DIVISION OF SUBSISTENCE
Alaska Department of Fish and Game
Revised, March 2021

The Chinook Salmon Research Initiative and Alaska's Subsistence Fisheries: What Did We Learn?

Introduction

In 2012, the Alaska Department of Fish and Game (ADF&G) launched the Chinook Salmon Research Initiative (CSRI) in response to statewide declines in productivity and abundance of Chinook salmon *Oncorhynchus tshawytscha* stocks (also commonly called "king salmon"; these two names are used interchangeably in this summary). ADF&G prepared a *Chinook Salmon Stock Assessment and Research Plan* to guide investigations, focusing on 12 "indicator stocks" (ADF&G Chinook Salmon Research Team 2013). A public Chinook Salmon Symposium in October 2012 informed the development of the plan.[1] In addition to stock assessment studies, nearshore marine surveys, and life history process studies, the CSRI recommended a set of harvest assessment, local and traditional knowledge (LTK), and other social science studies (ADF&G Chinook Salmon Research Team 2013:45–46).

Plate 1.–K'iytin, Chinook salmon backbones, dry in the sun at Tyonek, upper Cook Inlet.

In response to these recommendations, ADF&G's Division of Subsistence conducted 12 projects (Table 1) covering 8 of the 12 stocks with key LTK or other human-use knowledge gaps. The projects focused on three broad areas of inquiry. First, five studies documented and analyzed LTK and other observations by participants in subsistence fisheries about Chinook salmon in the Stikine, Chilkat, Kenai, Kuskokwim, and Yukon rivers. The CSRI plan (ADF&G Chinook Salmon Research Team 2013:16) noted:

> Regarding Chinook salmon, LTK can provide detailed observations about abundance, distribution, run timing, condition, and habitat, often focused on specific locations and informed by considerable time depth. In addition to empirical information, LTK raises research questions and hypotheses for further investigation and testing. Thus LTK studies seek both to document local knowledge and to involve the holders of this knowledge directly in applying this information to inform scientific inquiries and fisheries management.

The North Pacific Research Board's (2005:144) *Science Plan* includes a useful definition of LTK as

> an array of information, understanding, and wisdom accumulated over time based on experience and often shared within a group or community. This knowledge may be the product of an individual's time on the land or sea (local knowledge), or it may be accumulated over generations and perpetuated within a culture (traditional knowledge).

1. The presentations are available at https://www.adfg.alaska.gov/index.cfm?adfg=chinooksymposium. symposium_information_2012.

The NPRB's *Science Plan* also noted that to contribute to scientific and management goals, LTK research must meet standards as high as those applied to all other scientific programs (North Pacific Research Board 2005:146). Rigorous LTK studies have clear research goals, sound methods, an appropriate scope, qualified personnel, and an adequate budget, as identified through a research design. The CSRI LTK projects followed the guidance of Davis and Ruddle (2010) for identifying expert key respondents through systematic peer review. Finally, and equally important, successful LTK studies require a strong community role and must meet the ethical standards for social science research, including voluntary participation, informed consent, anonymity of respondents if requested, community review, and sharing of findings with the study communities. These standards are consistent with those developed by the Alaska Federation of Natives and the National Science Foundation's Office of Polar Programs.[2]

Table 1.–Chinook Salmon Research Initiative projects conducted by ADF&G Division of Subsistence.

Stock	Project Name	Technical Paper Number	Publication Date
Chignik	Harvest assessment of subsistence Chinook salmon in the Chignik Management Area	TP 462	*In prep.*
Chilkat	Traditional ecological knowledge of Chilkat River Chinook salmon held by resource users in Haines and Klukwan, Alaska	TP 463	*In prep.*
Copper	The intersection of commercial fisheries and the subsistence way of life in Cordova, Alaska	TP 444	March 2019
Kenai	Local and tradtional knowledge of abundance of Chinook salmon in the Kenai River	TP 431	July 2017
Nushagak	Nushagak River Chinook salmon: local and traditional knowledge and subsistence harvests	TP 453	September 2019
Stikine	Traditional ecological knowledge of Chinook salmon in the Stikine River and its tributaries	TP 430	June 2017
Kuskokwim	LTK of freshwater aspects of Chinook salmon life cycle, central and upper Kuskokwim River	TP 450	June 2019
Kuskokwim	Lower Kuskowkim River inseason estimation of Chinook salmon subsistence harvest	TP 449 (lower river) TP 455 (middle river)	June 2019 December 2019
Kuskokwim	Patterns and trends in salmon fishing on the Kuskokwim River	TP 468	July 2020
Kuskokwim	Kuskokwim Bethel subsistence patterns and trends	*merged with above*	
Yukon	LTK of Freshwater aspects of Chionook salmon life cycle, Yukon River	TP 447	June 2019
Yukon	Pilot inseason monitoring of subsistence salmon harvests in the Yukon River drainage	TP 448	June 2019
Yukon	Patterns and trends in salmon fishing on the Yukon River	TP 442	*In prep.*

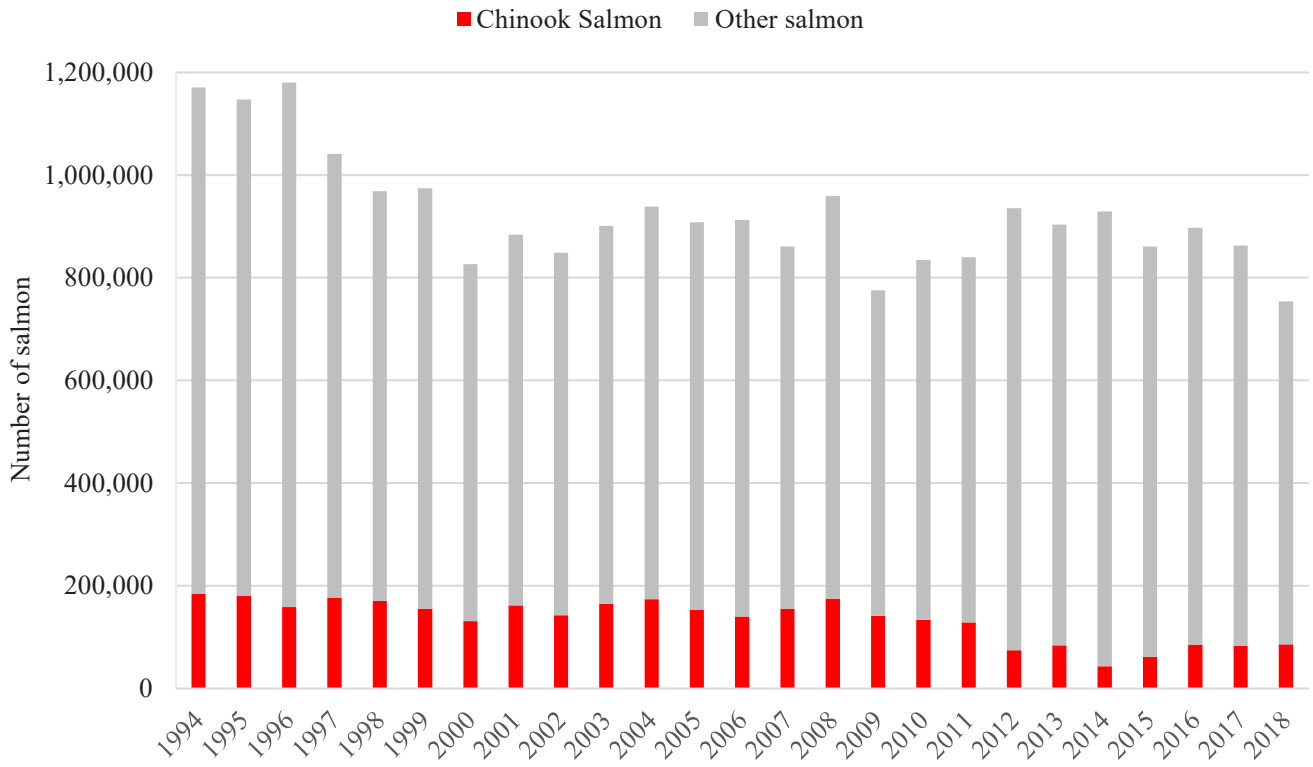
Acknowledging that reliable harvest data are key to effective management, a second set of projects focused on subsistence harvest assessment methods. Three studies evaluated the quality of harvest data in the subsistence fisheries of the Copper, Chignik, and Nushagak rivers, while two others field-tested inseason collection of subsistence harvest data in portions of the Yukon and Kuskokwim rivers.

Third, two "patterns and trends" studies, modeled after previous division research (e.g., Magdanz et al. 2005), examined for the first time more than two decades of postseason harvest survey data combined with household interviews in Yukon and Kuskokwim river communities to identify the multiple factors that influence subsistence harvest levels. It should also be noted that the harvest assessment and patterns and trends studies also recorded LTK and other local observations about Chinook subsistence fisheries, which are summarized in the final reports.

2. National Science Foundation Interagency Social Science Task Force. 2012. "Principles for the Conduct of Research in the Arctic." http://www.nsf.gov/od/opp/arctic/conduct.jsp; Alaska Federation of Natives. 2013. "Alaska Federation of Natives Guidelines for Research." Alaska Native Knowledge Network. http://www.ankn.uaf.edu/IKS/afnguide.html.

