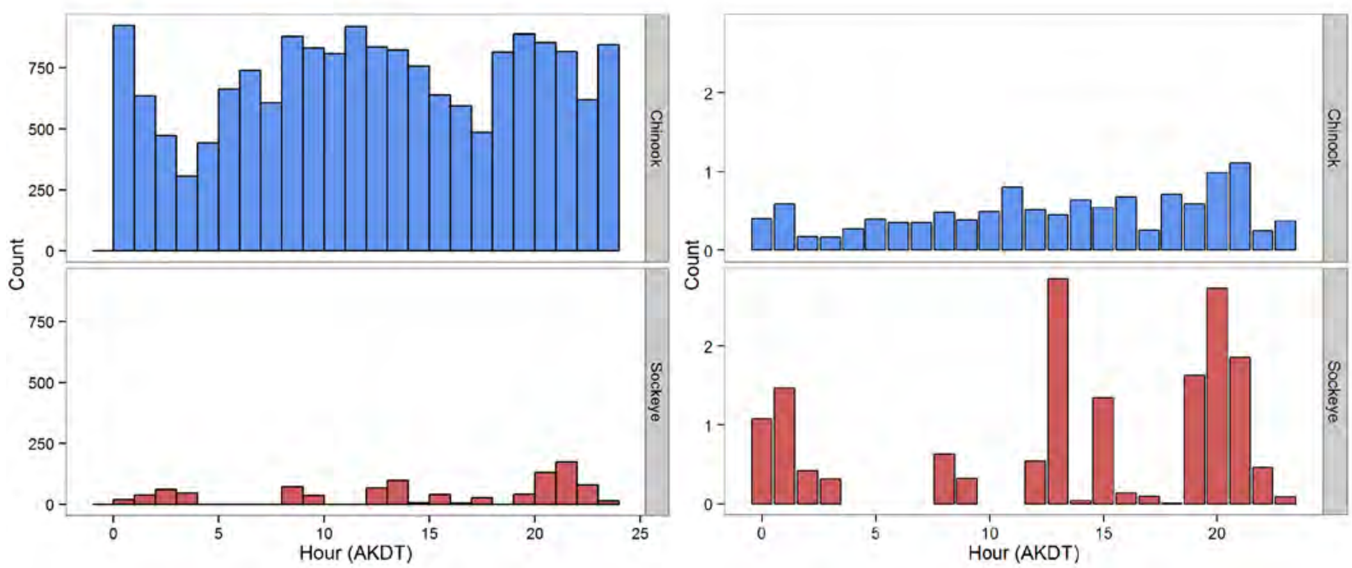

Figure E-2. Distribution of the number of detections recorded by hour (all days combined) for adult Chinook and sockeye salmon as they migrated over the north-south line of acoustic receivers along the western edge of the ESSN fishing district. Left: by detection; right: by fish.

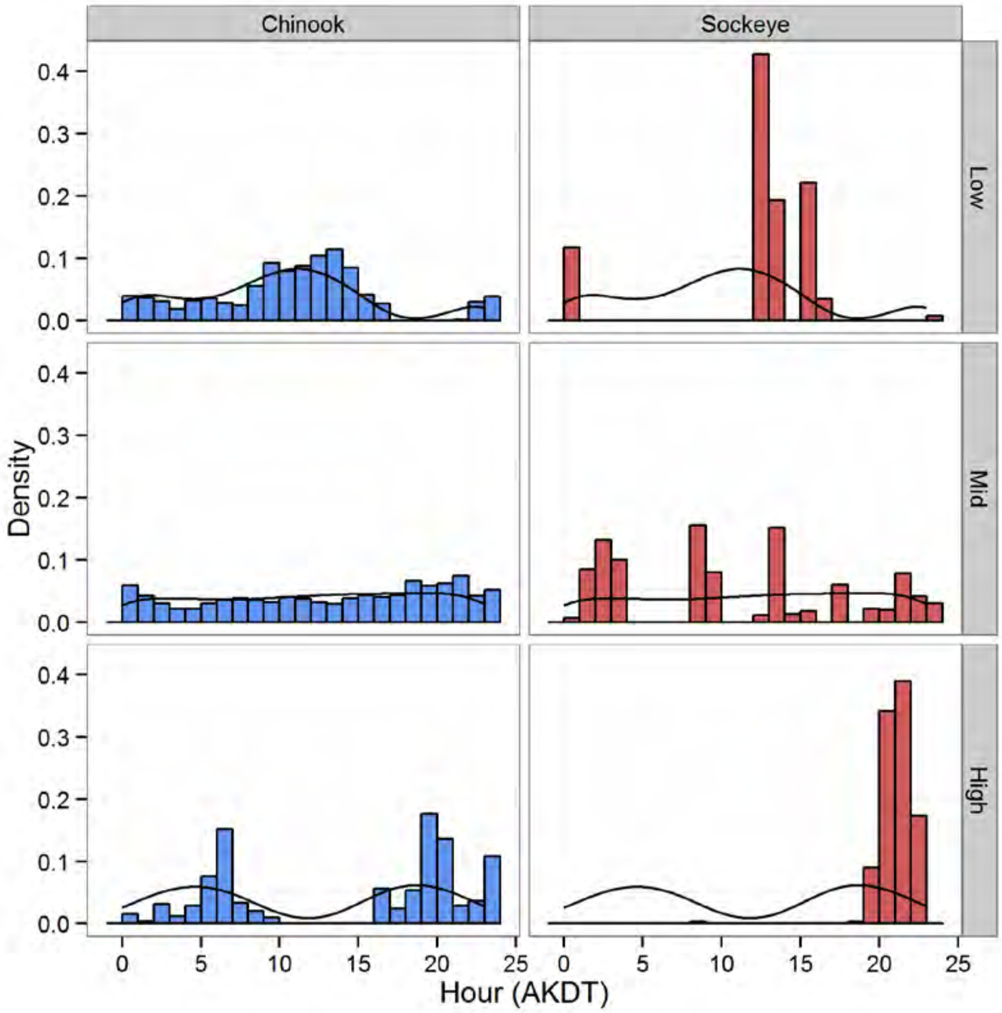

Figure E-3. Density distribution of detections recorded by time of day (AKDT) and binned by tide height for adult Chinook and sockeye salmon as they migrated along the western edge of the ESSN fishing district. The black line represents the hourly distribution of tides predicted for the migration period and binned by tide height (i.e., these are the tide heights that were available to the salmon).

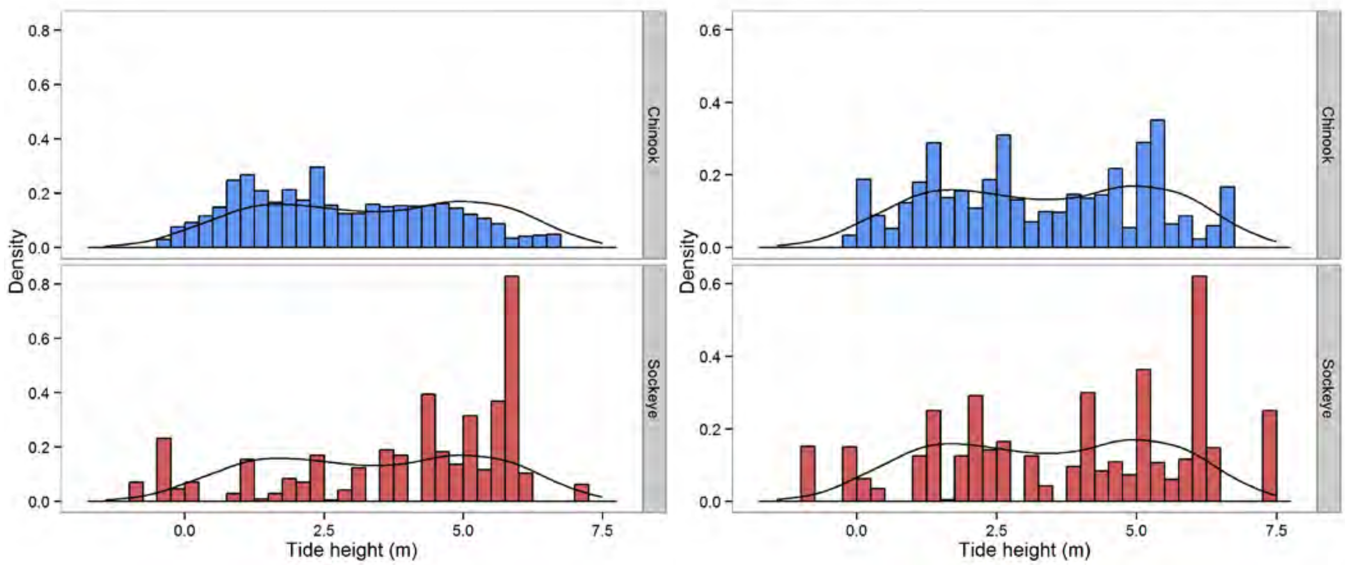

Figure E-4. Density distribution of detections recorded by tide height (m) for adult Chinook and sockeye salmon as they migrated over the north-south line of acoustic receivers along the western edge of the ESSN fishing district. Left: by detection; right: by fish. The black line represents the distribution of tide height during the migration period (i.e., these are the tide heights that were available to the salmon). Tide heights were predicted for the Kenai River mouth at 0.5 hour intervals and relative to Mean Lower Low water.

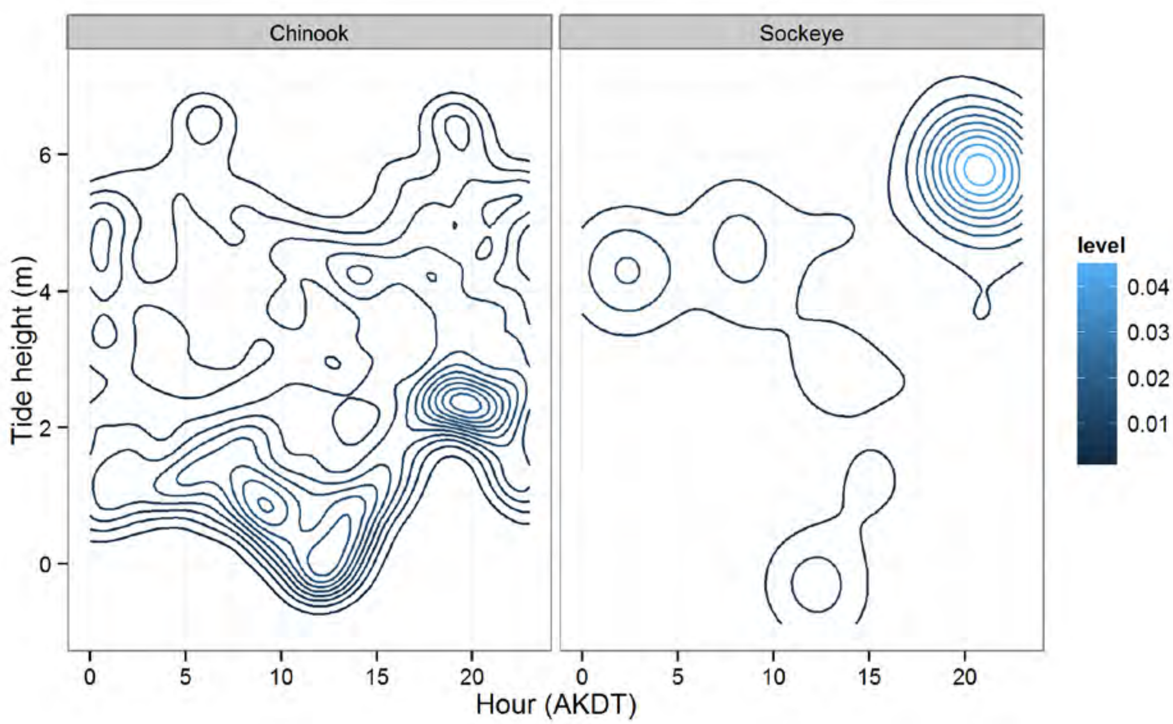

Figure E-5. Contour plot of adult sockeye and Chinook detections relative to tide height (m) and hour of day (AKDT) along the western edge of the ESSN fishing district. Tide heights were predicted for the Kenai River mouth and are relative to Mean Lower Low water.

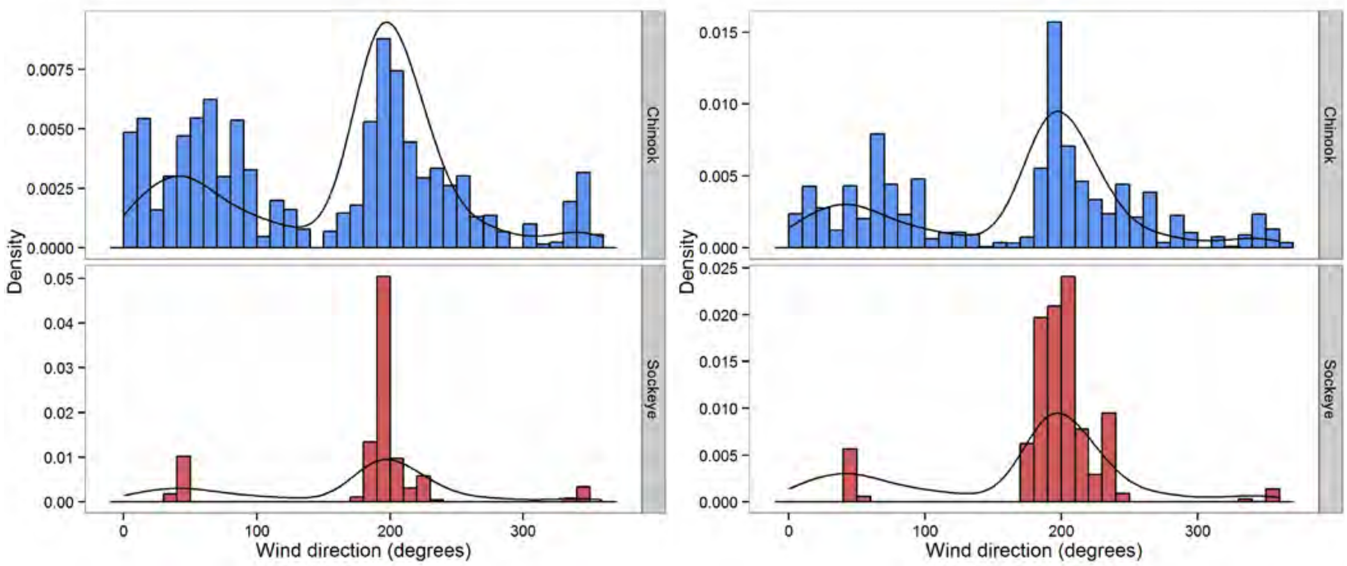

Figure E-6. Density distribution of detections recorded by wind direction (degrees) for adult Chinook and sockeye salmon as they migrated over the north-south line of acoustic receivers along the western edge of the ESSN fishing district. Left: by detection; right: by fish. Wind blows from the direction indicated. North is at 0 degrees; east is at 90 degrees; south is at 180 degrees, and west is at 270 degrees. The black line represents the distribution of wind direction during the migration period (i.e., these are the wind directions that were available to the salmon). Wind direction was measured at hourly intervals at the NOAA meteorological station at Nikiski.

