CHINOOK NEWS

Juvenile Chinook salmon
© John McMillan.

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WE WANT YOUR FEEDBACK!

PLEASE SEND COMMENTS OR QUESTIONS TO

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Welcome to Chinook News

Welcome to volume two of Chinook News. This publication by the Alaska Department of Fish and Game (ADF&G) is intended to inform you of our recent progress in research through the Chinook Salmon Research Initiative.

In this edition, we'll take a look at stocks in twelve important Chinook river systems around the state and the progress we're making to achieve the research plan goals as outlined by top fishery scientists in Alaska. These scientists produced the research plan now being implemented by nearly 200 ADF&G staff working on 35 projects funded by the Alaska Legislature.

You can also read about our research plans for each of these rivers, our marine research projects, and our cooperative efforts with the University of Alaska.

As Alaskans, we're all in this together, and the department remains committed to the long term health and sustainability of our fisheries resources.

Now I invite you to read and share this publication. I hope you find it informative.

Sincerely,

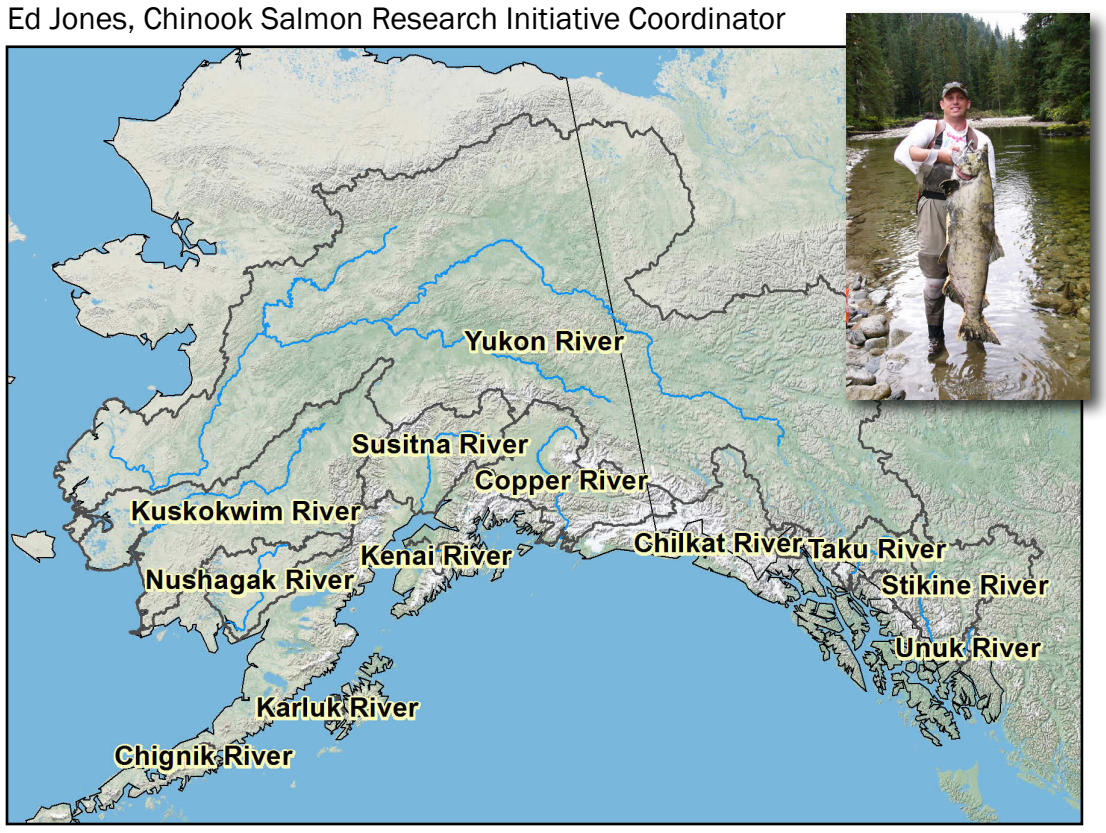
Commissioner Sam Cotten

Releasing a tagged Chinook salmon into the Susitna River. © ADF&G.