All 12 projects were conducted following approval by the study communities, and in accordance with the ethical standards for social science research described above. Residents of 47 Alaska communities participated in the projects. Local research assistants were hired to help with project implementation and data collection. Review of study findings occurred during community meetings. Findings are summarized in the Division of Subsistence *Technical Paper Series*.[3]

Figure 1.–Alaska subsistence salmon and Chinook salmon harvests, 1994–2018



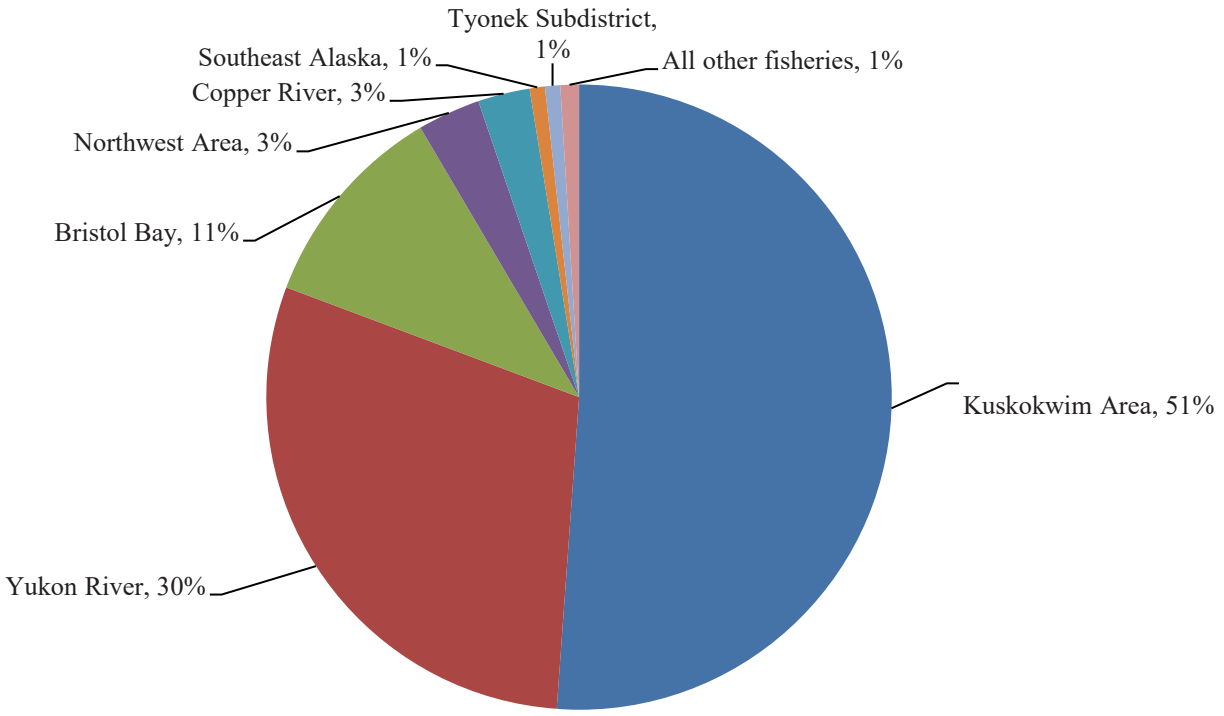
Background: Patterns of Subsistence Use of King Salmon in Alaska

A presentation at the Chinook Salmon Symposium in 2012 highlighted the key sociocultural, economic, and nutritional role of subsistence king salmon fisheries in Alaska. The presentation noted that from 1994 through 2010, Chinook salmon comprised 17% of the subsistence salmon harvest in numbers of fish and 34% in usable pounds, and accounted for about 12% of the wild food harvest in rural Alaska. These subsistence harvests were accomplished mostly by family groups with efficient technologies such as nets and fish wheels, and were preserved with a variety of methods including drying, smoking, canning, and freezing. Figure 1 updates subsistence harvest data through 2018. Harvest declines are notable after 2008. From 1994 through 2008, annual subsistence king salmon harvests averaged about 161,400 fish; from 2009 through 2018, the annual average was 91,800 Chinook salmon, a decline of 43%. As estimated in number of fish, kings were about 16.7% of the subsistence salmon harvest during 1994–2008, and 10.7% from 2009 through 2018 (Fall et al. *In prep.*).

For the period 1994 through 2018, three fisheries accounted for a large majority of the subsistence harvest of Chinook salmon in Alaska: Kuskokwim (51%), Yukon (30%), and Bristol Bay (11%). The combined subsistence fisheries of Northwest Alaska and the Copper River each accounted for about 3% of the harvest, while the combined subsistence fisheries of Southeast Alaska and the subsistence fishery in the Tyonek Subdistrict of Upper Cook Inlet accounted for about 1% each. All other subsistence fisheries accounted for the remaining 1% (Figure 2).

3. The Technical Paper Series can be found at http://www.adfg.alaska.gov/sf/publications/. See below for a list of the final reports for these CSRI projects.

Figure 2.–Percentage of average annual subsistence harvest of Chinook salmon by management area, 1994–2018.



Key Findings: Harvest Assessment

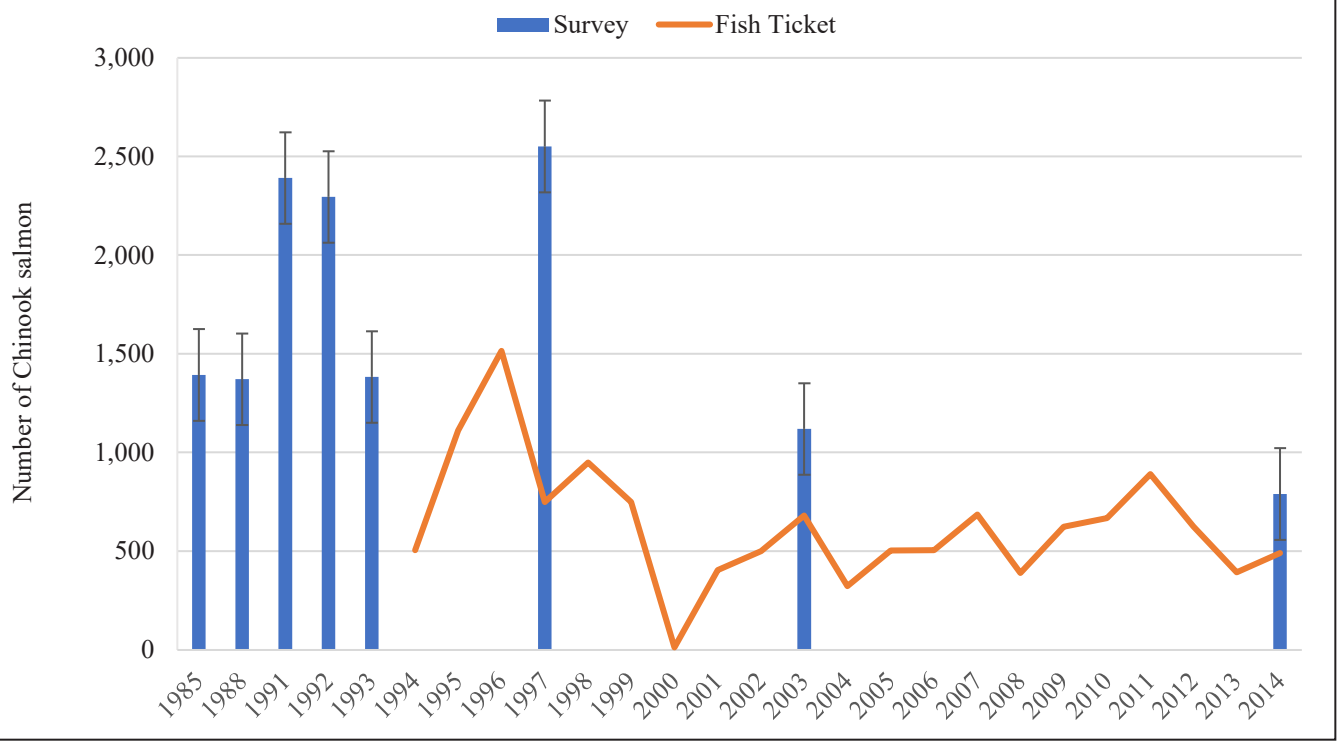
Copper River

Final Report: Sill et al. 2019

Copper River king salmon are harvested in commercial and subsistence fisheries near Cordova and upriver in subsistence, personal use, and sport fisheries. This study focused on retention of king and other salmon for home use by Copper River commercial fishermen, commonly known as "home pack." It was funded by the CSRI and the *Exxon Valdez* Oil Spill Trustee Council. Previous household surveys had found that commercial home pack is a primary source of salmon for home use in Cordova; in eight study years between 1985 and 2014, 66% of king salmon and 48% of all salmon species combined that were taken for home use were retained from commercial catches (Sill et al. 2019:25). However, this harvest was not fully documented by annual ADF&G harvest monitoring programs; reporting of home pack of Chinook salmon became mandatory for the Copper River fishery in 1994 and for all salmon in 2008. The study compared harvest data collected through commercial harvest tickets with estimates from systematic household surveys and, through key respondent interviews, explored reasons for the prevalence of home pack as a source of salmon for home use in Cordova as well as other observations regarding the Copper River king salmon run.

Figure 3 compares estimates of home pack Chinook salmon harvests by Cordova households based on household surveys and harvest ticket data. Chinook salmon home pack averaged 1,767 fish in five study years between 1985 and 1993. The average from harvest tickets from 1994 through 2014 was only 632 Chinook salmon. However, comparisons of findings for years with both survey and harvest ticket estimates suggest that reporting of Chinook salmon home pack through harvest tickets is improving. In 1997, the survey estimate was 2,551 Chinook salmon (+/-34%) while 749 Chinook salmon were reported as home pack on harvest tickets, a difference of 241%. In 2003, the survey estimate was 1,119 Chinook salmon (+/-34%) retained from commercial harvests for home use, 64% higher than the 681 kings reported on harvest tickets. In 2014, the CSRI study year, household surveys estimated 790 Chinook salmon home pack (+/-44%) and harvest tickets reported 490 Chinook, a 61% difference. Survey results also suggested im-

Figure 3.–Estimated harvests of Chinook salmon for home use from commercial home pack, Cordova commercial fishers, 1985–2014



provements in reporting of sockeye and coho salmon home pack. Most key respondents thought home pack reporting in recent years has been accurate.