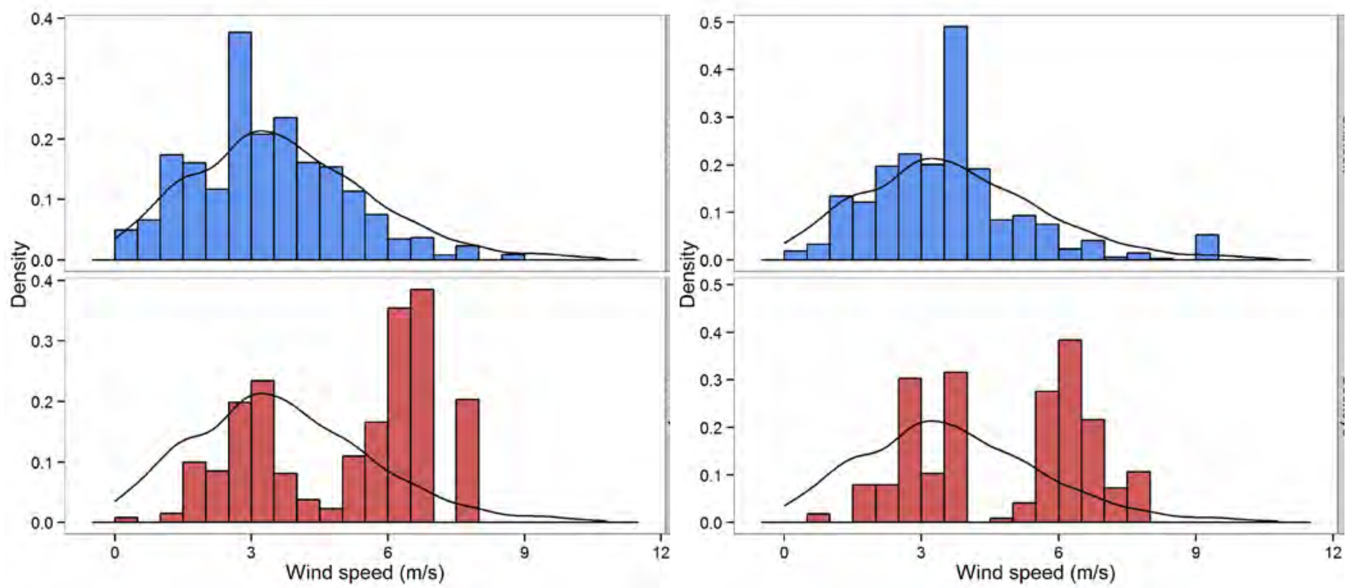

Figure E-7. Density distribution of detections recorded by wind speed (m/s) for adult Chinook and sockeye salmon as they migrated over the north-south line of acoustic receivers along the western edge of the ESSN fishing district. Left: by detection; right: by fish. The black line represents the distribution of wind speed during the migration period (i.e.,

these are the wind speeds that were available to the salmon).Wind speed was measured at hourly intervals at the NOAA meteorological station at Nikiski.

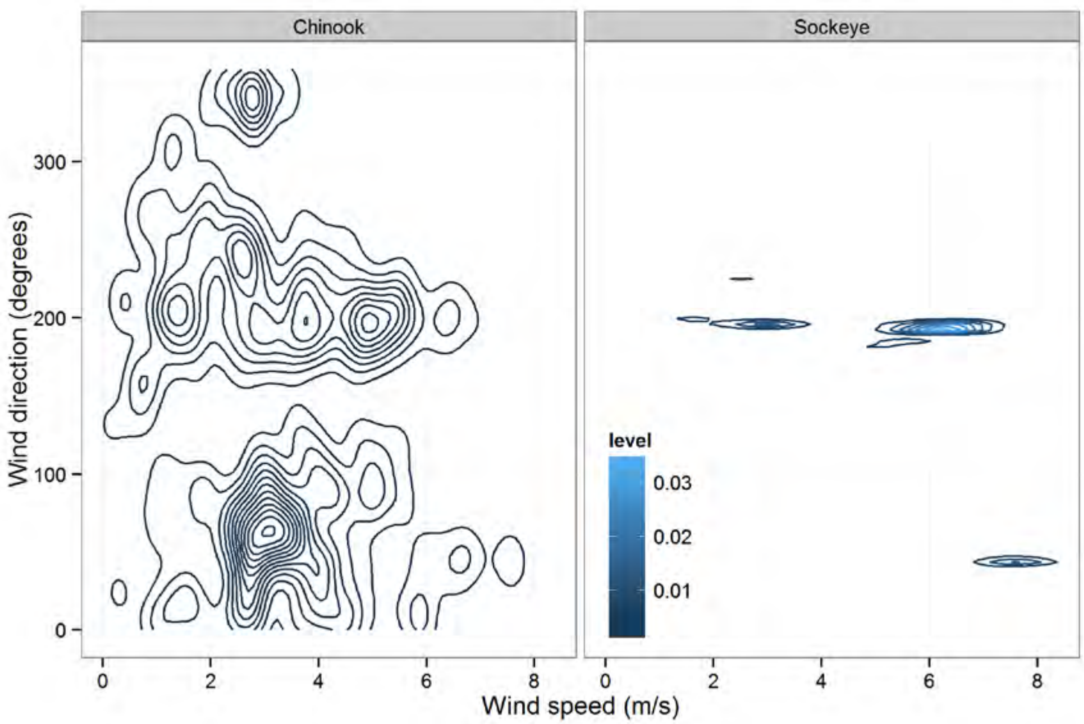

Figure E-8. Contour plot of adult sockeye and Chinook detections relative to wind speed (m/s) and direction (°N) along the western edge of the ESSN fishing district. Wind variables were measured at hourly intervals at the NOAA meteorological station at Nikiski.

F. Section 2.8 Migration rates— Supplementary

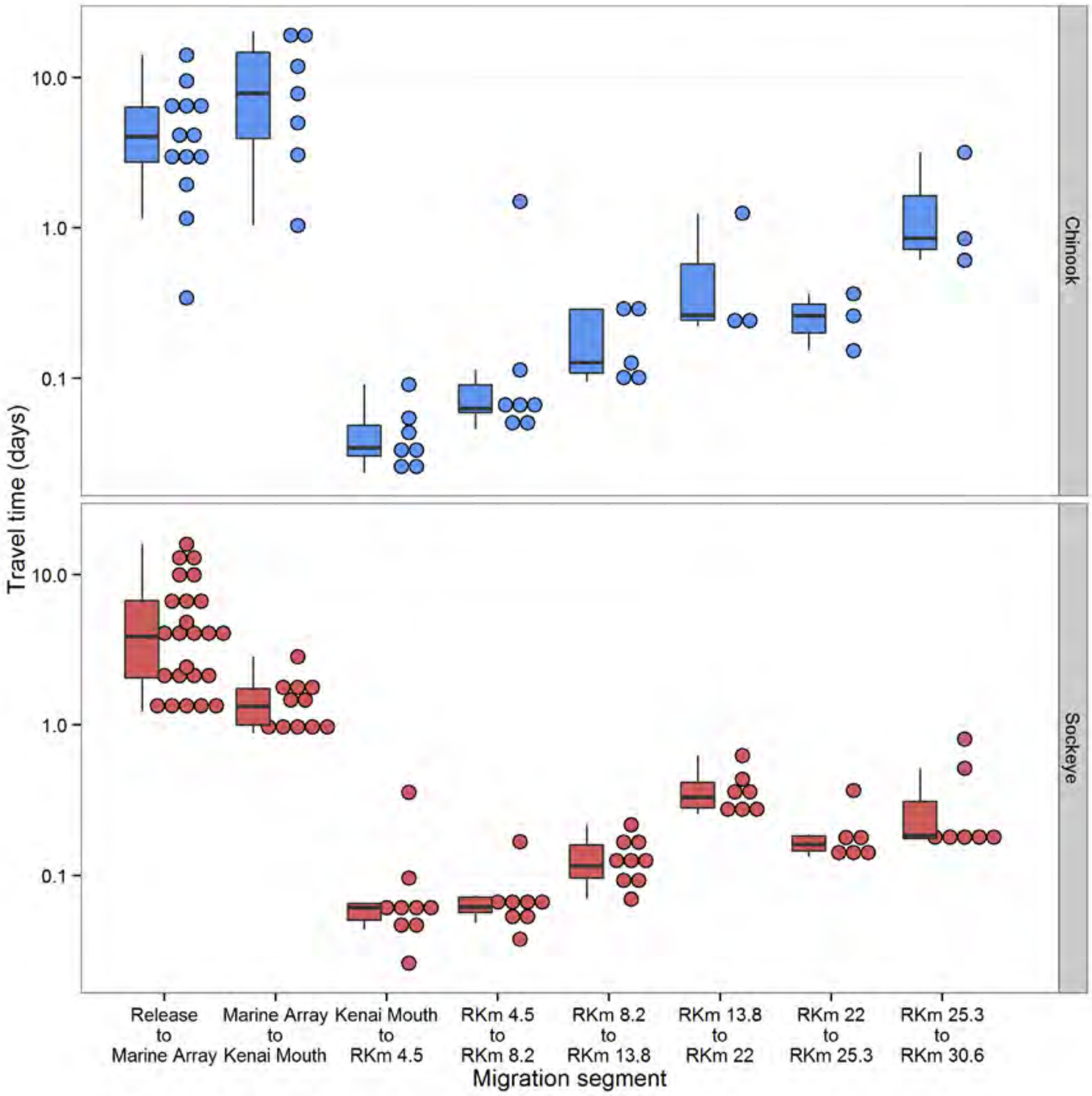

Figure F-1. Travel time (days) distribution for adult sockeye and Chinook migrating between segments of the acoustic array. Travel times were calculated from release to the first detection on the marine array, from the marine array to RKm 2 in the Kenai River, and then between all detection sites in the Kenai River. The top and bottom of each box are the 25th and 75th percentiles, the central band is the median, and the whiskers extend to the minimum and maximum values exclusive of outliers.

Table F-1. Travel time (days) for adult sockeye and Chinook migrating between segments of the acoustic array. Travel times were calculated from release to the first detection on the marine array, from the marine array to RKm 2 in the Kenai River, and then between all detection sites in the Kenai River. Travel times are listed beside the end of the segment.

						Percentiles						
Species	**Detection Site**	**N**	**Mean**	**SE**	**SD**	**Min**	**10th**	**25th**	**Median**	**75th**	**90th**	**Max**
Chinook	Marine Array	13	4.90	1.04	3.77	0.34	1.32	2.73	4.03	6.35	9.03	14.12
	RKm 2 Snug Harbor	7	9.57	2.80	7.40	1.04	2.25	4.02	7.81	14.93	18.86	20.22
	RKm 4.5 Inlet Fish	7	0.04	0.01	0.02	0.02	0.03	0.03	0.03	0.05	0.07	0.09
	RKm 8.2 Kenai Bridge	7	0.27	0.21	0.54	0.05	0.05	0.06	0.06	0.09	0.67	1.51
	RKm 13.8 Lower King Sonar	5	0.18	0.04	0.10	0.10	0.10	0.11	0.13	0.29	0.29	0.29
	RKm 22 Upper King Sonar	3	0.58	0.34	0.58	0.22	0.23	0.24	0.26	0.76	1.06	1.26
	RKm 25.3 Gaines Dock	3	0.26	0.06	0.11	0.15	0.17	0.21	0.26	0.31	0.35	0.37
	RKm 30.6 Sockeye Sonar	3	1.54	0.81	1.41	0.61	0.66	0.73	0.85	2.01	2.70	3.17
Sockeye	Marine Array	25	5.14	0.84	4.19	1.22	1.33	2.06	3.87	6.71	11.53	16.01
	RKm 2 Snug Harbor	11	1.46	0.18	0.60	0.88	0.90	1.00	1.32	1.74	1.88	2.85
	RKm 4.5 Inlet Fish	9	0.09	0.03	0.10	0.03	0.04	0.05	0.06	0.06	0.15	0.36
	RKm 8.2 Kenai Bridge	8	0.07	0.01	0.04	0.04	0.05	0.06	0.06	0.07	0.10	0.17
	RKm 13.8 Lower King Sonar	9	0.13	0.02	0.05	0.07	0.09	0.10	0.12	0.16	0.18	0.22
	RKm 22 Upper King Sonar	7	0.37	0.05	0.13	0.26	0.26	0.28	0.33	0.42	0.51	0.63
	RKm 25.3 Gaines Dock	6	0.19	0.04	0.09	0.13	0.14	0.15	0.16	0.18	0.28	0.37
	RKm 30.6 Sockeye Sonar	7	0.32	0.09	0.25	0.17	0.17	0.18	0.18	0.35	0.63	0.81

Table F-2. Cumulative travel time (days) for adult sockeye and Chinook migrating over the acoustic array. Travel times were calculated from release to the first detection on the marine array, and from release to all detection sites in the Kenai River. Note that these travel times do not increase continuously along the migratory pathway because the number of fish detected at different points in the river varies.

						Percentiles						
Species	**Detection Site**	**N**	**Mean**	**SE**	**SD**	**Min**	**10th**	**25th**	**Median**	**75th**	**90th**	**Max**
Chinook	Marine Array	13	4.90	1.04	3.77	0.34	1.32	2.73	4.03	6.35	9.03	14.12
	RKm 2 Snug Harbor	7	12.95	3.00	7.93	2.20	4.08	7.20	14.83	17.39	21.74	24.49
	RKm 4.5 Inlet Fish	7	13.00	2.99	7.92	2.29	4.15	7.24	14.86	17.43	21.77	24.52
	RKm 8.2 Kenai Bridge	7	13.27	3.07	8.13	2.35	4.24	7.32	14.92	18.21	22.69	24.56
	RKm 13.8 Lower King Sonar	5	10.86	3.42	7.64	2.64	3.84	5.63	9.24	15.03	19.06	21.74
	RKm 22 Upper King Sonar	3	11.79	5.35	9.27	3.90	5.01	6.68	9.46	15.73	19.49	22.00
	RKm 25.3 Gaines Dock	7	15.09	3.01	7.98	4.26	6.50	8.86	15.45	21.51	23.36	25.18
	RKm 30.6 Sockeye Sonar	3	13.59	5.24	9.08	4.87	6.48	8.88	12.89	17.95	20.98	23.00
Sockeye	Marine Array	25	5.14	0.84	4.19	1.22	1.33	2.06	3.87	6.71	11.53	16.01
	RKm 2 Snug Harbor	11	7.27	1.54	5.11	2.10	2.72	2.97	5.69	9.77	13.55	17.71
	RKm 4.5 Inlet Fish	10	6.92	1.51	4.78	2.17	2.70	3.78	5.44	7.72	12.51	17.80
	RKm 8.2 Kenai Bridge	9	8.49	1.68	5.04	2.82	3.34	5.19	7.69	11.96	14.50	17.87
	RKm 13.8 Lower King Sonar	9	8.62	1.68	5.04	2.96	3.44	5.29	7.81	12.03	14.66	17.99
	RKm 22 Upper King Sonar	7	8.13	1.56	4.14	3.26	3.60	5.15	8.14	10.50	13.29	14.23
	RKm 25.3 Gaines Dock	9	8.25	1.68	5.04	3.39	3.87	4.59	6.84	8.48	15.20	18.36
	RKm 30.6 Sockeye Sonar	7	7.64	1.35	3.57	4.17	4.19	5.12	7.36	8.56	11.03	14.60