ADF&G employee samples scales at the Kogrukluk weir. © University of Alaska Fairbanks.

Chinook Salmon Research Initiative

Ed Jones, Chinook Salmon Research Initiative Coordinator



Map showing 12 indicator stocks for the Chinook Salmon Research Initiative. © ADF&G, Division of Sport Fish, Research and Technical Services.

The Alaska Department of Fish and Game's Chinook Salmon Research Initiative is one of the largest and most comprehensive fisheries research programs in Alaska's history. Alaska has hundreds of Chinook salmon stocks, and to better understand their productivity across such a wide geographic range, twelve stocks were chosen as indicators of the overall health and production of Alaska's Chinook salmon. These indicator stocks provide the bulk of the state's wild Chinook salmon production and thus are vitally important to the subsistence, cultural, and economic sustainability of nearby rural and urban communities.

During 2013 and 2014 sessions, the Alaska legislature provided $15 million in support of this Initiative, funding 35 Chinook salmon projects in 2014. These research projects are increasing our confidence in estimates of adult spawning abundance. Simply put, we need to know how many fish are making it to their spawning grounds. At the same time, studies to estimate juvenile Chinook salmon abundance and stock-specific harvests in the various marine fisheries have been prioritized. Combined, these endeavors ultimately allow total run reconstructions on these stocks.

With the signing of the Pacific Salmon Treaty in 1985, Chinook salmon management and research in Southeast Alaska became a significant department focus. Because budgets and personnel were prioritized, today the Chinook salmon stock assessment program in Southeast leads by example and is second to none. These focused research efforts have resulted in multiple years of adult spawning and juvenile abundance estimates, marine survival, total harvest, and total run estimates. Used together, this information indicates the major factor for decreased Chinook salmon productivity in Southeast Alaska is the marine environment. Estimates of juvenile abundance in Southeast Alaska have fluctuated normally; however, the data gathered in our long standing stock assessment programs show that Chinook salmon in Southeast started dying at alarmingly high rates once they entered the ocean to rear beginning in the mid-2000s.

Detailed stock assessment information similar to that generated in Southeast Alaska is rare both within Alaska and the Pacific Northwest. Research like this takes time, money, and patience. Efforts started today will ultimately take years of continued effort to provide a sufficient time series of run statistics useful for production and trend analyses. Nevertheless, the state's investments are worthy because, lacking information, fisheries managers often let more fish escape than may be necessary to sustain the population. The Chinook Salmon Research Initiative has started a statewide process that will ultimately strengthen our confidence in estimates of abundance allowing for more timely and prudent management measures. When productivity allows, fishers will be afforded opportunity; and when productivity is poor, fish will be passed through to meet necessary escapement or spawning requirements.

I have always said there are two main ingredients in any good recipe for Chinook salmon production: adequate spawning abundance and favorable ocean conditions, which ensure marine survival. The marine survival ingredient is controlled mostly by Mother Nature; however, resource managers and subsistence, sport, and commercial users alike have a great deal of control over what happens in the freshwater environment, and our actions today have a great bearing on future fish production and fishing opportunities for future generations.

Chignik River

Charles W. Russell, Fishery Biologist, and Meredith Marchioni, Subsistence Resource Specialist

Chignik Lake residents harvest salmon with a subsistence net. © ADF&G.

Located in remote southwestern Alaska, the Chignik River is the largest Chinook salmon-producing system on the south side of the Alaska Peninsula (Figure 1), making it a prime candidate for the Chinook Salmon Research Initiative. The Chignik River watershed consists of Chignik Lagoon, Chignik Lake, Black Lake, and several tributaries that provide spawning and rearing habitat for all of Alaska's five species of Pacific salmon. Several communities line the watershed, and residents depend upon salmon resources to fulfill their subsistence needs. Chinook bound for the Chignik River drainage are targeted by sport and subsistence fisheries and are harvested incidentally in the Chignik Lagoon sockeye salmon commercial fishery.