The study identified reasons for the significance of home pack as a source of salmon for home use in Cordova, including the high food value of Chinook salmon and overlap between subsistence and commercial open fishing periods. In 2017, the Alaska Board of Fisheries modified subsistence regulations for the Copper River District, effective in 2018, establishing a fixed Saturday opening to provide more subsistence fishing opportunity. Follow-up research should occur to evaluate the effects of this regulatory change.

Key respondents also provided other observations about Copper River Chinook salmon. Many reported that king salmon are smaller than in the past. Some expressed concerns about changing ocean conditions affecting Chinook salmon size, abundance, and health, but other respondents said Copper River Chinook salmon are generally healthy.

Chignik River

Final Report: Hutchinson-Scarbrough et al. In prep.

The Chignik River supports the largest run of Chinook salmon on the south side of the Alaska Peninsula. Chinook, as well as the more abundant sockeye salmon and the other three species, are used for subsistence by residents of the area's communities of Chignik Bay, Chignik Lagoon, Chignik Lake, and Perryville. Division staff traveled to the four communities to conduct household harvest surveys and 38 key respondent interviews in 2014, 2015, and 2016. Survey data were used to evaluate subsistence harvest estimates based on permit returns; survey respondents also assessed how well they were able to meet their harvest goals. In addition, respondents shared LTK and other observations about Chinook and other salmon. They also mapped locations of subsistence harvests.

Survey and key respondents noted that local residents obtain most of their king salmon by retaining fish from their commercial harvests or with rod and reel. A Chignik Lagoon resident noted:

> Most guys here fish for reds with a gillnet. The king run isn't that large here, and locals mostly want the reds. If a person wants a king they just go get one in the river in their skiff and catch them with

a pole. Nets cost money and I don't know if anyone has a net to catch a king, you would need about a 7 or 8 inch mesh to do that then you might catch more than you need. No one wants to waste fish.

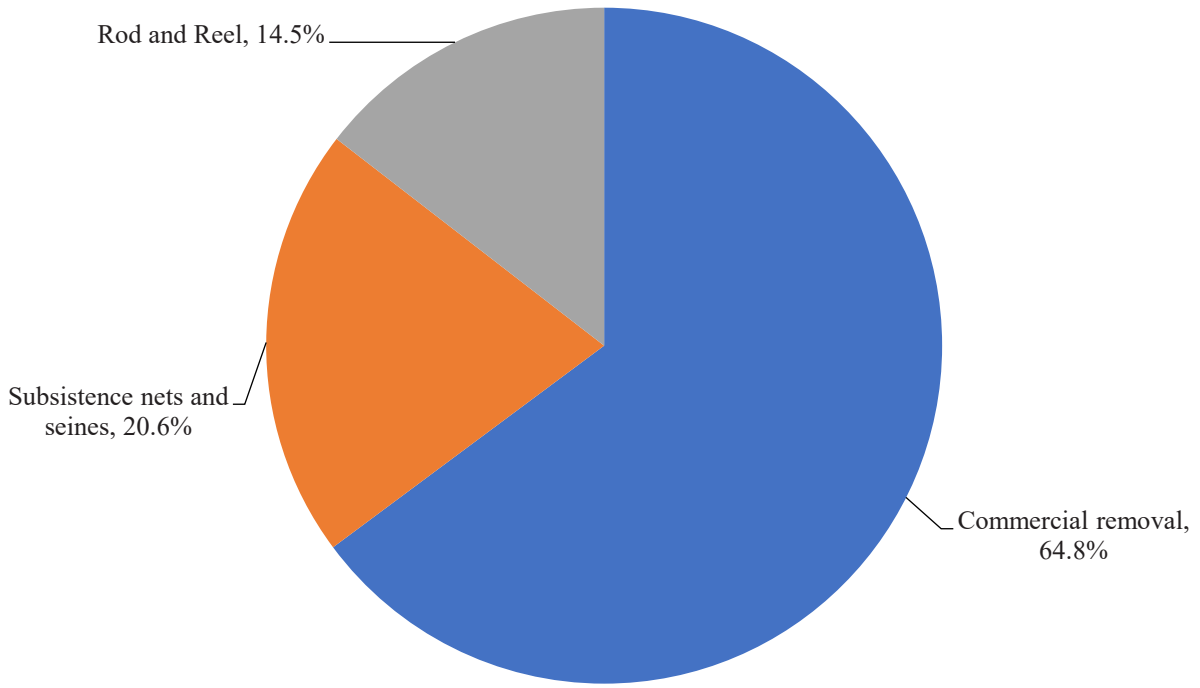
Based upon household survey results, over the three-year period, about 65% of king salmon harvested for home use in the four Chignik Management Area communities was retained from households' commercial harvests, about 21% was harvested with subsistence nets or seines, and about 14% was taken with rod and reel (Figure 4). Comparisons of harvest estimates from returned surveys with revised estimates following household surveys found that the pre-survey permit data alone for the local communities underestimated the Chinook salmon harvest with subsistence nets and seines and with rod and reel (allowable gear under federal regulations) by about 49% on average over the three study years (pre-survey estimate of 79 fish, post-survey estimate of 118 fish), and all salmon by about 56% (pre-survey estimate of 5,962 fish, post-survey estimate of 9,290 fish). Households who fished without a permit accounted for most of this difference; following the surveys, these households were added to the permit database.

Key respondents expressed concern over the declining Chinook returns to the Chignik River as well as lower returns of early- and late-run sockeye in 2015 and 2016. They offered a variety of reasons for the decline in Chinook salmon; no key respondent cited just one specific cause. Reasons included climate change causing warmer oceans; drying of freshwater habitats; escapements that are too low; sport and commercial harvests, including bycatch, that are too high; and underreporting of Chinook salmon retained by commercial fishermen for home pack. Some representative comments are:

> I have never seen the ocean as warm as it has been lately; some winters lately even Chignik Lake didn't freeze, you could take a skiff all the way from the Lake to the Lagoon all winter. The high temperature in the water—yes both in fresh water and salt water—has to be affecting the salmon. (Chignik Lake)

> Ocean currents changed, kings and reds this year came along the beach (by Perryville), they are normally further out. Fish are smaller, fish are fewer, halibut, salmon, candlefish not showing up anymore. Animals are smaller, caribou, rabbits … I don't know what's going on, something is happening, no food or something. It's going to change us too. (Perryville)

Figure 4.–Percentage of Chinook salmon harvests for home use by gear type, Chignik Area communities, annual average, 2014–2016.



N = annual average of 303 Chinook salmon

> We have never had to release a king in all the years until the sport's effort came in, and I think I am probably as guilty of this as the next guy up there, but I think what is happening up there early on when we started sport fishing them, we would never go by the weir and tell them what we brought home, so essentially he was getting his escapement probably, but we were taking maybe up to half their escapement back down through the weir between us and the sportsmen, and they had no idea this was happening. I think this is what has happened over the years. (Chignik Lagoon)

Nushagak River

Final Report: Halas and Cunningham 2019

The large run of Chinook salmon in Bristol Bay's Nushagak River supports important subsistence, sport, and commercial fisheries. This study investigated subsistence harvests and uses of Nushagak River Chinook salmon in five western Bristol Bay communities: Clarks Point, Dillingham, Ekwok, Koliganek, and New Stuyahok. Goals included evaluating the quality of annual subsistence harvest estimates based upon the permit system as well as documenting key respondents' observations about current trends in the Chinook salmon run. Methods included systematic household harvest surveys, key respondent interviews, and mapping of salmon harvest areas. Study years were 2014 and 2016 for Dillingham, and 2013 and 2014 for the other four communities.

Household harvest surveys found that, consistent with findings from other study years (e.g. Krieg et al. 2009), a very large portion of the Chinook salmon harvest for home use in these communities was accomplished with subsistence gillnets: about 94%, compared to about 4% retained from commercial harvests and 2% with rod and reel (Figure 5). Therefore, a reliable subsistence harvest reporting system is essential for documenting Chinook harvests for local home use in Nushagak River communities.

The study compared estimates of Chinook salmon harvested with subsistence gillnets based upon initial subsistence permit returns with those based on permit returns supplemented by postseason surveys (Table 2). For the five communities combined, initial permit estimates totaled 12,591 Chinook salmon based on a permit return rate of 76%. Estimates based on an enhanced permit return rate accomplished through household visits plus harvest data from households that did not obtain permits or whose collaborative harvest was not recorded on a permit totaled 16,907 salmon, an increase of 34%. This estimate is based on a sample of 92% of subsistence fishing households in the five communities.

For the 10-year period 2008–2017, the estimated annual total run of Nushagak River Chinook salmon (escapement, sport harvest, commercial harvest, and subsistence harvest) was about 140,000 fish. This total included an estimated annual subsistence harvest of about 11,200 Chinook salmon, or about 8% of the total run (Erickson et al. 2019). If subsistence estimates based solely on permit returns are low by about 34%, the average annual total run estimate would increase to 143,800 Chinook salmon, with an annual subsistence harvest of 15,000 Chinook salmon, or 10% of the total run. The findings suggest that while the permit system without supplemental postseason surveys underestimates

Table 2.–Comparison of estimates of subsistence harvests of Nushagak River Chinook salmon based solely on permit returns and on permit returns supplemented by postseason household surveys.