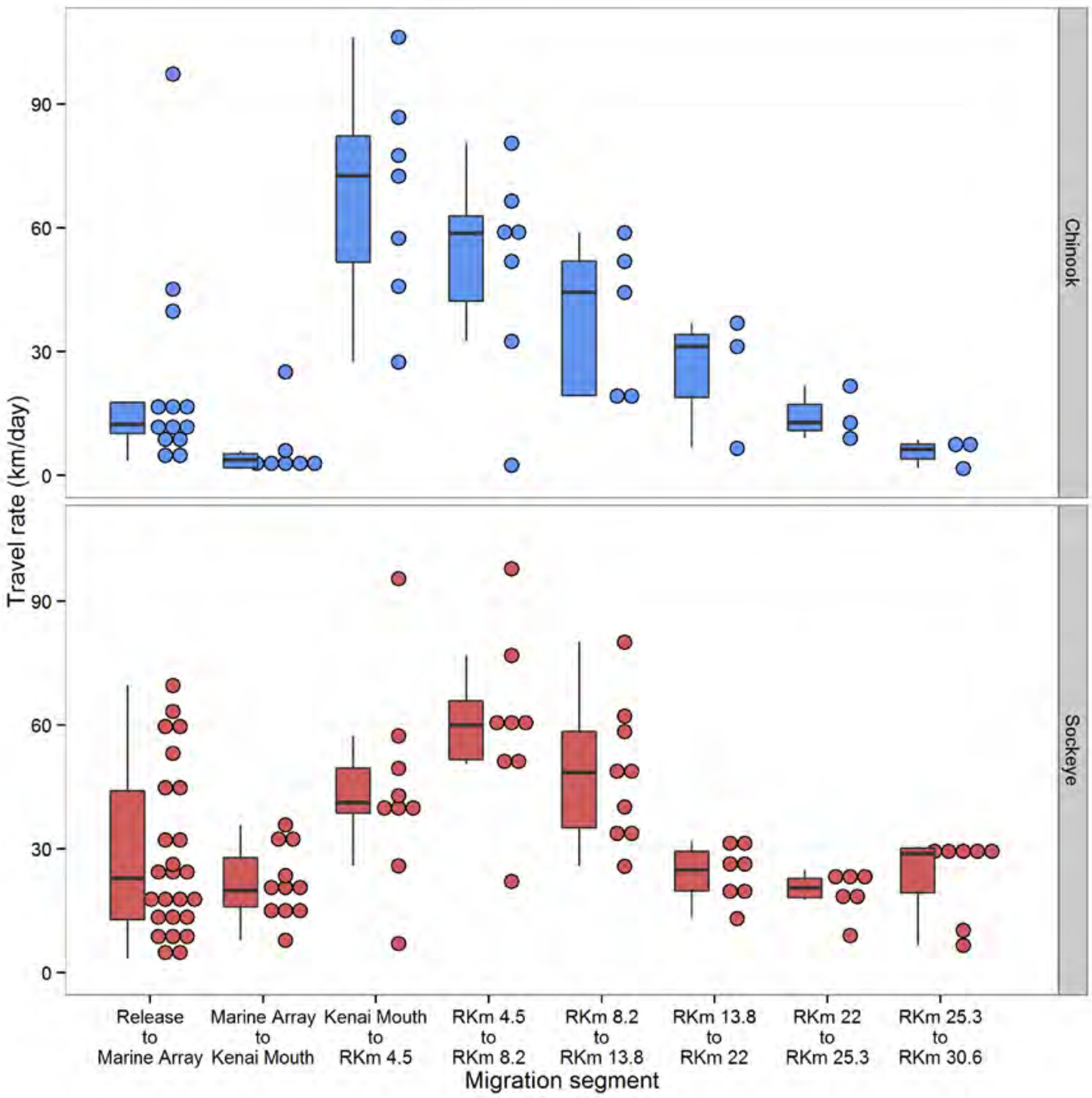

Figure F-2. Travel rate (km/day) distribution for adult sockeye and Chinook migrating between segments of the acoustic array. Rates were calculated from release to the first detection on the marine array, from the marine array to RKm 2 in the Kenai River, and then between all detection sites in the Kenai River. The top and bottom of each box are the 25th and 75th percentiles, the central band is the median, and the whiskers extend to the minimum and maximum values exclusive of outliers.

Table F-3. Travel rates (km/day) for adult sockeye and Chinook migrating between segments of the acoustic array. Rates were calculated from release to the first detection on the marine array, from the marine array to RKm 2 in the Kenai River, and then between all detection sites in the Kenai River. Travel rates are listed beside the end of the segment.

						Percentiles						
Species	**Detection Site**	**N**	**Mean**	**SE**	**SD**	**Min**	**10th**	**25th**	**Median**	**75th**	**90th**	**Max**
Chinook	Marine Array	13	22.66	7.10	25.60	3.52	6.33	10.15	12.25	17.66	44.03	97.29
	RKm 2 Snug Harbor	7	6.31	3.18	8.41	1.44	1.46	1.83	3.70	5.18	13.58	25.00
	RKm 4.5 Inlet Fish	7	67.67	9.95	26.33	27.48	38.51	51.68	72.46	82.15	94.55	106.14
	RKm 8.2 Kenai Bridge	7	50.22	9.67	25.58	2.46	20.49	42.20	58.56	62.83	72.05	80.48
	RKm 13.8 Lower King Sonar	5	38.68	8.26	18.46	19.10	19.22	19.40	44.30	51.84	56.00	58.78
	RKm 22 Upper King Sonar	3	24.87	9.32	16.14	6.53	11.46	18.85	31.17	34.04	35.76	36.91
	RKm 25.3 Gaines Dock	3	14.44	3.75	6.50	9.00	9.74	10.84	12.68	17.16	19.85	21.64
	RKm 30.6 Sockeye Sonar	3	5.53	2.05	3.56	1.67	2.59	3.96	6.24	7.46	8.19	8.68
Sockeye	Marine Array	25	28.27	3.98	19.90	3.28	8.50	12.76	22.73	44.03	59.85	69.58
	RKm 2 Snug Harbor	11	21.67	2.63	8.74	7.85	13.90	15.77	19.77	27.81	32.67	35.81
	RKm 4.5 Inlet Fish	9	44.11	8.00	24.01	6.99	22.10	38.63	41.17	49.45	64.94	95.45
	RKm 8.2 Kenai Bridge	8	60.12	7.69	21.74	22.10	42.08	51.51	59.84	65.79	83.10	97.82
	RKm 13.8 Lower King Sonar	9	47.93	5.66	16.98	25.69	31.10	34.99	48.45	58.35	65.70	80.08
	RKm 22 Upper King Sonar	7	23.95	2.58	6.82	13.05	16.49	19.75	24.86	29.23	31.17	31.82
	RKm 25.3 Gaines Dock	6	19.26	2.31	5.66	8.96	13.32	18.07	20.50	22.77	23.95	24.78
	RKm 30.6 Sockeye Sonar	7	23.52	3.93	10.40	6.57	8.79	19.27	28.77	30.12	30.36	30.50

Table F-4. Travel rates (body lengths/second) for adult sockeye and Chinook migrating between segments of the acoustic array. Rates were calculated from release to the first detection on the marine array, from the marine array to RKm 2 in the Kenai River, and then between all detection sites in the Kenai River. Travel rates are listed beside the end of the segment.

						Percentiles						
Species	**Detection Site**	**N**	**Mean**	**SE**	**SD**	**Min**	**10th**	**25th**	**Median**	**75th**	**90th**	**Max**
Chinook	Marine Array	13	0.26	0.09	0.33	0.04	0.07	0.10	0.14	0.21	0.49	1.25
	RKm 2 Snug Harbor	7	0.07	0.03	0.08	0.02	0.02	0.02	0.04	0.06	0.14	0.24
	RKm 4.5 Inlet Fish	7	0.77	0.12	0.31	0.26	0.46	0.60	0.82	0.97	1.06	1.18
	RKm 8.2 Kenai Bridge	7	0.55	0.11	0.28	0.03	0.26	0.48	0.57	0.71	0.83	0.90
	RKm 13.8 Lower King Sonar	5	0.45	0.10	0.22	0.18	0.21	0.24	0.55	0.57	0.65	0.70
	RKm 22 Upper King Sonar	3	0.27	0.10	0.18	0.06	0.12	0.20	0.35	0.37	0.38	0.39
	RKm 25.3 Gaines Dock	3	0.16	0.06	0.10	0.09	0.09	0.10	0.12	0.20	0.24	0.27
	RKm 30.6 Sockeye Sonar	3	0.06	0.02	0.04	0.02	0.03	0.05	0.08	0.08	0.08	0.08
Sockeye	Marine Array	25	0.55	0.08	0.41	0.06	0.16	0.23	0.40	0.84	1.21	1.32
	RKm 2 Snug Harbor	11	0.40	0.05	0.16	0.14	0.26	0.30	0.36	0.51	0.59	0.67
	RKm 4.5 Inlet Fish	9	0.81	0.15	0.45	0.13	0.41	0.68	0.74	0.87	1.23	1.78
	RKm 8.2 Kenai Bridge	8	1.10	0.15	0.42	0.39	0.74	0.94	1.10	1.22	1.52	1.84
	RKm 13.8 Lower King Sonar	9	0.88	0.11	0.32	0.45	0.56	0.61	0.90	1.04	1.20	1.51
	RKm 22 Upper King Sonar	7	0.44	0.05	0.12	0.25	0.30	0.35	0.46	0.54	0.56	0.56
	RKm 25.3 Gaines Dock	6	0.35	0.04	0.11	0.16	0.24	0.33	0.38	0.41	0.44	0.47
	RKm 30.6 Sockeye Sonar	7	0.43	0.07	0.19	0.13	0.16	0.34	0.52	0.54	0.55	0.57

PC 265

Mat-Su salmon
PARTNERSHIP

15 January 2014

Glenn Haight, Executive Director
Alaska Board of Fisheries
ADF&G Boards Support Section
P.O. Box 115526
Juneau, AK 99811-5526

ATTN: Board of Fisheries Comments for Upper Cook Inlet Finfish Meeting

Dear Mr. Haight and Board of Fisheries members:

We are writing to you on behalf of the Matanuska-Susitna Basin Salmon Habitat Partnership (Partnership) to update you about the status of salmon habitat in the Mat-Su Basin and the efforts that the Partnership is putting into conserving salmon habitat. We protect the healthy habitat that exists throughout the Mat-Su, restore degraded habitat and fish passage barriers in the more developed areas, and work with local government and communities through planning and best management practices to prevent the habitat degradation that can be associated with inappropriate development.

Management of Alaska's fisheries is respected around the world. We appreciate the crucial and challenging role the Board plays in this successful management model. We hope that knowing more about the Partnership and the status of salmon habitat in the Mat-Su will be helpful for the Board's consideration of Cook Inlet fisheries management policies.

The Matanuska-Susitna Basin Salmon Habitat Partnership[1] was formed in 2006 to address increasing impacts on salmon habitat from human use and development in the Mat-Su Basin with a collaborative, cooperative, and non-regulatory approach that brings together diverse stakeholders. This focus on a bottom-up, locally driven, voluntary and non-regulatory effort was inspired by the approach outlined by the National Fish Habitat Partnership (NFHP). The mission of NFHP is to "protect, restore, and enhance the nation's fish and aquatic communities through partnerships that foster fish habitat conservation and improve the quality of life for the American people." NFHP formally recognized the Mat-Su Salmon Partnership in 2007 as one of the first four fish habitat partnerships in the country. The Partnership operates under the guidance of NFHP and currently includes over 50 individuals and organizations. This diverse partnership has attracted local community groups; local, state, and federal agencies; businesses; fishing interests; non-profit organizations; Native Alaskans; and individual landowners. The Partnership has sought to include anyone concerned about conserving salmon in the Mat-Su Basin. *From the beginning, the Partnership has acted with the belief that thriving fish, healthy habitats, and vital communities can co-exist in the Mat-Su Basin.*

Our focus is on protecting and restoring the habitats that salmon need to thrive during all life stages in the Mat-Su Basin. We realize that the future of Mat-Su salmon depends upon what happens to

[1] For more about the partnership, visit www.matsusalmon.org

them during each life stage, from their incubation and rearing in freshwater, to their maturation in saltwater, and during their return back to freshwater to spawn. While debate continues about the reasons for decline of some salmon stocks across Alaska and in the Mat-Su, it is well-known that freshwater habitat loss and fragmentation are some of the primary drivers in the decline of anadromous fish elsewhere in the U.S. and the world. Our goal is to ensure that Mat-Su salmon have healthy habitats in the Mat-Su and upper Cook Inlet so that habitat loss does not contribute to the other stresses that Mat-Su salmon must endure. In the Mat-Su, healthy salmon habitat exists throughout the basin, and our top priority is to protect and maintain that habitat wherever possible.

In 2008, the Partnership worked with a wide range of scientists, agencies, community groups, and fishing interests to develop a Strategic Action Plan that identified major potential threats to salmon habitat in the Mat-Su Basin and the conservation strategies that the Partnership would undertake to address them. The Partnership has been busy in the last 5 years addressing the conservation strategies of that plan. Efforts have been wide-ranging: habitat protection to avoid future negative impacts, restoration of degraded habitat, reconnection between habitats for various life stages, and improving knowledge about the habitats that Mat-Su salmon need throughout their time in freshwater. With funding from NFHP, the Partnership has provided $1.9 million for salmon habitat projects in the Mat-Su since 2006, with $2.6 million in match from private and public sources. Here are a few highlights of the Partnership's accomplishments:

Science: The Partnership surveyed and added over 150 miles of stream to the Anadromous Waters Catalog, improving information about salmon distribution and affording streams the protections under state law that come by being listed. US Geological Survey (USGS) and Alaska Department of Natural Resources (DNR) implemented a groundwater model for the most developed area of the Mat-Su to facilitate understanding of the connections between surface and subsurface water as well as for the purpose of looking at habitat and water quality in the future. Aquatic Restoration and Research Institute (ARRI) completed one of the first stormwater studies, which helped to inform development of the Mat-Su Borough's stormwater management plan. ARRI also evaluated different kinds of streams to understand juvenile salmon growth in different systems, studied juvenile salmon habitat use during winter in glacial streams, and surveyed estuaries for fish use. Private, university, and agency partners conducted several studies to quantify juvenile fish distribution and habitat use to help inform conservation efforts including fish passage projects in key watersheds. Notable insight has been gained in the Little Susitna, Big Lake, and near shore estuarine waters. University and agency partners conducted several studies to assess the impacts of off-road recreational vehicles to salmon habitat in the Knik Public Use Area. USGS and US Fish and Wildlife Service (USFWS) studied distribution and abundance of spawning salmon in the Matanuska River and found that clearwater side channels of the glacial mainstem are the primary spawning habitat. The Matanuska River was found to be a larger producer of sockeye, chum, and coho salmon than previously thought, resulting in conservation efforts to keep them from being impacted over time and furthering understanding on how salmon use glacial rivers for their life cycle.

Water Reservations: Over the last 5 years, USGS, USFWS, Chickaloon Village and ADF&G filled in some of the gaps in water reservations within the Mat-Su on important salmon streams vulnerable to development. Enough data was obtained on three streams to fulfill application requirements with DNR: Moose, Wasilla and Montana Creeks. Three existing water reservations were strengthened on Meadow and Fish Creeks and Little Susitna River. Two new gages on Kashwitna Creek and Little Willow Creek are collecting 5 years of data for new reservations. These efforts, added to existing reservations on other streams, will cover much of the priority salmon-bearing waters for the Palmer-Wasilla area and along the Parks Highway to the Talkeetna turnoff.