In 2014, the Chinook Salmon Research Initiative funded three Chinook projects in the Chignik area, two of which are new in 2014. One project bolsters information collected on adults by gathering the age, sex, and length information of Chignik River Chinook salmon from day-to-day sampling at the Chignik River weir and creel sampling of the sport fishery. The information is used in run reconstructions and helps with estimating trends in abundance over time.

Figure 1.—Chignik River watershed.

Another project samples the marine commercial harvests of Chinook for age, sex, length, tissue, and mark and tag information (see "Marine Sampling Kodiak and Westward" on page 13). Finally, surveys of the subsistence harvest are conducted with interviews in the communities of Chignik Lagoon, Chignik Lake, Chignik Bay, and Perryville. Historically, no research has been performed on juvenile Chinook salmon in the Chignik River.

(continued on page 3)

CHIGNIK RIVER *(continued from page 2)*

Bolstering information on adult Chinook salmon

A longstanding way to count Chinook in the Chignik River is by using a weir (Figure 2). Two gates equipped with underwater cameras and lights remain open to allow for unrestricted fish passage. Every fish that passes through the weir during the first 10 minutes of every hour is counted and identified by species. Based on a proven statistical model, the total number of fish tallied during the first 10 minutes of each hour is then multiplied by six to create hourly estimates of salmon passage above the weir.

As a part of the Initiative, weir staff not only count returning Chinook, but also sample as many as possible for age, sex, and length using a trap that is incorporated into the weir. To make sure weir-sampled Chinook are not sampled again in the sport fishery, the adipose fin is clipped on every fish sampled in the trap.

Most inriver harvest of Chinook salmon comes from the guided sport fishery. Currently, only two sport fishing operations are active, and both are based downriver of the Chignik River weir, which affords weir staff the opportunity to access catches and sample for age, sex, and length information after guide boats have completed a day of fishing. In 2014, more than 140 Chinook were sampled in the sport fishery, and more than 60 percent of the fish were 5 years of age, having spent three years rearing in the marine environment, and averaged 32 inches in length.

Gathering important information from local residents

Staff from the Alaska Department of Fish and Game travelled to the communities of Chignik Lake, Chignik Lagoon, Chignik Bay, and Perryville during November 2014 to conduct subsistence salmon harvest surveys with a census of each community. The surveys will be used to assess how much salmon each household harvested in 2014, when and where each species was harvested, what ecological knowledge is held by area residents regarding the Chignik Chinook salmon run, and what local fishers think can be done to protect the future of the Chignik Chinook salmon population. Survey data will show how many Chinook each community harvested in 2014 and whether these harvests were enough to meet their subsistence needs. Detailed maps will display when and where in the Chignik River watershed Chinook were harvested.

Figure 2.–Chignik River weir. © ADF&G.

In-depth interviews were also conducted with elders and major subsistence harvesters in each of these communities. Data from survey questions will be combined with interview data to illustrate local knowledge regarding Chignik Chinook salmon, observations of how the species has changed over time, and beliefs about how the local Chinook stocks could be managed.

Chilkat River

Brian W. Elliott, Fishery Biologist, and Meredith A.F. Marchioni, Subsistence Resource Specialist