	Prior to household surveys					Following household surveys					
Community	Study year	Permits issued	Permits returned	Return rate	Estimated Chinook salmon harvest	Issued permits returned	Additional permits issued	Permits returned	Return rate	Estimated Chinook salmon harvest	Difference
Clarks Point	2013	11	9	81.8%	165	11	2	13	100.0%	177	7.3%
Dillingham	2016	357	277	77.6%	8,437	317	22	339	89.4%	9,732	15.3%
Ekwok	2013	20	16	80.0%	780	19	3	22	95.7%	939	20.4%
Koliganek	2013	12	7	58.3%	783	11	19	30	96.8%	1,501	91.7%
New Stuyahok	2013	39	24	61.5%	2,426	38	34	72	98.6%	4,558	87.9%
Communities combined		439	333	75.9%	12,591	396	80	476	91.7%	16,907	34.3%

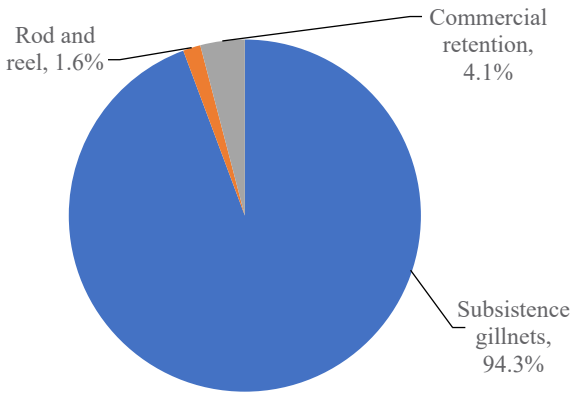
subsistence harvests, this underestimate is not so great as to significantly alter estimates of the total Nushagak River Chinook salmon return.

Although the primary objective of this project was to evaluate the subsistence permit system, LTK was also collected and summarized. Key respondents noted a decline in average Chinook salmon size and reported that Chinook salmon appear to be arriving later than in the past. However, overall, respondents said the Nushagak River Chinook salmon run is healthy as is the condition of the salmon. Environmental conditions that respondents thought might affect Chinook salmon in the future include warmer oceans, changing wind patterns, and decreasing water levels. Bycatch of Chinook salmon in the Bering Sea trawl fisheries was also a concern.

The report concludes with a set of recommendations (these are similar to those identified by the Chignik River project). The use of local permit vendors is critical for an effective subsistence salmon monitoring program in the Bristol Bay Management Area. Additional outreach by ADF&G staff about the importance of accurate and complete harvest data is also necessary. Periodic household surveys covering harvest trends and LTK observations should take place. Also, residents of local communities and community leaders need to take an active role in the state and federal fish and wildlife regulatory systems, including participation in advisory committees, regional advisory councils, and the regulatory board process.

Plate 2.–King salmon drying at Lewis Point, lower Nushagak River, Alaska.

Figure 5.–Source of Chinook salmon for home use, five Nushagak River communities.



N = annual average of 7,830 Chinook salmon

Yukon River In Season

Final Report: Brown and Jallen 2019

For decades, the Yukon River has supported the second largest subsistence harvest of Chinook salmon in the state. However, severe reductions in Chinook returns since 2008 have resulted in regulatory restrictions to the subsistence fishery and consequent drops in harvests. This pilot project, a collaboration between the ADF&G divisions of Subsistence and Commercial Fisheries, explored the feasibility of inseason collection of subsistence salmon harvest data. Currently, subsistence harvests of Yukon River salmon are estimated primarily through a postseason, face-to-face survey. Available harvest data in season could inform fishery management and help assess fishery performance. Also, because inseason data collection relies on community participation, it can strengthen communities' roles in harvest assessment and management. Local research assistants were hired in two communities: Grayling in the first study year (2013) and Marshall in the second study year (2014). Originally, three communities were to be involved in the second study year, but in two of these, local research assistants were not available.

In both study years, division staff trained the local assistants to survey subsistence fishers weekly over a 12- to 15-week period. They also distributed harvest calendars. In 2013, ADF&G researchers traveled to Grayling seven times to work with local researchers. In Grayling in 2013, between 24 and 34 households were surveyed each week, with 39 of the community's 53 households providing data during the fishing season. During the final inseason survey,

respondents reviewed their responses for the entire study year and confirmed or corrected the information. A final community estimate was then produced and compared with the sum of the weekly estimates. Differences were due to the incomplete samples used to generate the weekly estimates.

In 2014, due to the unsustainable costs associated with frequent travel to multiple communities and the goal to evaluate local capacity to conduct the data collection, ADF&G researchers traveled to Marshall at the beginning of the season to train local research assistants and then monitored progress telephonically. Local researchers faxed a compilation of weekly household harvest data to ADF&G in Fairbanks, where weekly harvest totals for the community were estimated. Survey comments were collated for further analysis.

Due to its larger size, a stratified sample of 69 of Marshall's 100 households was selected in 2014. Following training by ADF&G researchers, the local surveyors worked well independently. They faxed weekly data compilations to ADF&G. As with Grayling in 2013, during the final interviews in Marshall respondents reviewed all data for the season and corrections were made. Differences between the inseason and postseason estimates were within the 95% confidence interval for the inseason estimate for all species except Chinook; the estimated inseason Chinook salmon harvest was 201 fish (+/-61) compared to the postseason estimate of 128 fish (+/-27). Most (88%) Marshall respondents commented positively about the inseason data collection effort.

Plate 3.–Yukon River Chinook salmon harvest.

In reviewing the project's performance, the researchers identified issues related to cost, local capacity, and respondent burden compared to postseason harvest data collection. Because of the large number of communities in the Yukon Management Area and widely varying degrees of local capacity in the skills needed for independent work with a complex survey design, researchers concluded that the methods employed in the pilot study would not produce the amount and quality of data currently collected in the postseason survey and would not be cost effective. Also, given substantial year-to-year variation in run sizes and other conditions, as well as just one year of data to compare, it was not possible to use results of this project to compare the accuracy of inseason with postseason surveys. Researchers also noted that the Yukon River Drainage Fisheries Association (YRDFA) successfully collects inseason harvest data and local observations of run strength and timing during weekly fishery teleconferences (Moncrieff et al. 2014). However, the

YRDFA project does not attempt to estimate total community harvests, but rather provides an index of harvests and assists managers in assessing fishery performance in season.

Lower Kuskokwim River In Season

Final Report: Runfola et al. 2019a

This project tested the feasibility of collecting subsistence salmon harvest data in season from a sample of fishers in a portion of the lower Kuskokwim River in order to estimate effort, catch per unit of effort (CPUE), and harvest for each open fishing period. Over a four-year period (2015–2018), fishers were recruited to report harvests when they completed fishing to ADF&G, who calculated CPUE. Through surface surveys by boat, ADF&G estimated the number of boats actively subsistence fishing to estimate harvests. Study communities included Bethel, Oscarville, Napakiak, and Nunapitchuk in 2015–2017, as well as Atmautluak and Kasigluk in 2018.

Daily samples of subsistence fishers were too small to develop precise harvest estimates for inseason management. Challenges included fishers dropping out of the project, difficulties in contacting fishers, and delays in reporting of harvests to ADF&G researchers. However, the data collected inseason were useful for managers, including fishers' observations of run size and their progress towards their harvest goals. The project enhanced outreach and communication with fishers and communities. The project's final report compared study results with those of another inseason harvest assessment effort conducted by the U.S. Fish and Wildlife Service (USFWS) and the Kuskokwim River Inter-Tribal Fish Commission (KRITFC) (Staton 2018). With a relatively large staff, that project contacted several hundred fishers during each opening, primarily at the Bethel boat harbor. Aerial surveys by the USFWS provided counts of boats. Relatively precise harvest estimates for the openings were achieved, enabling an assessment of progress towards harvest goals set by the USFWS and the KRITFC.

The ADF&G study noted that local assistant trainings in harvest assessment projects sometimes focus primarily on project background, with not enough instruction on the skill development needed to successfully collect and report harvest data in season. The study identified key components for effective training of local research assistants, including: knowledge and comprehension of the survey form; effective methods of asking questions and recording responses that are precise and accurate; ability to anticipate and respond to unexpected difficulties when conducting surveys; and development of organizational skills for survey administration and data management in the field.

Middle Kuskokwim River In Season

Final Report: Runfola et al. 2019b

This project was funded by the CSRI and the Office of Subsistence Management of the USFWS. The Native Village of Napaimute was a collaborator on the project. The goal was to develop methods for resource management agencies and local communities to work together to collect information in season about subsistence salmon harvests. During the study period (2015–2018) household surveys took place in nine communities: Lower Kalskag, Upper Kalskag, Aniak, Chuathbaluk, Crooked Creek, Red Devil, Sleetmute, Stony River, and Lime Village. Respondents provided assessments of their fishing success and progress toward their harvest goals for the season. In Lower Kalskag, Upper Kalskag, and Aniak, local research assistants interviewed fishers after each fishery opening to record harvest and effort data. During each opening, ADF&G staff recorded the number of subsistence fishing boats in surface surveys conducted by boat within a 30-mile portion of the Kuskokwim River between Lower Kalskag and the mouth of the Aniak River.