Habitat Protection: The Great Land Trust and private partners have protected nearly 4000 acres of estuaries, wetlands, riparian areas, and uplands important for salmon habitat through conservation easements, transfer to state conservation units, and wetland preservation banks. Conservation groups have prioritized areas important to salmon but vulnerable to development. They have worked with willing landowners to voluntarily put portions of their property into conservation easements to protect important salmon habitat. Additionally, three wetland mitigation banks have been formed in the Mat-Su, protecting wetland areas around salmon streams.

Fish Passage: Over the past 10 years, partners have invested over $6 million into improving habitat connectivity at over 80 sites where roads cross salmon streams. About 70% of the 567 fish-bearing road-stream crossings evaluated to date by ADF&G likely prevent or limit salmon from reaching spawning and nursery habitats. Most fish passage issues in the Mat-Su affect juvenile salmon. To date, fish passage projects have restored access to well over 100 miles of historic spawning and rearing habitat in the Mat-Su. In 2011 the partnership completed a Fish Passage Improvement Plan. Currently an additional 18 culverts are scheduled for replacement on Borough roads over the next 3 years. As restoration work continues to target priority fish passage barriers, preventing the creation of new fish passage barriers is a key part of the overall Partnership strategy. This is evidenced in the Borough's recent adoption of fish passage design standards for road-stream crossings in Borough subdivisions. Over the next year, partners will conduct workshops for contractors, developers, public works staff and others that focus on how to implement the new standards as they continue to build new or upgraded existing roads throughout the Borough.

Riparian Assessments and Restoration: ADF&G started a streambank restoration cooperative program in partnership with USFWS to restore riparian areas on private and public lands. Over the last 5 years, the most significant projects have been improvements at the Sunshine Creek public fishing area, at the mouth of Willow Creek, at a park on Wasilla Lake, and at the Alaska Sailing Club on Big Lake. Chickaloon Village worked with the Mat-Su Trails Council on 500 feet of Plumly Maude Trail to divert McRoberts Creek from partially flowing down that trail. Partners are working together to document and quantify riparian habitat degradation in Mat-Su lakes and creeks that are important to salmon. Several partners are educating landowners about how to reduce their impacts to salmon habitat while retaining valued waterfront attributes like views and access. Additionally, the largest river restoration project in Mat-Su, at Moose Creek, restored 0.5 miles of a 60-foot wide river to its original meander bends and eliminated a human-induced 10-foot high waterfall, restoring king salmon access to miles of upstream habitat that had been blocked since the 1930s.

Mapping: Partnership projects have resulted in comprehensive and greatly improved mapping of wetland and hydrological resources in the Mat-Su Basin. In the core area, over one million acres have been surveyed, resulting in mapping of 358,000 acres of wetlands. These wetlands have been characterized more accurately, resulting in better permitting and assessment of wetland functions and values. Additionally, over 3,450 square miles of the Mat-Su was flown for LiDAR and aerial imagery, resulting in one of the largest publicly available datasets in the state for future modeling and habitat information. Impervious surfaces have also been mapped, helping guide watershed planning and a better understanding of changes to the landscape.

Policy and Management: The Mat-Su Borough developed its first Wetlands Management Plan, and the USFWS and Army Corps of Engineers are working with partners to develop a functional assessment of wetlands. In 2013 the Borough completed its Storm Water Management Plan. In 2006 green infrastructure was implemented by the MSB planning department. Since then, three community plans have included green infrastructure considerations such as recreation, open space, water quality, and fish and wildlife habitat.

Mat-Su Salmon Symposium: The Partnership has conducted six annual Mat-Su Salmon Science and Conservation Symposiums with over 25 presenters and 100+ attendees each year for the purposes of public education, research sharing, and project collaboration. Presentations have included stream assessments and fish distribution surveys, restoration projects, planning efforts to prevent future habitat degradation, groundwater modeling, and the economic value of healthy salmon fisheries and salmon habitat. Presentations and agendas from past symposiums are available on the Partnership website (www.matsusalmon.org).

Last year the Partnership identified the need to update its Strategic Action Plan. The Partnership is diverse, yet consensus exists on key issues and aspects of salmon conservation. The greatest potential threat to salmon habitat in the Mat-Su Basin is still development practices that lack adequate safeguards for salmon habitat. Science remains a core need and tool for conserving salmon habitat, and protection of salmon habitat remains a top priority strategy. The updated Strategic Action Plan[2] outlines twelve conservation strategy focus areas to conserve salmon habitat in the Mat-Su Basin in the coming years (Table 1). The Executive Summary of the plan is attached to this letter.

Table 1. Conservation Strategy Focus Areas to Conserve Salmon Habitat in the Mat-Su Basin	
1	Science Needs – Salmon Distribution, Water Quantity, Water Quality
2	Alteration of Riparian Areas
3	Climate Change
4	Culverts that Block Fish Passage
5	Filling of Wetlands
6	Impervious Surfaces & Stormwater Pollution
7	Invasive Northern Pike &Aquatic Plants
8	Large-scale Resource Development
9	Loss or Alteration of Water Flow or Volume
10	Loss of Estuaries & Nearshore Habitats
11	Motorized Off-road Recreation
12	Wastewater Management

In recent years, much has happened in the Mat-Su Basin. Population growth and the accompanying development have continued in the Knik-Wasilla-Palmer core area and along the Parks Highway. Industry interest in coal mining in the Matanuska Valley has returned, and the state is reconsidering a decades-old plan to dam the upper Susitna River for hydroelectric power. Invasive aquatic plants have found their way to south-central Alaska. Scientists have learned more about predicting climate change and how it will likely affect precipitation, temperatures, and other climatic attributes. By the summer of 2013, the State of Alaska had designated seven Mat-Su salmon populations as Stocks of Concern, resulting in sportfishing closures and restrictions on commercial fishing in Cook Inlet[3].

While some salmon runs are down in the Mat-Su Basin, the Partnership is optimistic that a multi-prong approach to understanding and addressing the issues that salmon face in both freshwater and saltwater can maintain their numbers so that they continue to support a vibrant economy, Alaskan lifestyle, and a

[2] The updated Strategic Action Plan, *Conserving Salmon Habitat in the Mat-Su Basin*, is available at www.matsusalmon.org.
[3] We note that most of these Stocks of Concern are in the remote and less populated areas of the Mat-Su Basin and not in areas heavily subjected to the development pressures discussed here and addressed by the Partnership.

healthy ecosystem in the Mat-Su Basin and beyond. We appreciate the role that the Board of Fisheries plays in fisheries management and ensuring the long-term health of Alaska salmon. The businesses, conservation organizations, government agencies, tribes, and other partners of the Matanuska-Susitna Basin Salmon Habitat Partnership will continue to work to ensure that Mat-Su salmon thrive in healthy habitats.

We welcome any questions or requests for information that the Board of Fisheries may find helpful in its work toward maintaining sustainable fisheries into the future for all Alaskans. If you have any questions for us about habitat issues in the Mat-Su, please contact Jessica Speed, Mat-Su Salmon Partnership Coordinator (jspeed@tnc.org, (907) 865-5713) or any member of the Steering Committee.

Sincerely,
The Steering Committee of the Mat-Su Salmon Partnership:

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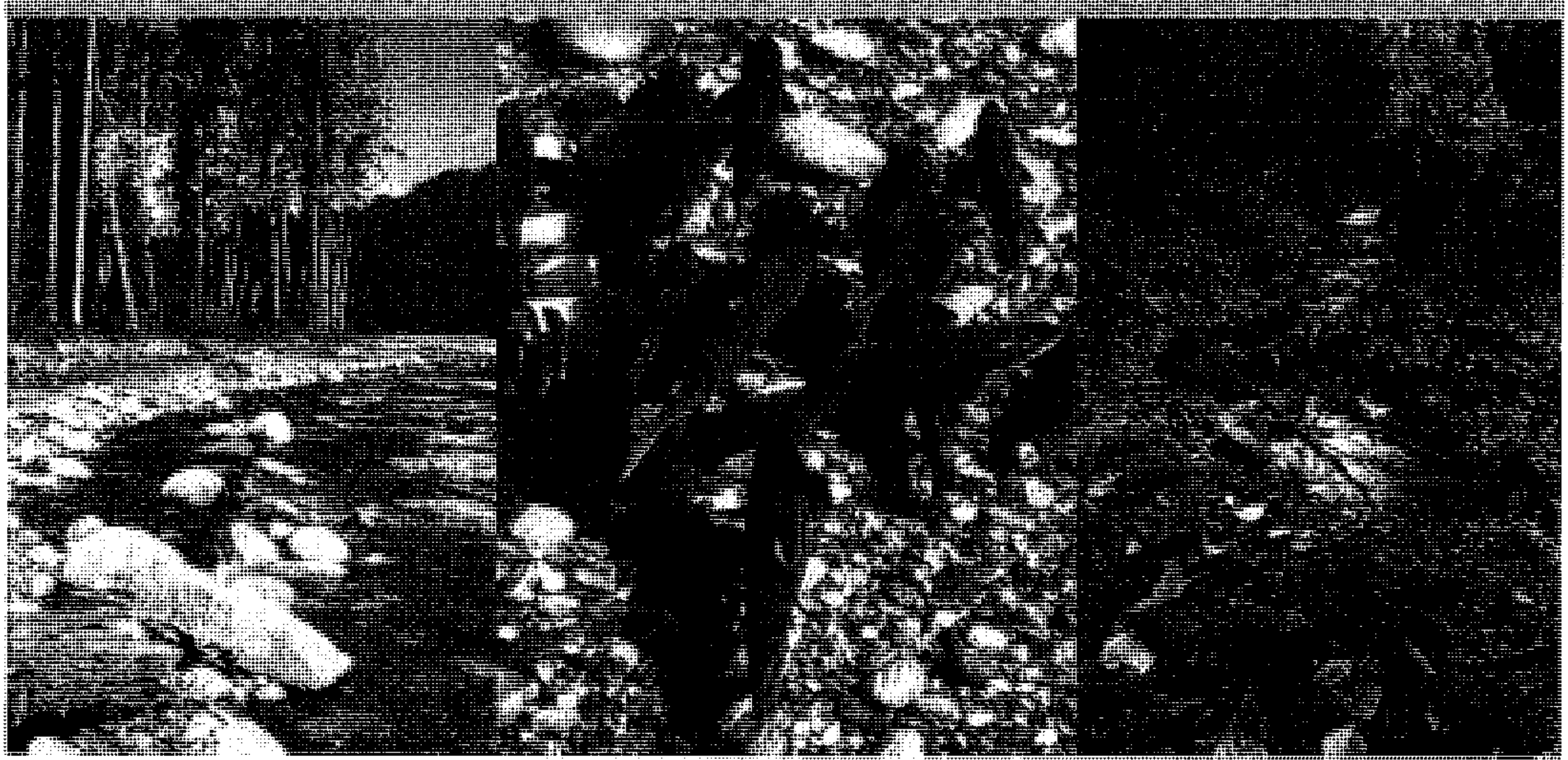
Conserving Salmon Habitat in the Mat-Su Basin



Executive Summary

The Strategic Action Plan

of the

Mat-Su Basin Salmon Habitat Partnership

2013 DRAFT

Mat-Su Basin Salmon Habitat Partnership Steering Committee 2013

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2013 Editors	Corinne Smith and Jessica Speed, The Nature Conservancy

This Strategic Action Plan was developed by the Mat-Su Basin Salmon Habitat Partnership under guidelines provided by the National Fish Habitat Board's National Fish Habitat Action Plan. This Strategic Action Plan was created through the dedication of its partners. Local agencies and organizations provided hours of in-kind support. We would especially like to thank the following for lending their staff to this project: Alaska Association of Conservation Districts; Alaska Department of Fish and Game; Alaska Department of Environmental Conservation; Alaska Department of Natural Resources; Alaska Department of Transportation; Alaskans for Palmer Hay Flats; Aquatic Restoration and Research Institute; Chickaloon Village Traditional Council; Cook Inlet Aquaculture Association; Cook Inletkeeper; Environmental Protection Agency; Envision Mat-Su; Fishtale River Guides; Friends of Mat-Su; Great Land Trust; Matanuska-Susitna Borough; Mat-Su Borough Fish and Wildlife Commission; Mat-Su Conservation Services; Mat-Su Borough Fish and Wildlife Committee; National Park Service; Natural Resources Conservation Service; NOAA's National Marine Fisheries Service; Palmer Soil and Water Conservation District; The Nature Conservancy; US Army Corps of Engineers; U.S. Fish and Wildlife Service; U.S. Geological Survey; USKH; and the Wasilla Soil and Water Conservation District. A complete list of participants in is Appendix 1.

Financial support was provided by the National Fish Habitat Action Plan, the U.S. Fish and Wildlife Service, The Nature Conservancy, ConocoPhillips Alaska, and the Alaska Sustainable Salmon Fund.

Chinook, coho, sockeye, pink, and chum salmon all return in great numbers to the streams and lakes of the Matanuska-Susitna (Mat-Su) Basin each summer to spawn. The Susitna River run of Chinook salmon is the fourth largest in the state. Yet rapid growth and urbanization in the Mat-Su Basin is threatening the fish habitat necessary to sustain healthy salmon populations and ultimately the quality of life for residents. Across the Mat-Su Basin, residents value healthy fish and wildlife populations, open space, clean air and water, recreational opportunities, and a rural lifestyle. For many, salmon are an integral part of their heritage and culture, and fishing is a regular part of life and an important means of caring for their families. The current pace of population growth in the region, combined with the current regulatory framework, enforcement, and common development and recreation practices, have many people concerned that these life-quality values cannot be maintained. The greatest risk to habitat for salmon and other freshwater fish in the Mat-Su Basin may be many small actions that compound over time to degrade riparian habitat, block fish passage, and impact water quality, quantity and flow.

Mat-Su Basin Salmon Habitat Partnership

The Matanuska-Susitna Basin Salmon Habitat Partnership formed to address increasing impacts on salmon habitat from human use and development in the Mat-Su Basin with a collaborative, cooperative, and non-regulatory approach that would bring together diverse stakeholders. Rapid population growth and the accompanying pressures for development will increasingly challenge the ability of stakeholders to balance fish habitat conservation with these changes over time. Water quality, water quantity, and other fish habitat-related conditions are among some of the more important issues that will have to be addressed to maintain the fish habitat required to sustain fish productivity. *From the beginning, the Partnership has acted with the belief that thriving fish, healthy habitats, and vital communities can co-exist in the Mat-Su Basin.*

There has been a history of fish habitat conservation efforts in the Mat-Su Basin, including upgrading traditional culverts to improve fish passage and maintain natural stream processes, stream restoration, and stream bank stabilization. Many of these were cooperative efforts between government agencies and local organizations. In the fall of 2005, The Nature Conservancy (TNC), the Matanuska-Susitna Borough (MSB), Alaska Department of Fish and Game (ADF&G), and U.S. Fish and Wildlife Service (USFWS) formalized a broad-based public and private partnership. From the beginning, this diverse partnership has attracted local community groups; local, state, and federal agencies; businesses; non-profit organizations; Native Alaskans; and individual landowners. The Partnership has sought to include anyone concerned about conserving salmon in the Mat-Su Basin.

This focus on a bottom-up, locally driven, voluntary and non-regulatory effort was inspired by the approach outlined in the National Fish Habitat Action Plan[1]. The mission of the National Fish Habitat Partnership is to "protect, restore, and enhance the nation's fish and aquatic communities through partnerships that foster fish habitat conservation and improve the quality of life for the American people."

[1] www.fishhabitat.org

The Intent of this Strategic Action Plan

In 2007 the Mat-Su Salmon Partnership embarked on an 18-month-long process to develop a Strategic Action Plan. In the 2008 plan, the Partnership selected eight areas of conservation strategies to address plus three over-arching science strategies to increase our knowledge about the location and characteristics of salmon habitat in the Mat-Su: fish distribution and life-cycle use, water quantity, and water quality.

In the last five years, much has happened in the Mat-Su Basin. Population growth and the accompanying development have continued in the Knik-Wasilla-Palmer core area and along the Parks Highway. Industry interest in coal mining in the Matanuska Valley has returned, and the state is reconsidering a decades-old plan to dam the upper Susitna River for hydroelectric power. Invasive aquatic plants have found their way to south-central Alaska. Scientists have learned more about predicting climate change and the impacts it will have to precipitation, temperatures, and other climatic attributes. By the summer of 2013, the State of Alaska had designated six salmon populations as Stocks of Concern, resulting in sportfishing closures and restrictions on commercial fishing in Cook Inlet.

The Mat-Su Salmon Partnership has also been busy in the last five years addressing the strategies of the 2008 Strategic Action Plan. Partners have replaced over 70 culverts that prevented adult and juvenile salmon from accessing key spawning and rearing habitat in Mat-Su streams. The state started a streambank restoration cooperative program that has helped restore riparian areas on private and public lands. Over 5000 acres of wetlands, riparian areas, and uplands important for salmon habitat have been protected through conservation easements, transfer to state conservation units, and wetland preservation banks. In the core area, wetlands have been mapped and characterized more accurately, the borough has a Wetlands Management Plan, and the Corps is working with partners to develop a functional assessment of wetlands. Throughout the borough, a higher resolution and more recent map of impervious surfaces has been created, and the borough is working on a Stormwater Management Plan.

One thing that hasn't changed since 2008 is the purpose of this strategic action plan. The Partnership Steering Committee developed the Strategic Action Plan to identify Partnership long-term goals and strategies and to provide a tool the Partnership can use to prioritize projects related to fish habitat goals in the Mat-Su Basin. The intent of this Strategic Action Plan is to identify long-term goals, strategies, and voluntary actions that the Partnership and others can undertake to conserve salmon habitat. The Steering Committee planned to revisit the original Strategic Action Plan every 3 to 5 years, and this edition is that first update to address changes in the Mat-Su Basin that could significantly affect the situation for salmon habitat.

The Partnership developed this Strategic Action Plan to identify collaborative projects and other actions that will protect and restore important habitat for wild salmon in the Mat-Su Basin. The Steering Committee initiated the plan under the guidance of the NFHP and administered the planning process. The NFHP clearly identifies fish habitat as the focus for partnerships. The

Steering Committee decided that the planning process would focus exclusively on habitat-related issues to remain consistent with the intent of the NFHP and the Mat-Su Salmon Partnership. The plan scope includes not only freshwater fish habitat in the Mat-Su Basin, but nearshore, estuarine, and marine habitat in Upper Cook Inlet as well (Figure 1).

The Steering Committee identified three specific purposes for the plan:

1. Identify important habitats for salmon and other fish species in the Mat-Su Basin.
2. Prioritize fish habitat conservation actions, including protection, enhancement, and restoration of key habitat, education and outreach, research, and mitigation.
3. Identify potential collaborations and funding sources for partners to address fish habitat conservation.

The future of Mat-Su salmon depends upon what happens to them during each life stage, from their incubation and rearing in freshwater, to their maturation in saltwater, and during their return back to freshwater to spawn. While debate continues about the reasons for decline of some salmon stocks across Alaska and in the Mat-Su, it is well-known that freshwater habitat loss and fragmentation are some of the primary drivers in the decline of anadromous fish elsewhere in the U.S. and the world. The Partnership's goal is to ensure that Mat-Su salmon have healthy habitats in the Mat-Su and upper Cook Inlet so that habitat loss does not contribute to the other stresses that Mat-Su salmon must endure. In the Mat-Su, healthy salmon habitat exists throughout the basin, and our top priority is to protect and maintain that habitat wherever possible.

Overall Health of Mat-Su Basin Salmon and Habitat

In 2008, the assessment of the health of wild salmon and their habitat indicated that, *taken as a whole across the Mat-Su Basin*, salmon and most of their habitats were healthy and required minimal human intervention for long term survival. A more local look at individual attributes of health, however, pointed out concerns about long-term sustainability of Mat-Su Basin salmon and some of the habitats they require for survival. For salmon, that assessment suggested that numbers for some sockeye, pink, and chum salmon runs may have been below a sustainable level and that some stocks might be seriously degraded in time without conservation action. Data for Mat-Su salmon populations is limited so the status of many stocks, especially in the Matanuska River watershed, is based on anecdotal information, professional judgment, or is unknown.

Since 2008, it has become evident that some Susitna salmon are experiencing significant declines. That year, the Alaska Board of Fisheries listed Susitna sockeye salmon as a Stock of Concern. Chinook salmon in that drainage missed their escapement goals for six years, and the Alaska Board of Fisheries listed six populations as Stocks of Concern in 2011. Little Susitna coho salmon have missed escapement goals for the past four years.

Not surprisingly, the health of Mat-Su Basin salmon habitat is linked to the level and location of human activity in the basin. The ecosystems that coincide with the more developed areas of the Mat-Su Basin may become seriously degraded without human intervention. Reduced health of these ecosystems is linked to alteration of native riparian vegetation, degraded water quality, and water flow changes, all of which have reached levels that may impair these ecosystems in the long-term. Within these areas, ADEC has identified over two dozen waterbodies that lack sufficient data to determine water quality and has designated four as Impaired. Some water pollution in these areas may be due to the replacement of more than 10% of native vegetation with impervious surfaces that concentrate stormwater runoff in surface waters.

Ecosystems coinciding with areas of little development have good overall health. Yet even these terrestrial ecosystems contain waterbodies that lack sufficient data, and ADEC has determined that insufficient information exists to assess how well Cook Inlet meets water quality standards. These are also largely the areas where the Stocks of Concern live out the freshwater portions of their life.

The current state of salmon and ecosystem health directs us to which species and ecosystems may require protection and prevention measures versus restoration to regain health. Preventative conservation measures in the undeveloped areas can ensure that these ecosystems remain healthy for salmon and other aquatic species. The more impacted terrestrial ecosystems of the developed areas will require not only protection against additional alteration and degradation but also mitigation and restoration actions to restore health.

Potential Threats to Salmon & Their Habitats

Many human activities pose potential threats to salmon and their habitats. Human activities can affect salmon by degrading or eliminating habitat; removing vegetation from wetlands and the banks of streams and lakes; degrading water quality; changing river flows; disconnecting flows between streams, lakes, and wetlands; or blocking fish passage. Lack of data to make management decisions can also be an impediment to conserving salmon and their habitats. Most of these activities are vital to human communities and can be mitigated to reduce or eliminate negative impacts to salmon and salmon habitat.

Potential Threats to Mat-Su Basin Salmon
Aquatic Invasive Species
Climate Change
Development in Estuaries and Nearshore Habitats
Ground & Surface Water Withdrawals
Household On-site Septic Systems & Wastewater
Large-scale Resource Development
Motorized Off-road Recreation
Residential, Commercial, & Industrial Development
Roads & Railroads
Stormwater Runoff

For the 2013 plan update, the scoping process confirmed that the seven potential threats in the 2008 plane were still important areas for the Partnership and recommended that four more potential threats be included in the Strategic Action Plan. An existing threat was expanded to include invasive aquatic plants along with northern pike. Climate change was included in this updated plan because more information exists and a clearer role for the Partnership emerged. Motorized off-road recreation has continued to negatively impact some salmon habitat in the Mat-Su, and some partners have been working with user groups to address the problem. Large-scale resource development includes diverse activities like hydropower and coal mining because the Partnership's roles around these potential threats – science and education – are anticipated to be similar. This plan outlines the potential impacts to salmon habitat from each threat and summarizes the current status or level of activity of the threat in the Mat-Su Basin.

Conservation Strategies

The Mat-Su Salmon Partnership's broad goals are to protect salmon and their habitats in the Mat-Su Basin and Upper Cook Inlet, mitigate threats to salmon and their habitats, restore connectivity between salmon habitats, and increase knowledge about salmon and their use of freshwater and marine habitats. The strategies for the Mat-Su Basin echo those that the National Fish Habitat Partnership uses to guide work at the national and partnership level.

A situation analysis for each threat brought into focus the more discrete issues upon which the Partnership can act and identified 11 conservation strategies to conserve salmon in the Mat-Su Basin. These strategies address the sources of the impacts and the impacts themselves. Some impacts have multiple sources that can be addressed collectively. Other potential threats have unique situations that lend themselves to being addressed specifically. For that reason, the conservation strategies are organized around a mix of impacts and threats.

Conservation Strategies	
1	Overarching Science Strategies
2	Alteration of Riparian Areas
3	Climate Change
4	Culverts that Block Fish Passage
5	Filling of Wetlands
6	Impervious Surfaces & Stormwater Pollution
7	Aquatic Invasive Species
8	Large-scale Resource Development
9	Loss or Alteration of Water Flow or Volume
10	Loss of Estuaries & Nearshore Habitats
11	Motorized Off-road Recreation
12	Wastewater Management

Conservation strategies are composed of objectives, which define a vision of success, and strategic actions that will achieve the objectives. The Partnership's strategies fall into four broad categories: protection, restoration, education, and science. In many places in the Mat-Su Basin, salmon and their habitats are healthy so protective measures, like reservations of water, land use planning, and voluntary land protection, can prevent degradation. In other places, restoration is necessary to re-establish fish passage and productive habitat. Public education, including best management practices, can prevent and mitigate impacts from human activities and help the general public connect their own individual actions to impacts on salmon habitat and water quality. Better understanding of salmon's needs throughout the Mat-Su Basin and Cook Inlet would improve management of salmon habitat and implementation of the recommendations in this plan. Three science strategies are highlighted because the information they will gather will inform multiple conservation strategies.

The Partnership's conservation strategies encourage collaboration among multiple partners to achieve common objectives that would be difficult for any one partner to accomplish alone. In some cases, comprehensive protection can be accomplished with revisions to local and state laws and increased enforcement of such laws; some strategies recommend such changes but in no way bind affected agencies to implement these strategies. What follows are objectives and strategic actions that the Partnership thinks it can accomplish in the next 10 to 20 years.

1. Overarching Science Strategies

Objective 1.1: Anadromous Waters Catalog

By 2020, ensure that all anadromous fish habitat in the Mat-Su Basin is included in the Anadromous Waters Catalog and thus given basic protections afforded under state law. Efforts to catalog anadromous fish should identify life stage information and document non-anadromous fish.

Objective 1.2: Habitat Quality

By 2020, characteristics of habitats that are critical for salmon at each life stage (spawning, rearing, and overwintering) will be identified and used to develop critical habitat definitions to identify places that provide these habitats.

Objective 1.3: Comprehensive Surface and Groundwater Studies

By 2018, an increased understanding of surface and groundwater exchange, including locations, quantities, flows, and variability in the Mat-Su Basin, will be sufficient to aid in identifying critical salmon habitat for each life stage.

Objective 1.4: Water Quality Monitoring

By 2018, a comprehensive baseline and monitoring program for water quality exists to track and manage changes in Mat-Su Basin waterbodies.

2. Alteration of riparian areas

Objective 2.1: Identification of Priority Riparian Areas for Salmon

By 2018, 50% of salmon riparian areas will be field surveyed, mapped and prioritized for long-term legal protection and/or restoration.

Objective 2.2: Protection of Priority Salmon Riparian Habitat

By 2018, secure long-term protective status (e.g., conservation easements, designated parks, land acquisition) of at least 10% of priority riparian habitats that have not been significantly altered.

Objective 2.3: Restoration of Priority Riparian Habitat

By 2018, 5% of priority riparian habitats that have been altered are restored.

3. Climate Change

Objective 3.1: Comprehensive Baseline and Monitoring for Stream Temperatures

By 2015, comprehensive baseline and monitoring program for stream temperatures exists to track and manage changes in priority Mat-Su Basin waterbodies and impacts on salmon and salmon habitat.

Objective 3.2: Integrate Climate Change into Priorities

By 2015, integrate climate change into habitat conservation strategies and prioritizations.

4. Culverts that block fish passage

Objective 4.1: No New Barriers

By 2015, effective fish passage is maintained at new road crossings through improved coordination between agencies, sufficient resources for applying current state statutes, and use of improved design and construction practices for effective fish passage.

Objective 4.2: Fish Passage Restoration

By 2015, fish passage will be restored in 65 priority culverts that currently block passage of juvenile or adult fish.

5. Filling of Wetlands

Objective 5.1 Identify, Map and Assess Functions of Wetlands for Salmon

By 2018, wetlands that are important for salmon will be identified, mapped and assessed for their functional importance for salmon.

Objective 5.2: Conserve Wetlands for Salmon

By 2020, loss of wetlands that are important for salmon either as spawning or rearing habitat, re-charge of streams, or filtration of streams, will be avoided, minimized, or mitigated with protection, management, and enhancement.

6. Impervious Surfaces and Stormwater Pollution

Objective 6.1: Minimization of Impacts on Water Quality

By 2018, new housing and urban development sites will not result in stormwater runoff that alters the quantity or quality of water in streams and lakes. All water flowing into salmon habitat will equal or exceed the quality necessary to protect the growth and propagation of fish as determined by state water quality standards for aquatic life.

Objective 6.2: Minimize Road Runoff

By 2018, the extent and potential of road runoff as a contributor to water quality issues at salmon streams will be known and BMPs developed to minimize impacts.

Objective 6.3: Imperviousness Impact Assessment
By 2018, understand the magnitude of impact of impervious surfaces and stormwater runoff in the most developed watersheds.

7. Aquatic Invasive Species

Objective7.1: Prevention
By 2016, identify potential vectors for introducing or spreading Aquatic Invasive Species (AIS) in the Mat-Su and conduct outreach to inform and influence target audiences so that their activities do not introduce or spread AIS.

Objective 7.2: Early Detection and Surveillance
By 2015, periodic surveillance surveys designed to have a high likelihood of detecting AIS at an incipient stage of infestation will be completed at priority waterbodies. Priorities are determined based on level of risk for introduction of AIS.

Objective 7.3: Rapid Response
By 2015, procedures are in place to respond rapidly to any newly discovered introductions or to newly detected expansion of existing AIS.

Objective 7.4: Control
By 2015, an effective program of integrated pest management for invasive species is developed and implemented, including elements of containment, eradication, control, and restoration.

8. Large-scale Resource Development

Objective 8.1 Education and Outreach about Large-scale Resource Projects
By 2017, the public will have access to information about proposed large-scale resource development projects and their potential to affect salmon and their habitats.

Objective 8.2: Agency Assistance for Large-scale Resource Projects
By 2017, state and federal agencies and stakeholders involved in permitting processes for large-scale resource development projects have the data, analytical tools, and expertise that they need to understand the potential to affect salmon and their habitat.