Regarding developing estimates of subsistence harvests in season, the project encountered challenges much like those of the similar lower Kuskokwim River effort (see above). The number of fishers providing harvest and effort data after each opening was insufficient to develop reliable harvest estimates. Researchers also noted that the inseason harvest data collection was labor intensive and expensive, and these challenges would increase if more fishing openings occurred. Despite these limitations, the data were provided to fishery managers to help them track the progress of the salmon run and better understand harvest trends. The interactions with fishers gave them a voice in season that informed management decisions, and enabled ADF&G staff to address fishers' questions about subsistence fishing.

The study was successful in building collaborative relationships between subsistence fishing families and ADF&G staff. The study results can be used to design and improve inseason harvest assessment methods that have stakeholder involvement. Interview respondents generally voiced support for the project. A fisher from Aniak said:

> It's good for surveys like this to be done, and any effort to report back the information gathered from these surveys reinforces people's desire to provide truthful information. I think it's absolutely critical they try to save the salmon whatever it takes. Some places in the country have lost their salmon already.

Key Findings: Local and Traditional Knowledge (LTK)

Stikine River

Final Report: Ream and Merriam 2017

The Stikine River is a transboundary river in Southeast Alaska that supports runs of Chinook and other salmon that are traditionally taken for subsistence and other uses by residents of Wrangell, Petersburg, and other southeast Alaska communities. Through key respondent interviews and archival research this study collected and analyzed LTK, concerns, and perspectives about Stikine River Chinook salmon and their habitats over time. Respondents also offered other historical and ethnographic information. The 23 key respondents included subsistence, sport, and commercial fishers. Key respondents generally considered any king salmon brought home for food as "subsistence" regardless of the fishery or regulations under which they were taken. A key respondent described his family's experience with the fishery as follows:

> We just had this net in the bow of the skiff, and we went up there and set up camp and setnetted it out. I think we only had to put the net out about three times. It stayed in the water for about 40 minutes each time. We had a lot of fish and just dressed them all out and iced them with glacier ice. We stayed the night and then headed home in the morning. Really efficient, you know it would take us a month to catch that many fish with a pole.

Regarding changes in the Stikine River Chinook salmon stock over time, respondents reported lifetime observations of fluctuations and periods of both boom and bust, but several suggested that recent downward trends in Chinook salmon abundance are alarming and beyond normal cyclic patterns. They noted declines in king salmon numbers into the 1960s, then improvements following initiation of state management, and a downward trend since about 2005. Respondents have also observed declines in Chinook salmon size, which some attributed to selection in local salmon derbies or hatchery production. Respondents noted later returns of king salmon, which some connected to warming water temperatures. They also reported reduced returns to Andrew Creek (the main king salmon spawning stream in the U.S. portion of the Stikine River) and Bradford River/Bradford Canal.

Respondents described the dynamic nature of the Stikine River delta, including changing water levels and flow patterns. Generally, respondents viewed these changes as part of natural cycles, except for major recent flooding events and earlier spring thaws, which they considered unusual.

Respondents also discussed species that prey upon, or are prey for, Chinook salmon. Marine mammal predation is a contributing stressor on the Chinook salmon stock due to increasing populations of harbor seals, sea lions, and humpback whales. Humpback whales are now overwintering in Southeast Alaska; they consume Pacific herring, an important food source for king salmon that respondents perceived to be already depleted by commercial overfishing. Abundant harbor seals now occur upstream of the Stikine River delta and remove salmon from subsistence nets. Sea lion haulouts have grown on Liesnoi Island, near the mouth of the Stikine River. Some respondents advocated amending the federal Marine Mammal Protection Act to allow non-Alaska Native hunting as a management tool.

Other concerns included perceived lack of enforcement of rules governing the inriver commercial gillnet fishery in Canada; bycatch of Chinook salmon in commercial trawl fisheries; and proposed open-pit mines in Canada that in respondents' views will destroy salmon habitat and flush toxic chemicals into the river. Key respondents generally supported the federal inriver subsistence fishery, but offered suggestions for improvements, such as requiring attending the net to prevent predation by seals. In 2015, the Federal Subsistence Board adopted a regulation requiring Stikine River subsistence fishers to check their nets twice daily.

Chilkat River

Final Report: Sill and Van Lanen In prep.

The Chilkat River, in northern Southeast Alaska, is a major producer of Chinook salmon, along with other salmon species. Division staff and collaborators from the University of Alaska interviewed 36 subsistence, commercial, and sport fishers in the Chilkat River communities of Haines and Klukwan to document LTK of Chinook salmon migration, behavior, health, abundance, habitat, and perceived reasons for declines in the runs. Respondents described changes they have observed in local marine and freshwater environments and possible effects of these changes on Chinook salmon. Respondents also mapped contemporary and historical fishing locations. The project also evaluated subsistence harvest data.

According to respondents, the main factors contributing to declines of Chilkat River Chinook salmon are habitat alterations and the multiple fisheries that incidentally harvest Chinook salmon. Commercial fishing respondents placed less significance on the local commercial gillnet fishery as a source of Chinook salmon mortality, and more on commercial seine and trawl fisheries. Many respondents discussed marine survival and uncertainty during that life stage. Many are concerned about future harm to all Chilkat River salmon runs from the Constantine North mine proposed in the Klehini River watershed.

Chinook salmon caught in subsistence gillnets in the Chilkat River may be legally retained, but some key respondents from all three user groups suggested that this harvest is underreported. The study compared Chinook harvest estimates for Haines and Klukwan from permit returns (1983–2017) with four rounds of household survey data (1983, 1987,

Plate 4.–Chilkat River king salmon subsistence harvest.

1996, and 2012 for Haines; 1983, 1987, 1996, and 2014 for Klukwan). For Haines, total subsistence harvest estimates averaged 77 kings, while annual subsistence net harvests for the four survey years averaged 194 kings. For Klukwan, permit estimates averaged 1 king salmon taken in subsistence nets, while survey data averaged 65 king salmon annually. Reasons for underreporting include distrust of management agencies, misunderstanding of regulations, or fear of enforcement actions.

Respondents from Klukwan described traditional and contemporary methods to selectively harvest salmon and minimize harvests of Chinook. Traditionally, gaffs were their preferred selective harvest method, but gaffs are not a legal gear under state regulations. Now, Klukwan subsistence fishers, who overwhelmingly target sockeye salmon, place their nets on the west side of the river, which has shallower water preferred by sockeye salmon, rather than set their nets in the deeper water on the east side of the river, preferred by Chinook salmon. For example, a Klukwan elder said:

> … most of the people, village, fishes on the far [west] side. Could be the village kings hardly ever laid on that side. It is always on, you know this [east] side of the river; it's deeper. The sockeye want that [west] side, so you don't catch any [king salmon] on that side. … kings usually run up to the deep side, right here in the bank.

Klukwan respondents explained that shallower water creates a faster river current and that Chinook salmon prefer the slower and more relaxing current of deeper water.

The report concludes that better communication is necessary about salmon management and research between ADF&G and fishers from Haines and Klukwan, between subsistence and commercial fishers, and between local residents and project developers within state agencies. The report also offers several recommendations, including: improved harvest reporting in the subsistence fishery; improved reporting of salmon retained for home use in the commercial fishery; investigation of the effects of river rafting on salmon habitat; documentation of baseline river/watershed conditions, such as streamflow, temperature, snowpack, and silt load; and mapping of locations of known spawning beds currently and in the past.

Kenai River

Final Report: Jones and Kukkonen 2017

Southcentral Alaska's Kenai River supports two distinct Chinook salmon runs: early and late. With its Chinook, sockeye, coho, and pink salmon runs, the river provides opportunities for sport, personal use, educational, and commercial fisheries. Chinook salmon are the first salmon to arrive in the spring and traditionally have been an important source of food, recreation, and income for Alaska residents. The socioecological relationship between local residents, the Kenai River watershed, and Kenai River Chinook salmon has changed markedly through time, due in large part to human population growth and economic development in Alaska's road-connected area. The Kenai River and the Taku River are the only watersheds included in the CSRI that are entirely within a state nonsubsistence area, where, according to a finding by the Alaska Joint Board of Fisheries and Game, subsistence is not a principal characteristic of the economy, culture, and way of life (5 AAC 99.015(a)(3)).

This project focused on LTK of Kenai River Chinook salmon held by long-term users of the Kenai River watershed. The project gathered small-scale, place-based observations to explore catalysts and changes in Kenai River Chinook salmon size, abundance, health, and uses. This project also explored changes in key salmon habitat in the Kenai River and its tributaries. A diverse set of 26 interviewees from different user groups were selected as key respondents. Researchers placed an emphasis on speaking with people who had a long history of participation in one, or several, of the Kenai River Chinook salmon fisheries. The respondents described historical as well as contemporary observations of Chinook salmon presence in the Kenai River and their habitat based on observations and experiences fishing and working on the river throughout their lifetimes. They focused more on local, human-caused factors rather than those associated with broader trends such as weather patterns or climate change.

Most key respondents described exponential development and increased human population within and near the Kenai watershed. Reports about the large size and unique character of Kenai River Chinook salmon attracted increased numbers of fishermen to the river starting in the late 1970s. All respondents noted the correlations between amplified human involvement in the area and the resulting increased pressure on Chinook salmon and the river habitat. Overall, respondents cited a combination of localized and open ocean factors that are affecting the health of Kenai River Chinook salmon. They noted declines in Chinook salmon size and more jack salmon[4] in the return and recommended additional study of the life history of Chinook salmon at sea. In addition to documenting knowledge and perceptions of Chinook salmon, this project archived an extensive oral history of Kenai Chinook salmon uses over time.

4. "Jacks" are small Chinook salmon that mature after spending only one winter in the ocean and are typically male. See Alaska Department of Fish and Game, "Chinook Salmon (*Oncorhynchus tshawytscha*) Species Profile: Description, Life History," Accessed January 23, 2017, http://www.adfg.alaska.gov/index.cfm?adfg=chinook.main.