Objective 8.3: Address Data Gaps
By 2017, data gaps for large-scale resource development projects will be identified and filled as feasible for the licensing and permitting processes.

9. Loss or alteration of water flow or volume

Objective 9.1: Instream Flow on Anadromous Waters

By 2020, partner organizations have filed applications for reservations of water with ADNR to preserve the flow regimes of priority anadromous lakes and streams.

Objective 9.2: Community Water Needs Study
By 2012, current and future use and need of ground and surface water by Mat-Su Basin communities are quantified in order to assess impacts to water quantity.

10. Loss of estuaries and nearshore habitats

Objective 10.1: Salmon Ecology of Cook Inlet
By 2018, implement the Knik Arm Salmon Ecology Integrated Research Plan (HDR, 2010) to significantly improve the understanding of salmon ecology in Knik Arm.

Objective 10.2: Conserve Estuaries for Salmon
By 2018, assure no long-term impairments of vulnerable coastal habitats from incompatible shoreline developments.

11. Motorized Off-road Recreation

Objective 11.1: Impacts to Salmon and Salmon Habitat
By 2018, qualify the impacts to salmon and salmon habitat from off-highway vehicles (OHV) use regarding stream structure and water quality to specifically determine physical damage to the stream and banks and hydrocarbon and sedimentation inputs to streams.

Objective 11.2: Mitigate OHV Use at Streams
By 2018, establish effective and publicly acceptable mechanisms to support stream health near OHV trails and at stream crossings.

12. Wastewater Management

Objective 12.1: Improved Wastewater Disposal
By 2018, septic systems are designed and constructed based on parcel size, number of parcels in a subdivision, and soil suitability, with an emphasis on developing community systems and connecting to public systems, so that septic systems do not contribute to degraded water quality.

Objective 12.2: Expanded Wastewater Infrastructure
By 2018, Mat-Su Borough and its communities have a wastewater infrastructure and treatment facilities that can handle sewage discharges in the Mat-Su Borough.

Objective 12.3 Wastewater Pollution Prevention
By 2018, quantify the extent and sources of possible wastewater pollution to surface and ground waters from on-site septic systems and wastewater discharge.

The Future for the Mat-Su Salmon Partnership

The Mat-Su Salmon Partnership developed its first Strategic Action Plan in 2008 and updated the plan in 2013 in an effort to help partners set priorities for collaborative actions to conserve habitat for wild salmon that spawn, rear, or over-winter in the Mat-Su Basin. Relevant actions that could be guided by this plan include regulatory development; permitting; protection, restoration, and mitigation activities; assessment and research projects; and education and outreach activities.

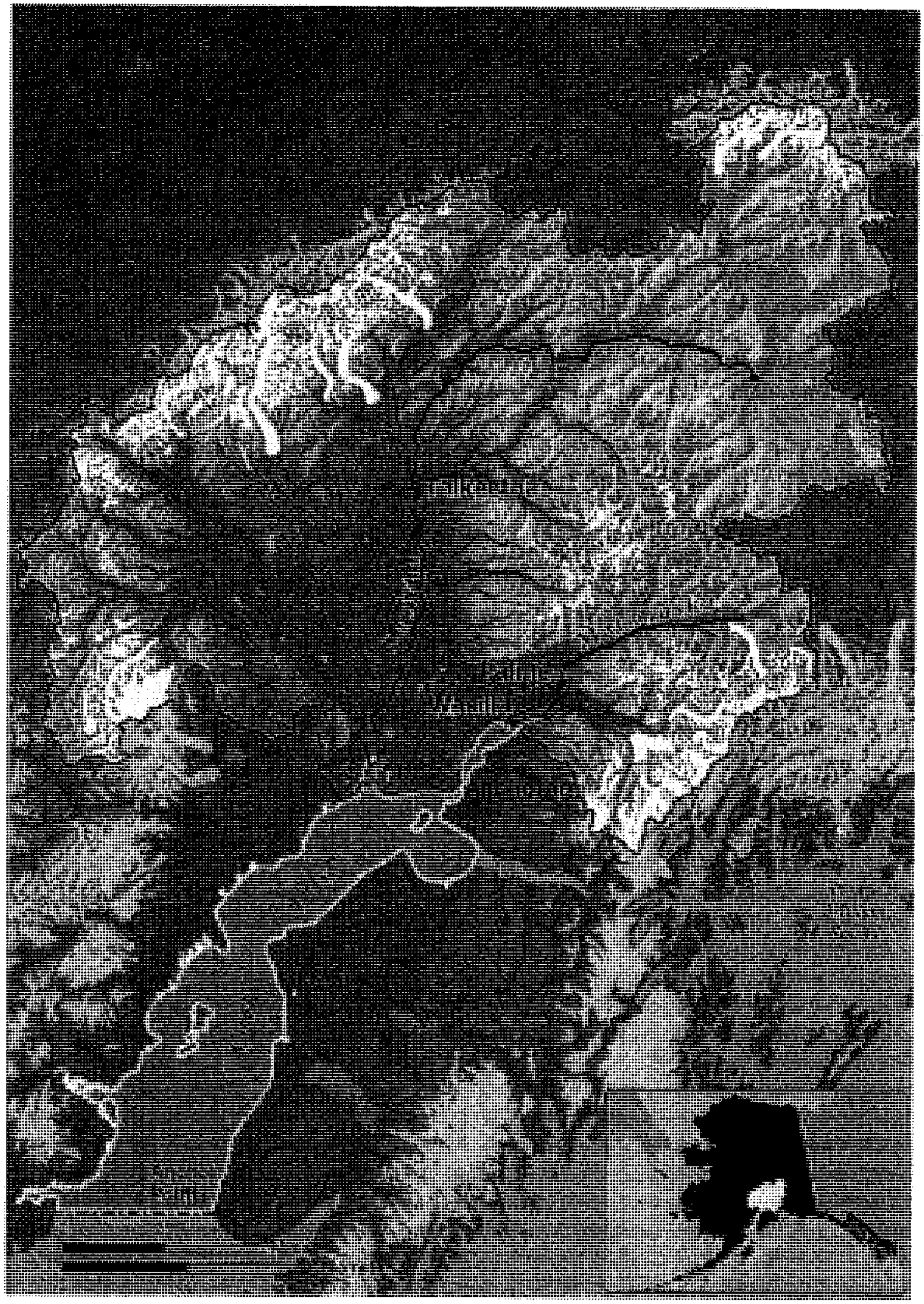
This Strategic Action Plan sets out priorities for this Partnership to conserve wild salmon and their habitat in the Mat-Su Basin. Achievement of these goals and objectives will depend upon commitment by partner organizations and collaboration between partners. The history of salmon in other parts of the world indicates that wild salmon cannot persist in their full abundance unless stakeholders work together to protect salmon habitat. Within this Partnership, each partner has unique capabilities, responsibilities, and resources that can address a key component for salmon habitat. Only in working together, can all the key components for salmon habitat be protected to ensure healthy, abundant salmon runs in the Mat-Su Basin into the future.

Table 1. Mat-Su Basin Salmon Habitat Partnership

AK Dept of Commerce, Community & Economic Development	City of Palmer	Natural Resources Conservation Service
AK Dept of Environmental Conservation	ConocoPhillips Alaska, Inc.	Palmer Soil & Water Conservation District
* AK Dept of Fish & Game	Cook Inlet Aquaculture Association	Pioneer Reserve
AK Dept of Natural Resources	Cook Inletkeeper	Sierra Club
AK Dept of Transportation & Public Facilities	Environmental Protection Agency	The Conservation Fund
Alaska Center for the Environment	*Envision Mat-Su	* The Nature Conservancy
Alaska Outdoor Council	Fishtale River Guides	The Wildlifers
Alaska Pacific University	Glacier Ridge Properties	Three Parameters Plus,Inc
Alaska Railroad Corporation	Great Land Trust	Tyonek Tribal Conservation District
Alaska Salmon Alliance	HDR Alaska Inc.	United Fishermen of Alaska
*AlaskaChem Engineeering	Knik River Watershed Group	Upper Susitna Soil & Water Conservation District
Alaskans for Palmer Hay Flats	Matanuska River Watershed Coalition	US Army Corps of Engineers
*Aquatic Restoration & Research Institute	* Matanuska-Susitna Borough	* U.S. Fish and Wildlife Service
Bureau of Land Management	Mat-Su Anglers	US Geological Survey
Butte Area Residents Civic Organization	Mat-Su Conservation Services	USDA Forest Service
* Chickaloon Village Traditional Council	Montana Creek Campground	Wasilla Soil & Water Conservation District
	* National Marine Fisheries Service	
	National Park Service	
	Native Village of Eklutna	

Note: *indicates Steering Committee member
Partners as of November 2013

Figure 1. The Scope of the Strategic Plan: Mat-Su Basin and Upper Cook Inlet



Phil Young
4940 Manytell Ave.
Anchorage, AK 99516

January 13, 2014

RE: Letter of support for Upper Cook Inlet sport fishery

Glenn Haight
Alaska Board of Fisheries Executive Director
PO Box 115526
Juneau, AK 99811-5526

Dear Chair Johnstone and members of the Alaska Board of Fisheries,

The upcoming Board of Fisheries meeting for Upper Cook Inlet will be critical for the sustainability of Kenai River king salmon and all other kings in Cook Inlet, many of which are stocks of concern. The abrupt fall in numbers of kings in the Inlet should be a red flag to all concerned parties. I urge you to action to deal with the conservation of kings at your upcoming meeting. My views on certain proposals are as follows.

A life long Alaskan that enjoys and lives on our wild fish.

It is short-sighted to manage a fully allocated resource with multiple groups wanting fish on the basis of yield instead of maximizing the overall returns. A larger pie allows more fish to be utilized by more users. Put more king salmon into the Kenai River to spawn, not less. Lowering the escapement goals for kings is not a viable or responsible long-term policy.

Therefore I am in support of proposal 188 that seeks to maintain an optimal escapement goal of 5,300 - 9,000 for early-run Kenai kings and proposal 207 that seeks a new optimal escapement goal of 20,000 - 40,000 for late-run Kenai kings.

Sport, personal use and commercial set net fisheries can all fish but must share equitably in the burden of king salmon conservation. To assure future sustainable and healthy king salmon returns to the Kenai River, everyone must be held accountable for their harvest and mortality of kings. Without acc ountability for all user groups, there will be no conservation success stories for king salmon.

Therefore I am in support of proposal 209 that seeks to pair restrictions for sport, personal use (dipnet) and commercial set net fisheries and proposal 211 that seeks to allow for incremental gear restrictions in the commercial set net fisheries.

Commercial fisheries in Alaska do a great job in providing food resources to national and global markets. However, the majority of Alaskans do not want to be dependent upon that supply chain for an essential food source for their families. Many Alaskans put fish in their freezers from a rod and reel and / or dipnet. Nowhere do more Alaskan families depend upon access and opportunity to harvest fish than in Cook Inlet, home to the state's largest sport and personal use (dipnet) fisheries. I favor reasonable opportunities for Alaskans to harvest meaningful numbers of fish for consumption.

Therefore I am in support of proposal 169 that starts the Kenai sockeye bag limit at 6 fish, proposal 161 that allows more sockeye to enter and spawn in the Kenai River, proposal 112 that raises the trigger to open Kasilof beaches to set net fishing, proposal 156 that mandates a Tuesday window closure for Kasilof set net fishing, proposal 248 that sets a coho bag limit of 3 fish with the set net fishery closes, proposal 126 that prohibits commercial set net fishermen from stacking (doubling) permits, and proposal 139 that expands time for commercial drift fleet to harvest Kenai and Kasilof sockeye.

It is important for all Alaskans to be able to enjoy salmon, not just the commercial fisherman. I even like the out of State people to come up and catch a fish--- they didn't catch many this year.
Your work on the Alaska Board of Fisheries is important. Alaska is known for its sustainable fisheries management. The crisis in low numbers of Kenai kings is a significant challenge. No other sport fishery in Alaska is as well-known as the Kenai. Your actions will shape the health of the fish and the viability of this fishery for years to come.
Sincerely,

Phil Young

Phil Young
4940 Manytell Ave.
Anchorage, AK 99516

Email address: phil.apex@gmail.com
Phone number: 907-267-9588
Additional information about me:
I am a Resident Sport Angler, Personal Use / Dipnetter, Concerned Citizen

John Farner
19414 Middleton Loop
Eagle River, AK 99577

January 13, 2014

RE: Letter of support for Upper Cook Inlet sport fishery

Glenn Haight
Alaska Board of Fisheries Executive Director
PO Box 115526
Juneau, AK 99811-5526

Dear Chair Johnstone and members of the Alaska Board of Fisheries,

I am very concerned about the decline of king salmon in Cook Inlet, especially on the Kenai River. Kenai kings are important and must not be ignored. The health of king salmon is now threatened. When you consider actions at your next meeting, please keep these ideas in mind.

I remember the first Kenai king that I caught when I was 16, almost 20 years ago, while fishing with Russell Knight and my father. It was the first of many trips to the peninsula when kings were abundant. Over the years I have taken countless trips with friends, family and co-workers on both private and guided trips. These past five years it hasn't even been worth the time and money. One does not have to talk to many residents of the area to find someone that has been adversely affected by the decline. Local business owners, guides, and residents have all felt the affects of reduced tourism revenues during the king season. If the board does not take action soon, the federal government will step in and completely devastate the economy of the area as the federal measures will not only affect fishing for kings, but all species in the Kenai waters. I implore the board to think of the long-term affects of continuing on the current path will have on all residents of Alaska.

King salmon are a sport fish priority in Cook Inlet salmon fisheries. Sport fisheries benefit more from greater abundances of fish, not less. We benefit from managing Kenai River king salmon fisheries for maximum sustained return, not minimum escapement goals. Making sure we have healthy escapements to deliver larger returns of kings is critical.

Therefore I am in support of proposal 188 that seeks to maintain an optimal escapement goal of 5,300 - 9,000 for early-run Kenai kings and proposal 207 that seeks a new optimal escapement goal of 20,000 - 40,000 for late-run Kenai kings.

In these times of historic low returns of king salmon to Cook Inlet and especially to the Kenai River, all user groups must share equitably in the burden of conservation. Sport anglers have seen harvest rates on the Kenai River for king salmon decline by 95 percent, while personal use (dipnetters) have foregone any harv est opportunity for Kenai kings the last two years. Meanwhile, in 2013, despite record-low numbers of king salmon, a severely restricted sport fishery and escapement goals barely being met, commercial set net sockeye fishermen were granted significant net-in-the-water time until near the end of the season.

Therefore I am in support of proposal 209 that seeks to pair restrictions for sport, personal use (dipnet) and commercial set net fisheries and proposal 211 that seeks to allow for incremental gear restrictions in the commercial set net fisheries.

I support increased, meaningful opportunity for sport and personal use (dipnetting) fishing in Cook Inlet. Alaskans greatly depend upon the fish harvested in these fisheries. The social, recreational, cultural and economic values generated in these fisheries are much greater in value than those generated in the

area's commercial salmon fisheries. As a public resource, it makes most sense to manage Cook Inlet salmon resources for the greatest number of Alaskans - those that fish and harvest in the sport and personal use (dipnetting) fisheries.
Therefore I am in support of proposal 169 that starts the Kenai sockeye bag limit at 6 fish, proposal 161 that allows more sockeye to enter and spawn in the Kenai River, proposal 112 that raises the trigger to open Kasilof beaches to set net fishing, proposal 156 that mandates a Tuesday window closure for Kasilof set net fishing, proposal 248 that sets a coho bag limit of 3 fish with the set net fishery closes, proposal 126 that prohibits commercial set net fishermen from stacking (doubling) permits, and proposal 139 that expands time for commercial drift fleet to harvest Kenai and Kasilof sockeye.
Thank you for the opportunity to comment on these issues. I appreciate your consideration of my thoughts and concerns. As you consider the man y proposals, remember - Long Live the Kings!
Sincerely,

John Farner

Farner, John
19414 Middleton Loop
Eagle River, AK 99577

Email address: jfarner@gci.net
Phone number: 907-351-0873
Additional information about me:
I am a Resident Sport Angler

Kara Moriarty
1931 Bluegrass Circle
Anchorage, AK 99502

January 13, 2014

RE: Letter of support for Upper Cook Inlet sport fishery

Glenn Haight
Alaska Board of Fisheries Executive Director
PO Box 115526
Juneau, AK 99811-5526

Dear Chair Johnstone and members of the Alaska Board of Fisheries,

In areas like the Kenai River, many people feel like I do that king salmon are more important as a sport fishery than as a commercial fishery. In my mind, the obvious decline in the number of king salmon returning to the Kenai demands your attention. When returns, catch rates, and angler hours all drop by three quarters in less than a decade, something is wrong and business as usual is no longer acceptable. At the fast approaching Board of Fisheries meetings for Cook Inlet, please make king salmon management a priority consideration.

I have lived in Alaska for almost 17 years. My husband is a pilot and we have three young children who love the Alaskan lifestyle.

It is short-sighted to manage a fully allocated resource with multiple groups wanting fish on the basis of yield instead of maximizing the overall returns. A larger pie allows more fish to be utilized by more users. Put more king salmon into the Kenai River to spawn, not less. Lowering the escapement goals for kings is not a viable or responsible long-term policy.

Therefore I am in support of proposal 188 that seeks to maintain an optimal escapement goal of 5,300 - 9,000 for early-run Kenai kings and proposal 207 that seeks a new optimal escapement goal of 20,000 - 40,000 for late-run Kenai kings.

The Alaska Sustainable Salmon Policy directs that the burden of conservation will be applied to users in close proportion to the users' respective harvest of the salmon stock. Where the impact of resource use is uncertain, but likely presents a measureable risk to sustained yield, priority should be g iven to conserving the productive capacity of the resource. All user groups need to bear in the burden of conservation of Kenai River king salmon in an equitable manner.

Therefore I am in support of proposal 209 that seeks to pair restrictions for sport, personal use (dipnet) and commercial set net fisheries and proposal 211 that seeks to allow for incremental gear restrictions in the commercial set net fisheries.

I support putting Alaskan residents first in the management of Cook Inlet salmon fisheries. Many people harvest fish to feed our families and share with friends. Access to fish is one of the primary reasons Alaskans value living in Alaska. When fishery managers puts the needs of Alaskan residents behind the needs of national and global fish markets, people are justifiably resentful. Cook Inlet supports Alaska's largest sport and personal use (dipnetting) fisheries. The needs of Al askan residents must be a top priority in Cook Inlet.

Therefore I am in support of proposal 169 that starts the Kenai sockeye bag limit at 6 fish, proposal 161 that allows more sockeye to enter and spawn in the Kenai River, proposal 112 that raises the trigger to open Kasilof beaches to set net fishing, proposal 156 that mandates a Tuesday window closure for Kasilof set net fishing, proposal 248 that sets a coho bag limit of 3 fish with the set net fishery closes,

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proposal 126 that prohibits commercial set net fishermen from stacking (doubling) permits, and proposal 139 that expands time for commercial drift fleet to harvest Kenai and Kasilof sockeye.
I know you will consider several proposals throughout your next Board meeting. The bottom line for me is after living in Alaska for 17 years, I have never caught a king salmon. I have tried a few times, and even though I fish the Kenai once/twice a year, I want my kids to have the oppor tunity to catch a king. I'm not a biologist so I don't pretend to know which of the proposals will produce more salmon in the river, I just hope that you diligently consider each proposal with the overall goal of more fish for everyone.
Service on the Alaska Board of Fisheries is time-consuming and important work. Thank you for the chance to share my ideas. I trust that you recognize the critical state facing king salmon on the Kenai River and in Cook Inlet. I wish you and your colleagues on the board good fortune as you tackle these matters.
Sincerely,

Kara Moriarty

Kara Moriarty
1931 Bluegrass Circle
Anchorage, AK 99502

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Phone number: 907-351-1116
Additional information about me:
I am a Resident Sport Angler, Concerned Citizen

Scott Eggemeyer
35655 Teresa Way
Soldotna, AK 99669

January 13, 2014

RE: Letter of support for Upper Cook Inlet sport fishery

Glenn Haight
Alaska Board of Fisheries Executive Director
PO Box 115526
Juneau, AK 99811-5526

Dear Chair Johnstone and members of the Alaska Board of Fisheries,

The upcoming Board of Fisheries meeting for Upper Cook Inlet will be critical for the sustainability of Kenai River king salmon and all other kings in Cook Inlet, many of which are stocks of concern. The abrupt fall in numbers of kings in the Inlet should be a red flag to all concerned parties. I urge you to action to deal with the conservation of kings at your upcoming meeting. My views on certain proposals are as follows.

The litmus test for this cycle's BOF should be simply; does this action have any possibility of saving Cook Inlet King Salmon or does this action have the possibility of killing King Salmon. Now you as a board have to decide FIRST, do you want to save the King Salmon of Cook Inlet or should they simply become a foot note in our history. This is purely up to you as a board, it is painfully obvious that average residents and non resident users of this resource cannot contain their need to kill every last one nor can the "ma nagers" of the resource, manage. So it comes down to you as a board.

King salmon are a sport fish priority in Cook Inlet salmon fisheries. Sport fisheries benefit more from greater abundances of fish, not less. We benefit from managing Kenai River king salmon fisheries for maximum sustained return, not minimum escapement goals. Making sure we have healthy escapements to deliver larger returns of kings is critical.

Therefore I am in support of proposal 188 that seeks to maintain an optimal escapement goal of 5,300 - 9,000 for early-run Kenai kings and proposal 207 that seeks a new optimal escapement goal of 20,000 - 40,000 for late-run Kenai kings.

The Alaska Sustainable Salmon Policy directs that the burden of conservation will be applied to users in close proportion to the users' respective harvest of the salmon stock. Where the impact of resource use is uncertain, but likely presents a measureable risk to sustained yield, priority should be given to conserving the productive capacity of the resource. All user groups need to bear in the burden of conservation of Kenai River king salmon in an equitable manner.

Therefore I am in support of proposal 209 that seeks to pair restrictions for sport, personal use (dipnet) and commercial set net fisheries and proposal 211 that seeks to allow for incremental gear restrictions in the commercial set net fisheries.

A majority of Alaskans have access to the Cook Inlet salmon fisheries and we love to fish. Alaskans have the highest rates of participation in recreational fishing in the nation. Sport and personal use (dipnetting) fisheries provide essential food for many Alaskan households. Cook Inlet is the primary location in the state of Alaska where the majority of residents provide food for their families. It must be a top management priority. It is time to put Alaskans first in Cook Inlet.

Therefore I am in support of proposal 169 that starts the Kenai sockeye bag limit at 6 fish, proposal 161 that allows more sockeye to enter and spawn in the Kenai River, proposal 112 that raises the trigger to

open Kasilof beaches to set net fishing, proposal 156 that mandates a Tuesday window closure for Kasilof set net fishing, proposal 248 that sets a coho bag limit of 3 fish with the set net fishery closes, proposal 126 that prohibits commercial set net fishermen from stacking (doubling) permits, and proposal 139 that expands time for commercial drift fleet to harvest Kenai and Kasilof sockeye.
I could bore you with all of the numbers and science of why you should want to save the King Salmon of the Cook Inlet, but a lot of people have done that and they are way smarter than I. So here it is, " its the right thing to do". Take away the socio economical jargon and get down to the grit, you can be the board that saves them or kills them. Understand if you maintain status quo the Kings are gone.
Thank you for the opportunity to comment on these issues. I appreciate your consideration of my thoughts and concerns. As you consider the many proposals, remember - Long Live the Kings!
Sincerely,

A. Scott Eggemeyer

Scott Eggemeyer
35655 Teresa Way
Soldotna, AK 99669

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Phone number: 907-244-4777
Additional information about me:
I am a Resident Sport Angler

Anna Sappah
1711 Logan Street
Anchorage, AK 99508

January 13, 2014

RE: Letter of support for Upper Cook Inlet sport fishery

Glenn Haight
Alaska Board of Fisheries Executive Director
PO Box 115526
Juneau, AK 99811-5526

Dear Chair Johnstone and members of the Alaska Board of Fisheries,

Major indicators show a steep decline in Kenai River king salmon. Angler hours have dropped by 80 percent and harvest rates are 95 percent less than a decade ago. We are barely, if at all, making minimum escapements for kings on the Kenai and many other rivers in Cook Inlet. Although king salmon declines are a statewide issue, it is an emergency situation here. For your next meeting, I will share with you a couple of important ideas for your consideration.

I am a lifelong Alaskan, and Alaskan native who was raised in SouthCentral Alaska. The bulk of my fishing has been on the Kenai peninsula. I was taught to fish,as a child, by my dad. My mothers family is Alutiiq and fishing and other substance activities are a large part of that heritage. I value the ability to share these traditions with my 4 children and 12 grandchildren. I have been actively engaged in guiding on the Kenai river since 2001. One of my greatest joys is to teach others to fish and watch them as they experience their first catch. Having these opportunities available for people and their families, in an area that is easily accessible without spending thousands on travel to remote fishing grounds is imperative. Everyone who is interested should have the opportunity to have these experiences, feed their families with their catch and share the outdoors with their family.

King salmon are a sport fish priority in Cook Inlet salmon fisheries. Sport fisheries benefit more from greater abundances of fish, not less. We benefit from managing Kenai River king salmon fisheries for maximum sustained return, not minimum escapement goals. Making sure we have healthy escapements to deliver larger returns of kings is critical.

I support proposals:

#188: Early-run Spawning Escapement Goal of 5,300-9,000

#207: Late-run Spawning Escapement Goal of 20,000-40,000

During times of scarcity for any fishery resource, the right thing to do is to make all user groups share equitably in the burden of conservation. All major indicators show a steep decline in Kenai River king salmon. All user groups must share equitably in the burden of Kenai River king salmon conservation. It is a shared responsibility to maintain the future and health of this resource.

I support proposals:

#209: Paired restrictions for sport, personal use (dipnet) and set net fisheries

#211: Allows for incremental gear restrictions for set net fisheries

A majority of Alaskans have access to the Cook Inlet salmon fisheries and we love to fish. Alaskans have the highest rates of participation in recreational fishing in the nation. Sport and personal use (dipnetting) fisheries provide essential food for many Alaskan households. Cook Inlet is the primary location in the state of Alaska where the majority of residents provide food for their families. It must be a top management priority. It is time to put Alaskans first in Cook Inlet.

I support proposals:
#169: Kenai sockeye bag limit starts at 6, not 3
#161: Allow more sockeye to enter and spawn in the Kenai River
#112: Raise trigger to open Kasilof beaches to set net fishing
#156: Mandate Tuesday window closure for Kasilof set net fishing
#248: Coho bag limit of 3 when set net fishery closes
#126: Prohibit commercial set net fishermen from stacking (doubling) permits
#139: Expand time for commercial drift fleet to harvest Kenai and Kasilof sockeye
The resources should be available to all of us. The fishery should be managed in a way that allows the king salmon stocks to recover and become sustainable. Given the economy and push toward healthy activity, the sockeye and coho fishery provides an excellent opportunity for Alaskans to provide for their families, teach children about respecting our resources, have healthy family activity and provide nutritious food for their tables. The resources on the Kenai should be managed with the needs of Alaskans in mind. My goal is to have these resources available for my children and their children and generations to come.
Thank you for the opportunity to comment on these issues. I appreciate your consideration of my thoughts and concerns. As you consider the many proposals, remember - Long Live the Kings!
Sincerely,

Anna Sappah

Anna Sappah
1711 Logan Street
Anchorage, AK 99508

Email address: annasappah@hoymail.com
Phone number: 907-717-7282
Additional information about me:
I am a Resident Sport Angler

Dennis Gease
PO Box 2451
Kenai, AK 99611

January 13, 2014

RE: Letter of support for Upper Cook Inlet sport fishery

Glenn Haight
Alaska Board of Fisheries Executive Director
PO Box 115526
Juneau, AK 99811-5526

Dear Chair Johnstone and members of the Alaska Board of Fisheries,

I am very concerned about the decline of king salmon in Cook Inlet, especially on the Kenai River. Kenai kings are important and must not be ignored. The health of king salmon is now threatened. When you consider actions at your next meeting, please keep these ideas in mind.
My wife and I chose to retire to Alaska in part because of its great fishing and hunting opportunities. We bought a retirement home on the Kenai River so that we could enjoy the benefits of its great salmon runs, especially kings. I have seen the fishery steadily get worse - much harder to catch a king now than ten years when we first got here.
Adequate numbers of king salmon must be allowed to spawn. We must manage the Kenai River king run for maximum sustained return, not for minimum escapement goals. Managing for lower numbers of spawning king salmon is a bad idea and leaves no room for margin of error. Recent returns show a change from the historical norms: there are now a larger proportion of younger fish; all fish are smaller at age; there are a larger proportion of immature males; and there are a smaller number of the larger, more fecund females. All of these issues with the quality of the more recent king salmon escapements points to taking a precautionary, conservative management approach.
I support proposals:
#188: Early-run Spawning Escapement Goal of 5,300-9,000
#207: Late-run Spawning Escapement Goal of 20,000-40,000
Sport, personal use and commercial set net fisheries can all fish but must share equitably in the burden of king salmon conservation. To assure future sustainable and healthy king salmon returns to the Kenai River, everyone must be held accountable for their harvest and mortality of kings. Without accountability for all user groups, there will be no conservation success stories for king salmon.
I support proposals:
#209: Paired restrictions for sport, personal use (dipnet) and set net fisheries
#211: Allows for incremental gear restrictions for set net fisheries
The fix to the management failure of not providing Alaskan residents a reasonable opportunity to harvest meaningful numbers of fish for food is not directing them to purchase those same fish from commercial fishermen. That tactic is just insulting to Alaskans who want to harvest their own fish for personal consumption and to share with family and friends. In the Cook Inlet region, the harvest needs of 200,000 resident and non-resident anglers and the more than 30,000 personal use (dipnetting) households must be a top management priority, not an afterthought based on incidental escapement in the prosecution of commercial fisheries.
I support proposals:
#169: Kenai sockeye bag limit starts at 6, not 3