Yukon River

Final Report: Trainor et al. 2019

In 16 interviews conducted in 2014, respondents explored LTK of spawning grounds, juvenile rearing habitat, and other environmental factors that affect adult Chinook and chum salmon migration and reproduction in freshwater systems of the Yukon River watershed. Based on their lifetime experiences traveling on the land and waters around their communities, they also mapped environmental changes that may have affected salmon migration and spawning. Interviews took place in Anvik, Huslia, Allakaket, and Fort Yukon. These communities were chosen because of their proximity to an existing or a historical enumeration project so that researchers could compare local observations of fluctuating salmon presence with existing data sets. The final project report also includes a salmon fishing profile for each study community, including trends in subsistence harvests.

Respondents described a rapidly changing ecosystem that affects salmon and people's ability to participate in subsistence harvest activities. Three key themes related to ecological/aquatic change were common to all four study communities. These were: 1) changes to freeze-up and breakup timing; 2) thawing of permafrost; and 3) drying of lakes. For example, a respondent from Anvik observed:

> Well, the freeze-up, it's not as cold as it used to be. For a while I know it was like in the fall time, you get into October, it will get like twenty below for like three or four days. It doesn't do that until like November. That's when it seems like the river is still open, November.

A respondent from Allakaket commented on the possible connections between recent intense forest fires and environmental change.

> I wonder if this global warming has something to do with that too because the permafrost melts and the water just gets soaked up by the land instead of staying on top of the permafrost … Seems like there's more lakes, more grassy [lakes] than usual. We usually have water in them, especially close to the river … not much water anymore.

These changes have created a sense of uncertainty for community residents. The seasonal round they grew up with is no longer predictable. The timing of seasonal events and reliability of factors such as frozen ground or thick river ice is no longer certain. A respondent commented: "No, you can't predict the weather no more, them days are gone." The report concludes with a set of proposed additions to ADF&G's *Anadromous Waters Catalog*, based on key respondents' observations of spawning and migrating salmon.

Kuskokwim River

Final Report: Mikow et al. 2019

This LTK study centered on five communities of the middle and upper Kuskokwim River: Aniak, Sleetmute, Stony River, McGrath, and Nikolai. In 32 interviews in 2014, key respondents shared LTK about spawning grounds, juvenile rearing habitats, and other environmental factors that affect salmon migration and reproduction. Researchers worked with respondents to map environmental changes that may have affected salmon movements and spawning locations. Key respondents discussed several major themes, including observations of Chinook salmon behavior and environmental change, perspectives on declining Chinook salmon populations, potential causes of the decline, and concerns over management of the fishery.

Key respondents cited both low and high water levels, influenced by lower snowfall in winter and rainier weather in summer, as affecting access to fishing sites. Rainier summers result in more spoilage of drying fish, as well as more debris in rivers. Respondents did not link water level changes to salmon movements, but they reported that warmer water causes an earlier spring breakup and an earlier migration of Chinook salmon upriver. However, due to the warmer water, king salmon remain in the main channel and seek deeper, colder water, which affects harvest success. Rapid thawing of permafrost has also caused bank erosion and the loss of fishing sites. Respondents also reported a decrease in the size of king salmon, as well as reduced abundance near their communities. A Sleetmute respondent said:

> The thing that sticks in my mind more than the drop in the numbers was the change in size, that we were not getting the big females and males. Catching 40-pound kings in my little five and a quarter inch net. We weren't catching lots of them, but boy, you know, 40-pound king's a lot of king meat as compared to a six-pound jack.

Many respondents were unsure of causes of the king salmon decline but did express concern about potential overharvests in the lower river subsistence fishery and bycatch in the Bering Sea pollock commercial fishery.

Another key concern, expressed specifically regarding the Aniak River, was the potential effects of guided sport fishing on Chinook salmon spawning beds. Respondents described high boat traffic whose wakes disturb riverbanks and streambeds, stirring up sediment during Chinook salmon spawning. In their view, sport fishers interfere with salmon spawning and disturb spawning habitat by walking in streams and on riverbanks.

Plate 5.–Fish wheel on the Kuskokwim River near Chuathbaluk with subsistence harvest of salmon and whitefish.

Key findings: Patterns and Trends

Yukon River

Final Report: Brown et al. In prep.

This project received funding from the CSRI and the NPRB and was conducted in collaboration between the ADF&G divisions of Subsistence and Commercial Fisheries. The goal was to better understand the environmental, regulatory, economic, social, cultural, and personal factors that influence subsistence salmon harvests at the household, community, and regional levels within the Yukon River watershed. The six study communities were Alakanuk and Marshall in the lower river subregion; Nulato and Galena in the middle river subregion; and Beaver and Eagle in the upper river subregion. Based upon postseason household surveys, the Yukon River salmon harvest database records harvests through unique household identifiers, allowing researchers to track household production through time while aggregating to the community and regional levels. This research combined a retrospective analysis of harvest trends with an ethnographic exploration of the factors that shaped participation in the fishery from the households themselves.

The first phase was to organize the household survey database for the period 1990–2014; the database includes the results of about 24,000 postseason surveys of about 2,200 households. From this, multi-year records of salmon harvests were produced for a sample of 94 households in the six study communities. The second phase was to interview this sample to identify factors that shaped their harvests over time.

Researchers found that lower, middle, and upper Yukon River regions have unique demographics, river morphologies, and fishing profiles, which in turn shape patterns in subsistence salmon harvests. In all regions of the river, regulatory restrictions, including fishing closures, were identified by most respondents as a major factor that affected harvest. However, respondents in each community identified a nearly equal number of instances where something other than regulations affected their fishing practices, demonstrating the wide variability of factors that shape participation in the fishery over time (Table 3). An analysis of household-level harvests demonstrated that lower harvests—primarily

Table 3.–Top factors affecting subsistence salmon fishing, Yukon River communities.

	Percentage of households					
Factor	Alakanuk n = 20 HHs	Marshall n = 20 HHs	Nulato n = 14 HHs	Galena n = 15 HHs	Beaver n = 7 HHs	Eagle n = 18 HHs
Closures	70%	40%	36%	47%	100%	78%
Amount of fish needed	55%	0%	14%	27%	43%	44%
Gas prices	50%	25%	21%	60%	86%	11%
Personal health	40%	10%	0%	7%	14%	6%
Abundance of fish	40%	25%	14%	53%	43%	83%
Wind	35%	0%	14%	33%	0%	6%
Gear restrictions	35%	15%	64%	13%	71%	6%
Household demograhics	30%	0%	7%	53%	57%	39%
Summer precipitation	25%	15%	14%	0%	0%	22%
Gear cost/availability	20%	15%	29%	33%	43%	28%
Fish condition	10%	5%	14%	13%	43%	61%
Gear types used	5%	20%	0%	33%	14%	11%
Erosion	5%	0%	50%	0%	43%	0%
Cooperative harvests	5%	0%	36%	7%	0%	11%
Local fishing location	0%	10%	57%	13%	29%	6%
High water	0%	10%	14%	53%	86%	100%
Dogs to feed	0%	5%	0%	20%	29%	89%

Note Factors listed were in the top five for at least one community.

the result of lower abundance and more restrictive regulations—appeared to result in higher inequalities in household harvests, especially in the middle and upper regions of the Yukon River. That is, fewer households in these communities are bearing the responsibility of providing salmon for their entire communities. Although Alaska's subsistence economies have always been characterized by harvest specialization (Wolfe et al. 2010), Yukon River salmon harvest data suggest that the higher harvest inequalities resulting from lower salmon abundance and increased regulations may diminish the resilience of salmon-harvesting communities since many households may not be able to continue participating in the fisheries. The vulnerabilities created by increased specialization in the salmon fishery have implications for food security, dog teams, and the cultural transmission of knowledge. Local input from fishers underlined the importance of not only conserving salmon, but also conserving fishing families as critical to continuing the cultural traditions that underlie subsistence. Understanding these harvest patterns may improve managers' ability to provide more sustained harvests while ensuring spawning abundance.

Kuskokwim River[5]

Final Report: Godduhn et al. 2020

In this project, researchers investigated factors associated with changing Kuskokwim River subsistence salmon harvests. They prepared a database with households' responses to annual postseason harvest surveys for the period 1998–2012. A sample of households in six study communities was interviewed to identify and discuss social, economic, environmental, and regulatory factors that affected households' subsistence salmon harvests, and in doing so elucidate the resultant effects on communities and the region. Study communities were Bethel (lower river); Aniak, Sleetmute, and Stony River (middle river); and McGrath and Nikolai (upper river). In total, 168 households were interviewed. In addition, researchers compiled subsistence salmon harvest data for three sections of the Kuskokwim River (lower, middle, and upper), as well as the six study communities, to depict harvest patterns and trends for the period 1990–2016. Although causes of declining Kuskokwim River Chinook salmon are uncertain, a more refined understanding of harvest trends based upon fishery participants' input can inform managers in adapting management systems that allow for more sustained opportunities for subsistence fishing while ensuring escapements.

As shown in Figure 6, average annual subsistence salmon harvests for the period 2010–2016 for most species in each section of the Kuskokwim River were notably lower than annual averages for 1990–1994. For all species combined,

5. This project was originally two separate CSRI projects, one focused on Bethel and the other on five middle and upper river study communities. The projects were combined because of identical goals and methods.

average annual harvests were down 38%. Average annual Chinook salmon harvests declined in each portion of the river: 59% in the lower river, 71% in the middle river, 61% in the upper river, and 60% for the river in total.