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#161: Allow more sockeye to enter and spawn in the Kenai River
#112: Raise trigger to open Kasilof beaches to set net fishing
#156: Mandate Tuesday window closure for Kasilof set net fishing
#248: Coho bag limit of 3 when set net fishery closes
#126: Prohibit commercial set net fishermen from stacking (doubling) permits
#139: Expand time for commercial drift fleet to harvest Kenai and Kasilof sockeye
The king salmon decline has negatively impacted our lifestyle in retirement. Many of my older friends feel the same way - in fact some retirees have already moved away because of the extremely low numbers of kings and lack of quality opportunity to go fishing on the Kenai. I have also observed the negative impact on the local economy that this situation has created. Many local businesses are being impacted by the fewer numbers of people participating in the fisheries, especially the non-resident tourists.
The Alaska Board of Fisheries faces an urgent responsibility to give clear direction on how best to mitigate the king salmon disaster occurring in Cook Inlet and on the Kenai River. Simply lowering escapement numbers and then maintaining status quo management is not a recipe for long-term success. I urge you to take the necessary time to fully work through the king salmon conservation and management issues at your next meeting for Upper Cook Inlet. There is no higher priority than this.
Sincerely,

Dennis Gease

Dennis Gease
PO Box 2451
Kenai, AK 99611

Email address: dennisgease@gmail.com
Phone number: 907-252-9291
Additional information about me:
I am a Resident Sport Angler, Conservationist, Personal Use / Dipnetter, Concerned Citizen

Kevin Branson
3313 Cottonwood St
Anchorage, AK 99508

January 13, 2014

RE: Letter of support for Upper Cook Inlet sport fishery

Glenn Haight
Alaska Board of Fisheries Executive Director
PO Box 115526
Juneau, AK 99811-5526

Dear Chair Johnstone and members of the Alaska Board of Fisheries,

Many people share my unease about the steep decline of king salmon on the Kenai River and elsewhere in Cook Inlet. It is a very important situation that demands careful consideration and action at your next fisheries meeting for Upper Cook Inlet. You must make this a priority - we need to act now before it is too late. From the many proposals for you to look at, I think these are areas to pay close attention to.
I moved to Anchorage out College to start my career in public accounting because Alaska was the last frontier. I have been raising my family here and now have two grandchildren. We all love Alaska because of the outdoors. We hunt and fish to provide food for our family. We eat game and fish we hunt and catch rather than buy it in the store because we want to know what we are eating. We also enjoy the fishing adventure and teaching the next generation. Access to hunting and fishing is a primary reason to live in Alaska. The decline i n the Kenai River king salmon is really bad news for the entire State. It impacts tourism statewide. It is sad to think my grandchildren may have to be shown pictures instead of seeing for themselves the mighty Kenai King salmon that use to be. Since we eat a lot of salmon the dip net fishery is very helpful and fun. I have a cabin on the lower Kenai river and love to fish for kings but have not for the last two years when allowed to help with conservation.
It is short-sighted to manage a fully allocated resource with multiple groups wanting fish on the basis of yield instead of maximizing the overall returns. A larger pie allows more fish to be utilized by more users. Put more king salmon into the Kenai River to spawn, not less. Lowering the escapement goals for kings is not a viable or responsible long-term policy.
I support proposals:
#188: Early-run Spawning Escapement Goal of 5,300-9,000
#207: Late-run Spawning Escapement Goal of 20,000-40,000
Sport, personal use and commercial set net fisheries can all fish but must share equitably in the burden of king salmon conservation. To assure future sustainable and healthy king salmon returns to the Kenai River, everyone must be held accountable for their harvest and mortality of kings. Without accountability for all user groups, there will be no conservation success stories for king salmon.
I support proposals:
#209: Paired restrictions for sport, personal use (dipnet) and set net fisheries
#211: Allows for incremental gear restrictions for set net fisheries
Alaska residents should not have to buy our fish back from commercial fishermen. There should be increased, meaningful opportunity for sport and personal-use fishing for sockeye on the Kenai River. I support the expanded use of the commercial drift-gillnet fleet to harvest Kenai and Kasilof sockeye in Upper Cook Inlet.
I support proposals:

#169: Kenai sockeye bag limit starts at 6, not 3
#161: Allow more sockeye to enter and spawn in the Kenai River
#112: Raise trigger to open Kasilof beaches to set net fishing
#156: Mandate Tuesday window closure for Kasilof set net fishing
#248: Coho bag limit of 3 when set net fishery closes
#126: Prohibit commercial set net fishermen from stacking (doubling) permits
#139: Expand time for commercial drift fleet to harvest Kenai and Kasilof sockeye
We need to protect the Kenai Kings. The decline is real and what is being done to stop it? I love to fish for Kenai Kings but as I said before I have not fished for them in the last two years during the limited times it was possible because I wanted to help protect them. What are you doing to protect them or improve their sustainability? I think the dip net fishery is a great way for Alaskan's to enjoy catching and eating sockeye salmon. This last summer was poorly managed in my opinion. People came from around the state on the weekend of the big surge and all the commercial nets were out and stayed out and the public went home empty handed.That was wrong for a public resource. Give it to the few and take from the many? I do appreciate the efforts of the members of the Board and your dedication to public service. I understand it is not an easy job. The fish come first - protect the Kings!
Service on the Alaska Board of Fisheries is time-consuming and important work. Thank you for the chance to share my ideas. I trust that you recognize the critical state facing king salmon on the Kenai River and in Cook Inlet. I wish you and your colleagues on the board good fortune as you tackle these matters.
Sincerely,

Kevin Branson

Kevin Branson
3313 Cottonwood St
Anchorage, AK 99508

Email address: kevinb@thgcpa.com
Phone number: 907-272-1571
Additional information about me:
I am a Resident Sport Angler, Personal Use / Dipnetter, Concerned Citizen

Mark Hylen
8540 Sultana Dr.
Anchorage, AK 99516

January 13, 2014

RE: Letter of support for Upper Cook Inlet sport fishery

Glenn Haight
Alaska Board of Fisheries Executive Director
PO Box 115526
Juneau, AK 99811-5526

Dear Chair Johnstone and members of the Alaska Board of Fisheries,

I am writing this letter to express my concerns about fish issues in Cook Inlet. I am very worried about the lack of king salmon. The Board of Fisheries must deal with the scarcity of kings in Cook Inlet at the next board meeting in Anchorage. There are many proposals to consider, but I want to talk about a few that are important to me.

I am a lifelong Alaskan who has great memories fishing on the Kenai and want to ensure my kids share the same opportunity to experience the great things Alaska has to offer.

It is short-sighted to manage a fully allocated resource with multiple groups wanting fish on the basis of yield instead of maximizing the overall returns. A larger pie allows more fish to be utilized by more users. Put more king salmon into the Kenai River to spawn, not less. Lowering the escapement goals for kings is not a viable or responsible long-term policy.

I support proposals:

#188: Early-run Spawning Escapement Goal of 5,300-9,000

#207: Late-run Spawning Escapement Goal of 20,000-40,000

Sport, personal use and commercial set net fisheries can all fish but must share equitably in the burden of king salmon conservation. To assure future sustainable and healthy king salmon returns to the Kenai River, everyone must be held accountable for their harvest and mortality of kings. Without accountability for all user groups, there will be no conservation success stories for king salmon.

I support proposals:

#209: Paired restrictions for sport, personal use (dipnet) and set net fisheries

#211: Allows for incremental gear restrictions for set net fisheries

I support putting Alaskan residents first in the management of Cook Inlet salmon fisheries. Many people harvest fish to feed our families and share with friends. Access to fish is one of the primary reasons Alaskans value living in Alaska. When fishery managers puts the needs of Alaskan residents behind the needs of national and global fish markets, people are justifiably resentful. Cook Inlet supports Alaska's largest sport and personal use (dipnetting) fisheries. The needs of Alaskan residents must be a top priority in Cook Inlet.

I support proposals:

#169: Kenai sockeye bag limit starts at 6, not 3

#161: Allow more sockeye to enter and spawn in the Kenai River

#112: Raise trigger to open Kasilof beaches to set net fishing

#156: Mandate Tuesday window closure for Kasilof set net fishing

#248: Coho bag limit of 3 when set net fishery closes

#126: Prohibit commercial set net fishermen from stacking (doubling) permits

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#139: Expand time for commercial drift fleet to harvest Kenai and Kasilof sockeye
Your work on the Alaska Board of Fisheries is important. Alaska is known for its sustainable fisheries management. The crisis in low numbers of Kenai kings is a significant challenge. No other sport fishery in Alaska is as well-known as the Kenai. Your actions will shape the health of the fish and the viability of this fishery for years to come.
Sincerely,

Mark Hylen

Mark Hylen
8540 Sultana Dr.
Anchorage, AK 99516

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Additional information about me:
I am a Resident Sport Angler, Concerned Citizen

Ted Smith
3591s. brookshore place
Boise, ID 83706

January 13, 2014

RE: Letter of support for Upper Cook Inlet sport fishery

Glenn Haight
Alaska Board of Fisheries Executive Director
PO Box 115526
Juneau, AK 99811-5526

Dear Chair Johnstone and members of the Alaska Board of Fisheries,

King salmon management and conservation needs to be at the top of the list of priorities that you deal with at the next Board of Fisheries meeting for Upper Cook Inlet. No other issue has changed as dramatically as the disappearance of healthy runs of king salmon on the world famous Kenai River and in other rivers in Cook Inlet. Please take time to carefully consider how best manage these iconic fish - your actions will be critical in how well king salmon survive. My opinions on various proposals are as follows.
I have enjoyed visiting Alaska for the purpose of Kenai King fishing almost every year since moving out of Alaska in 1986. I am a property owner and last year spent 13 weeks living in Alaska around Soldotna. Frankly I am very concerned about the boards's lack of concern for Kenai Kings and there effect on Alaska's economy.
King salmon are a sport fish priority in Cook Inlet salmon fisheries. Sport fisheries benefit more from greater abundances of fish, not less. We benefit from managing Kenai River king salmon fisheries for maximum sustained return, not minimum escapement goals. Making sure we have healthy escapements to deliver larger returns of kings is critical.
Therefore I am in support of proposal 188 that seeks to maintain an optimal escapement goal of 5,300 - 9,000 for early-run Kenai kings and proposal 207 that seeks a new optimal escapement goal of 20,000 - 40,000 for late-run Kenai kings.
During times of scarcity for any fishery resource, the right thing to do is to make all user groups share equitably in the burden of conservation. All major indicators show a steep decline in Kenai River king salmon. All user groups must share equitably in the burden of Kenai River king salmon conservation. It is a shar ed responsibility to maintain the future and health of this resource.
Therefore I am in support of proposal 209 that seeks to pair restrictions for sport, personal use (dipnet) and commercial set net fisheries and proposal 211 that seeks to allow for incremental gear restrictions in the commercial set net fisheries.
Commercial fisheries in Alaska do a great job in providing food resources to national and global markets. However, the majority of Alaskans do not want to be dependent upon that supply chain for an essential food source for their families. Many Alaskans put fish in their freezers from a rod and reel and / or dipnet. Nowhere do more Alaskan families depend upon access and opportunity to harvest fish than in Cook Inlet, home to the state's largest sport and personal use (dipnet) fisheries. I favor reasonable opportunities for Alaskans to harvest meaningful numbers of fish for consu mption.
Therefore I am in support of proposal 169 that starts the Kenai sockeye bag limit at 6 fish, proposal 161 that allows more sockeye to enter and spawn in the Kenai River, proposal 112 that raises the trigger to open Kasilof beaches to set net fishing, proposal 156 that mandates a Tuesday window closure for Kasilof set net fishing, proposal 248 that sets a coho bag limit of 3 fish with the set net fishery closes,

proposal 126 that prohibits commercial set net fishermen from stacking (doubling) permits, and proposal 139 that expands time for commercial drift fleet to harvest Kenai and Kasilof sockeye.
Without these focused, timely corrections in place, Alsaka's fisheries will decline substantially and the quality of life Alaskan's hold so cherished will slip away. Don't let this happen on your watch. Restore the Kenai Kings. Keeping them strong keeps Alaska strong. We owe it to our sons and daughters.
Service on the Alaska Board of Fisheries is time-consuming and important work. Thank you for the chance to share my ideas. I trust that you recognize the critical state facing king salmon on the Kenai River and in Cook Inlet. I wish you and your colleagues on the board good fortune as you tackle these matters.
Sincerely,

Ted Smith

ted smith
3591s. brookshore place
boise, ID 83706

Email address: ted@tedrsmith.com
Phone number: 2087940431
Additional information about me:
I am a Non-Resident Sport Angler

Cindy Hulquist
P O Box 671988
Chugiak, AK 99567

January 14, 2014

RE: Letter of support for Upper Cook Inlet sport fishery

Glenn Haight
Alaska Board of Fisheries Executive Director
PO Box 115526
Juneau, AK 99811-5526

Dear Chair Johnstone and members of the Alaska Board of Fisheries,

I am writing this letter to express my concerns about fish issues in Cook Inlet. I am very worried about the lack of king salmon. The Board of Fisheries must deal with the scarcity of kings in Cook Inlet at the next board meeting in Anchorage. There are many proposals to consider, but I want to talk about a few that are important to me.

I am a 30+ year Alaska resident who enjoys sport fishing as a family activity that brings us all together for some wonderful, memorable family times. It also helps us feed our family with delicious and nutritional fish.

It is short-sighted to manage a fully allocated resource with multiple groups wanting fish on the basis of yield instead of maximizing the overall returns. A larger pie allows more fish to be utilized by more users. Put more king salmon into the Kenai River to spawn, not less. Lowering the escapement goals for kings is not a viable or responsible long-term policy.

Therefore I am in support of proposal 188 that seeks to maintain an optimal escapement goal of 5,300 - 9,000 for early-run Kenai kings and proposal 207 that seeks a new optimal escapement goal of 20,000 - 40,000 for late-run Kenai kings.

During times of scarcity for any fishery resource, the right thing to do is to make all user groups share equitably in the burden of conservation. All major indicators show a steep decline in Kenai River king salmon. All user groups must share equitably in the burden of Kenai River king salmon conserv ation. It is a shared responsibility to maintain the future and health of this resource.

Therefore I am in support of proposal 209 that seeks to pair restrictions for sport, personal use (dipnet) and commercial set net fisheries and proposal 211 that seeks to allow for incremental gear restrictions in the commercial set net fisheries.

I support increased, meaningful opportunity for sport and personal use (dipnetting) fishing in Cook Inlet. Alaskans greatly depend upon the fish harvested in these fisheries. The social, recreational, cultural and economic values generated in these fisheries are much greater in value than those generated in the area's commercial salmon fisheries. As a public resource, it makes most sense to manage Cook Inlet salmon resources for the greatest number of Alaskans - those that fish and harvest in the sport and personal use (dipnetting) fisheries.

Therefore I am in support of proposal 169 that starts the Kenai sockeye bag limit at 6 fish, proposal 161 that allows more sockeye to enter and spawn in the Kenai River, proposal 112 that raises the trigger to open Kasilof beaches to set net fishing, proposal 156 that mandates a Tuesday window closure for Kasilof set net fishing, proposal 248 that sets a coho bag limit of 3 fish with the set net fishery closes, proposal 126 that prohibits commercial set net fishermen from stacking (doubling) permits, and proposal 139 that expands time for commercial drift fleet to harvest Kenai and Kasilof sockeye.

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These issues are very important to our family, particularly to our children, grandchildren, and the future generations.
Thank you for your service to responsible fisheries management in Alaska. I can think of no higher priority than to deal successfully and in a forthright manner with the crisis we are now facing with the Kenai River king salmon. Their future is in your hands.
Sincerely,

Cindy L. Hulquist

Cindy Hulquist
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Chugiak, AK 99S67

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Additional information about me:
I am a Resident Sport Angler, Concerned Citizen