Survey respondents identified a range of factors that affected their subsistence salmon harvests, but regulatory closures and gear restrictions in response to low returns of Chinook salmon were the most frequently cited reason in all the study communities except Stony River (Table 4). A resident of Aniak commented on the effects of short subsistence openings.

> When I was younger, we would all go to fish camp and we would just be there … when we weren't regulated on what we were doing. It was, you didn't have to cut 200 fish a day and make it be extreme work. You could cut 30 fish, the first day you get to fish camp, 20 fish, 10 fish, 50 fish. It wasn't a mad dash to get it done on your opening and make it not be a family gathering. Now it gets to be where you need to be there on time. And, there is not a lot of time to stop and teach the younger ones because you gotta get all of that done and then in the smokehouse. I still, like mom taught me, teach my girl to cut the way mom has taught me to cut. But I can't spend time like mom used to spend with me.

Other frequently cited reasons for lower harvests included run size, the cost of fuel, environmental conditions (weather, water conditions), and personal factors (such as time constraints due to jobs). Explaining why subsistence salmon harvests have declined, a respondent from Stony River said:

> The cost of gas. Every year it's been going up … we're paying pretty close to eight seventy-five a gallon. Yeah, a lot of people can't get fish.

Figure 6.–Change in average annual subsistence harvests of salmon by species and section of Kuskokwim River, 2010–2016 compared to 1990–1994

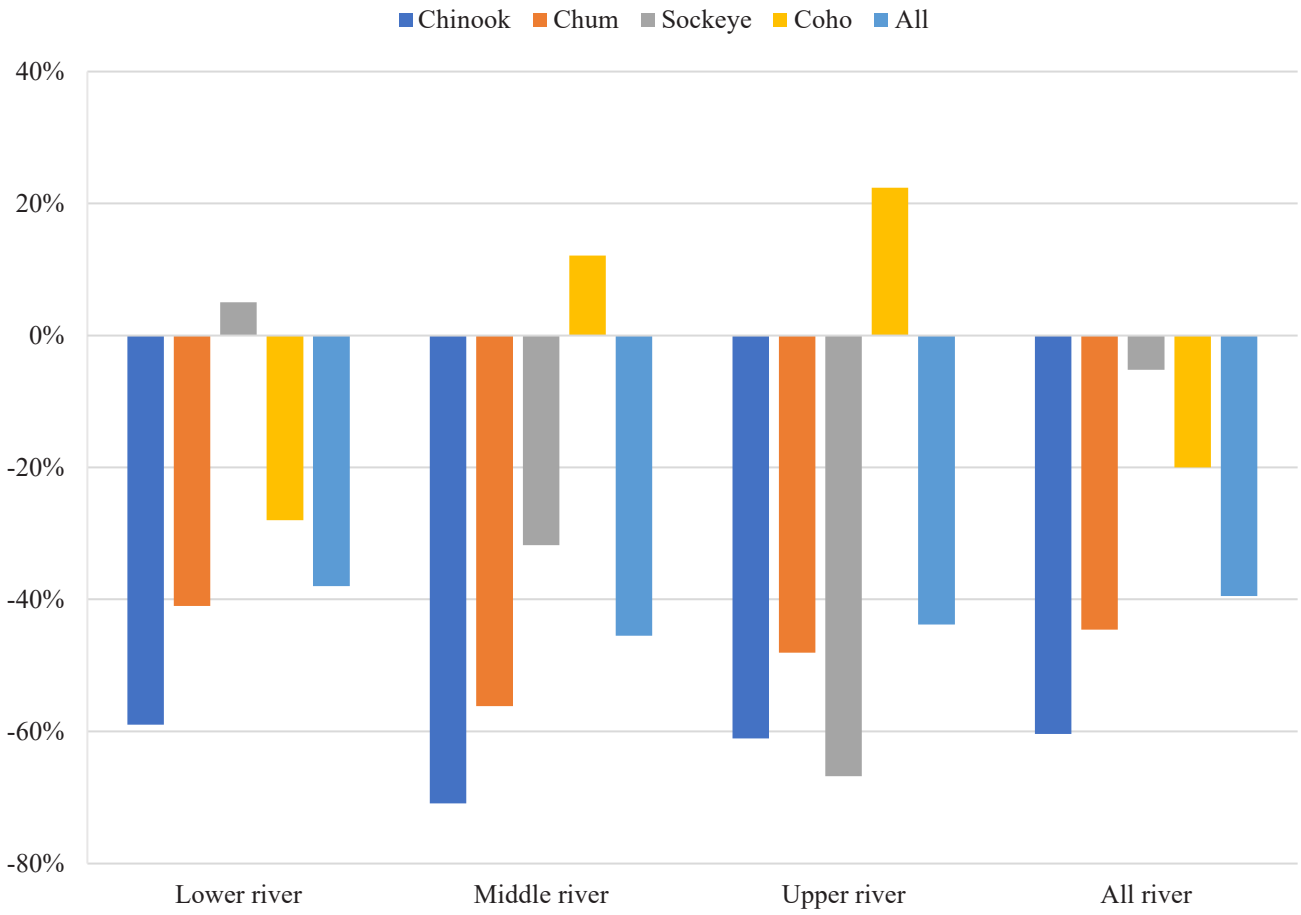


Table 4.–Factors affecting subsistence salmon fishing, Kuskokwim River communities.

Factor	Percentage of households					
	Bethel n = 99 HHs	Aniak n = 23 HHs	Sleetmute n = 9 HHs	Stony River n = 5 HHs	McGrath n = 18 HHs	Nikolai n = 14 HHs
Closures/gear restrictions	88%	78%	67%	0%	44%	43%
Abundance of salmon	21%	48%	11%	0%	28%	14%
Unusual weather	19%	0%	44%	20%	17%	7%
Price of gasoline	17%	39%	56%	40%	28%	43%
Working at a job	9%	17%	11%	20%	44%	36%
Unusual water conditions	5%	0%	33%	60%	22%	14%
Condition of boat/motor	8%	9%	22%	20%	11%	14%
Number of people in household	4%	13%	11%	0%	11%	0%

Note Factors listed were in the topfive for at least one community.

A resident of McGrath explained how lower king salmon abundance resulted in a shift in targeted species.

> Number of fish, that's the most important to me. If the river was full of Chinooks I would fish for them. But I don't want to fish for them because the numbers are so low. The net I bought was a four-and-a-half [inch] net, and I target chums and cohos with them. Only because I don't want to catch any big Chinooks.

Discussion

This overview has highlighted only a small portion of the findings of the division's Chinook Salmon Research Initiative projects. We encourage readers to consult the projects' final reports for more detail about key findings and recommendations. Here we note several common themes that emerged during the research. Perhaps the most important conclusion is that "the effective management of fish and wildlife and protection of subsistence fishing and hunting opportunities depend upon the involvement of people who have direct knowledge of these resources and their habitats" (Halas and Cunningham 2019:355). Encouraging more involvement of local people and leaders in advisory committees, regional advisory councils, and regulatory boards is necessary to sustain viable fisheries management. Also, managers and researchers need to increase the time they spend in communities and among fishers, directly engaging with the public during the fishing season (Runfola et al. 2019a:35)—a central component of most of these CSRI projects. Also essential is adhering to high standards of scientific research, including thorough training of local research assistants. Strong partnerships also support successful research; they reduce costs and help build consensus about fisheries trends. Also, we note that the strong majority of people we contacted in 47 mostly rural Alaska communities supported and agreed to participate in the CSRI research.

The five projects that investigated subsistence harvest assessment methods found that harvest data regarding Chinook salmon are generally good. However, reliance solely on permit returns likely underestimates harvests and participation levels in most fisheries; therefore, periodic postseason surveys and collaborative review of results are necessary. Implementation of inseason subsistence harvest data collection proved challenging, especially as a means to estimate total annual harvests. However, these projects enhanced communication between agency staff and subsistence fishers and provided useful data for assessing salmon returns and achievement of harvest goals. Harvest monitoring programs need to balance the desire for precision and immediacy of data availability with costs and respondent burden (see also, for example, Fall and Shanks 2000).

Five projects focused on local and traditional knowledge about Chinook salmon, but all 12 projects documented and discussed LTK. Respondents offered a range of observations and ideas about the causes of the statewide declines in Chinook salmon stocks. Many linked the declines to the rapidly warming climate and consequent environmental change, but the effects of development (such as roads and mines), overharvest, and human population growth were also described.

Similarly, the two projects that investigated patterns and trends in subsistence harvests through evaluation of postseason survey responses and key respondent interviews found a diversity of reasons for household, subregional, and

drainagewide changes in harvest patterns, a "total environment of change" (Moerlein and Carothers 2012). Respondents cited personal circumstances, run strength, regulations, and unusual weather patterns, among others, as factors that affected their harvest goals, fishing effort, and success. Many respondents noted their increasing difficulties with predicting and understanding weather patterns with the rapidly changing climate. In coordination with reliable harvest assessment programs, future research should periodically conduct interviews with fishers to provide context for change and document their broader observations of environmental conditions.

Finally, we need to note that despite the significant and rapid changes they described and have experienced regarding Chinook salmon and other vital natural resources, participants in this research also expressed confidence in the resilience of their way of life. A respondent from Perryville said:

> Yes, all of these changes to the environment and our resources worry me, but my people have lived here, fished here, and hunted here since the beginning of time—we will adapt as we always have done.

Consistent with the goal to support Alaska's diverse communities and cultures, the CSRI projects summarized here contribute to improved understanding of the complex factors that shape Chinook and other salmon productivity and sustainability.

References Cited

List of Final CSRI Reports

Brown, Caroline L., and Deena M. Jallen. 2019. "Pilot Inseason Monitoring of Subsistence Salmon Harvests in the Yukon River Drainage." Fairbanks: Alaska Department of Fish and Game, Division of Subsistence Technical Paper No. 448. http://www.adfg.alaska.gov/techpap/TP 448.pdf.

Brown, Caroline L., Alida Trainor, Brooke M. McDavid, James S. Magdanz, and Gulfaya Rakhmetova. *In Prep.* "Patterns and Trends of Salmon Harvest and Use in the Yukon River Drainage, Alaska, 1990–2014." Fairbanks: Alaska Department of Fish and Game Division of Subsistence, Technical Paper No. 442.

Godduhn, Anna R., David M. Runfola, Christopher R. McDevitt, Gulfaya Rakhmetova, Helen S. Cold, and Caroline L. Brown. 2020. "Patterns and Trends of Subsistence Salmon Harvest and Use in the Kuskokwim River Drainage, 1990–2016." Fairbanks: Alaska Department of Fish and Game Division of Subsistence, Technical Paper No. 468. http://www.adfg.alaska.gov/techpap/TP 468.pdf.

Halas, Gabriela, and Margaret Cunningham. 2019. "Nushagak River Chinook Salmon: Local and Traditional Knowledge and Subsistence Harvests." Anchorage: Alaska Department of Fish and Game Division of Subsistence, Technical Paper No. 453. http://www.adfg.alaska.gov/techpap/TP453.pdf.

Hutchinson-Scarbrough, Lisa, James M. Van Lanen, and David Koster. *In prep.* "Subsistence Harvest Assessment of Salmon and Local and Traditional Knowledge of Chinook Salmon in the Chignik Management Area, 2014–2016." Anchorage: Alaska Department of Fish and Game Division of Subsistence, Techncial Paper No. NNN.

Jones, Bronwyn E., and Malla Kukkonen. 2017. "Local and Traditional Knowledge of Abundance of Chinook Salmon in the Kenai River." Anchorage: Alaska Department of Fish and Game Division of Subsistence, Technical Paper No. 431. www.adfg.alaska.gov/techpap/TP431.pdf.

Mikow, Elizabeth H., Brittany Retherford, David M. Runfola, and Daniel Gonzalez. 2019. "Local Traditional Knowledge of Salmon Freshwater Ecology in the Middle and Upper Kuskokwim River." Fairbanks: Alaska Department of Fish and Game, Division of Subsistence Technical Paper No. 450. http://www.adfg.alaska.gov/techpap/TP 450.pdf.

Ream, Joshua T., and Jessie Merriam. 2017. "Local and Traditional Knowledge of Stikine River Chinook Salmon: A Local Perspective on a Vital Commercial, Sport, and Subsistence Fish." Anchorage: Alaska Department of Fish and Game Division of Subsistence Technical Paper No. 430. http://www.adfg.alaska.gov/techpap/TP432.pdf.

Runfola, David M., Loraine S. Naaktgeboren, and David Koster. 2019a. "Inseason Estimation of Subsistence Salmon Fishing Effort and Harvest in the Lower Kuskokwim River, 2015–2018." Fairbanks: Alaska Department of Fish and Game Division of Subsistence, Technical Paper No. 449. http://www.adfg.alaska.gov/techpap/TP 449.pdf.

———. 2019b. "Inseason Subsistence Salmon Harvest Assessments in 9 Communities of the Middle Kuskokwim River, 2015–2018." Fairbanks: Alaska Department of Fish and Game Division of Subsistence, Technical Paper No. 455.

Sill, Lauren A., Gabriela Halas, and David Koster. 2019. "Copper River Chinook Salmon: The Intersection of Commercial Fisheries and the Subsistence Way of Life in Cordova, Alaska." Anchorage: Alaska Department of Fish and Game Division of Subsistence, Technical Paper No. 444. http://www.adfg.alaska.gov/techpap/TP444.pdf.

Sill, Lauren A., and James M. Van Lanen. *In prep.* "Local and Traditional Knowledge of Chilkat Chinook Salmon." Anchorage: Alaska Department of Fish and Game Division of Subsistence, Technical Paper No. NNN.

Trainor, Alida, Brooke M. McDavid, Lauren A. Sill, and Loraine S. Naaktgeboren. 2019. “Local Traditional Knowledge of the Freshwater Life Stages of Yukon River Chinook and Chum Salmon in Anvik, Huslia, Allakaket, and Fort Yukon.” Fairbanks: Alaska Department of Fish and Game Division of Subsistence, Technical Paper No. 447. http://www.adfg.alaska.gov/techpap/TP 447.pdf.

Other References Cited

ADF&G Chinook Salmon Research Team. 2013. “Chinook Salmon Stock Assessment and Research Plan, 2013.” Anchorage: Alaska Department of Fish and Game, Special Publication No. 13-01. http://www.adfg.alaska.gov/FedAidPDFs/SP13-01.pdf.

Davis, Anthony, and Kenneth Ruddle. 2010. “Constructing Confidence: Rational Skepticism and Systematic Enquiry in Local Ecological Knowledge Research.” *Ecological Applications* 20 (3): 880–894. https://doi.org/10.1890/09-0422.1.

Erickson, Jack, Tim Sands, Greg Buck, and Suzanne Maxwell. 2019. “Nushagak River Chinook Salmon Assessment Program, Management Structure, and Stock Status.” n.p. [Anchorage]: Report to BOF Special Committee on Nushagak-Mulchatna King Salmon Fishery Management Plan: October 21, 2019. https://www.adfg.alaska.gov/static-f/regulations/regprocess/fisheriesboard/pdfs/2019-2020/nush-oct/nush_king_assessment.pdf.

Fall, James A., Anna Godduhn, Jaqueline M. Keating, Lisa Hutchinson-Scarbrough, Bronwyn Jones, Brooke McDavid, Elizabeth Mikow, Lauren A. Sill, and Terri Lemons. *In prep*. “Alaska Subsistence and Personal Use Salmon Fisheries 2018 Annual Report.” Anchorage: Alaska Department of Fish and Game Division of Subsistence, Technical Paper No. NNN.

Fall, James A., and Roland Shanks. 2000. “Statewide Subsistence Fisheries Harvest Monitoring Strategy.” Anchorage: U.S. Fish and Wildlife Service, Office of Subsistence Management, Fisheries Resource Monitoring Program Final Report (Study No. FIS 00-017). Alaska Department of Fish and Game Division of Subsistence. http://www.subsistence.adfg.state.ak.us/download/download/ssfhms.pdf.

Krieg, Theodore M., Davin L. Holen, and David Koster. 2009. “Subsistence Harvests and Uses of Wild Resources in Igiugig, Kokhanok, Koliganek, Levelock, and New Stuyahok, Alaska, 2005.” Dillingham: Alaska Department of Fish and Game Division of Subsistence, Technical Paper No. 322. http://www.adfg.alaska.gov/techpap/TP322.pdf.

Magdanz, James S., Eric Trigg, Austin Ahmasuk, Peter Nanouk, David S. Koster, and Kurt Kamletz. 2005. “Patterns and Trends in Subsistence Salmon Harvests, Norton Sound and Port Clarence, 1994–2003.” Juneau: Alaska Department of Fish and Game, Division of Subsistence, Technical Paper 294. http://www.adfg.alaska.gov/techpap/tp294.pdf.

Moerlein, Katie J., and Courtney Carothers. 2012. “Total Environment of Change: Impacts of Climate Change and Social Transitions on Subsistence Fisheries in Northwest Alaska.” *Ecology and Society* 17 (1): 10.

Moncrieff, Catherine, Jill Klein, Teddy Willova, and Gerald Maschmann. 2014. “Yukon River In-Season Salmon Teleconferences and Harvest Survey, 2013. Annual Report for FWS Agreement No. F12AC00196.” Anchorage: Yukon River Drainage Fisheries Association.

North Pacific Research Board, ed. 2005. *North Pacific Research Board Science Plan: Building a Clear Understanding of the North Pacific, Bering Sea, and Arctic Ocean Ecosystems That Enables Effective Management and Sustainable Use of Marine Resources*. 1st ed. Anchorage, Alaska: North Pacific Research Board.

Staton, B.A. 2018. “In-Season Harvest and Effort Estimates for 2018 Kuskokwim River Subsistence Salmon Fisheries during Block Openers. Project Summary Report.” Bethel, Alaska: U.S. Fish and Wildlife Service, Yukon Delta National Wildlife Refuge. https://www.fws.gov/uploadedFiles/2018KuskokwimRiverSalmonSubsistenceHarvestReport.pdf.

Wolfe, Robert J., Cheryl L. Scott, William E. Simeone, Charles J. Utermohle, and Mary C. Pete. 2010. “The ‘Super-Household’ in Alaska Native Subsistence Economies.” Final Report to the National Science Foundation, Project ARC 0352611.

Note This March 2021 revision of the document originally published in September 2020 updates pre- and post-survey salmon harvest estimates for the Chignik Management Area in the first full paragraph of page 6.

This document should be cited as:
ADF&G. 2021rev. The Chinook Salmon Research Initiative and Alaska’s Subsistence Fisheries: What Did We Learn? Alaska Department of Fish and Game Division of Subsistence, Anchorage.

DIVISION OF SUBSISTENCE

ANCHORAGE
333 Raspberry Rd.
Anchorage, AK 99518- 1599
(907) 267-2353

FAIRBANKS
1300 College Rd.
Fairbanks, AK 99701-1551
(877) 646-7320

DOUGLAS
PO Box 110024
Juneau, AK 99811-0024
(907) 465-3617