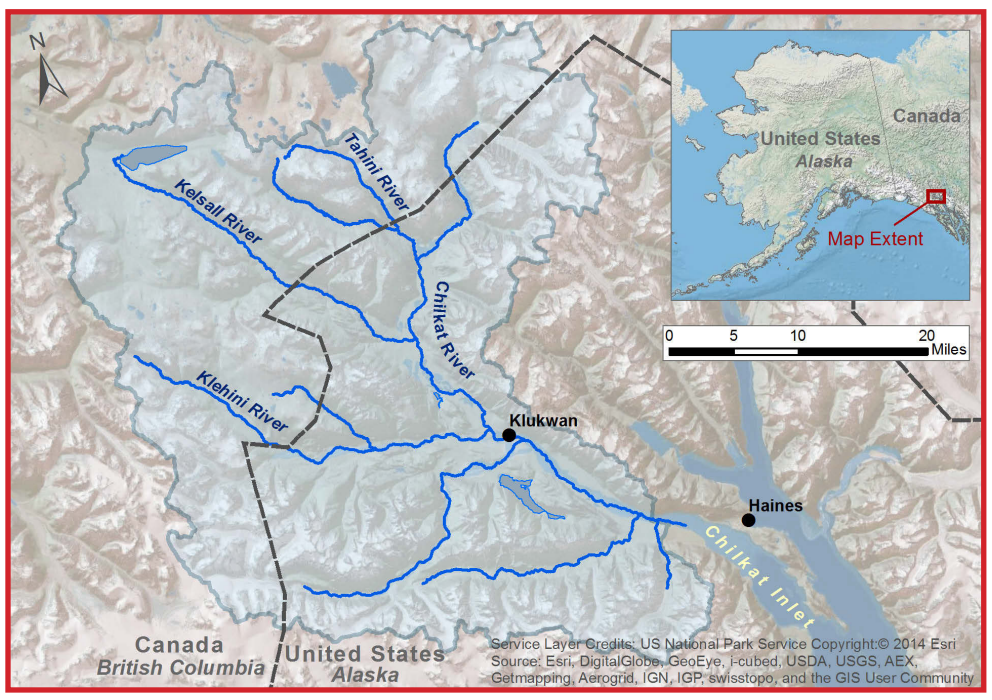


Figure 1.—The Chilkat River drainage originates in northwestern British Columbia and terminates in Southeast Alaska near Haines.

The Chilkat River is a large glacial system that originates in British Columbia and flows into Chilkat Inlet in northern Lynn Canal (Figure 1). It is one of the principal producers of Chinook salmon in Southeast Alaska with runs averaging 4,600 large fish (28 inches or greater in length). Nearly all Chilkat River Chinook rear one year in freshwater and spend between one and five years in marine waters before returning to spawn. Adults typically return in three or four years and spawn in several tributaries in the Chilkat River drainage including the Tahini, Kelsall, and Klehini rivers.

For the past 15 years, Chinook stock assessment projects on the Chilkat River have provided estimates of adult and juvenile abundance, juvenile overwinter survival, marine harvest, and juvenile-to-adult marine survival.

Recent poor runs can be largely attributed to poor juvenile-to-adult marine survival coupled with harvest rates in marine mixed-stock fisheries in Southeast Alaska that have increased relative to the overall run size. Like other declining Southeast Alaska wild Chinook stocks, assessment research is critical to inform fisheries managers on how to conserve these fish.

Adult spawning abundance

Mark-recapture projects have been conducted in the Chilkat River since 1991. Returning adults are captured in the lower river with fish wheels and drift gillnets, tagged with uniquely numbered external tags, and released to resume their spawning migration (see "Mark-recapture research for population estimation" on page 4). Tagged fish are potentially recaptured on their spawning grounds, and the percentage of recaptured marked fish determines the drainagewide spawning abundance estimate. Since 1991, average annual escapement has been estimated at 3,713 large Chinook salmon. The 2014 preliminary spawning abundance estimate was about 1,520 large Chinook salmon, well below the escapement goal lower bound of 1,750 fish (Figure 2).

Juvenile abundance

Mark-recapture projects to estimate annual abundance of juvenile Chinook in the Chilkat River have been conducted since 1999, and abundance is estimated to average 172,624 fish. These projects use methodologies similar to the adult mark-recapture; however, the duration is longer and covers the entire juvenile-to-adult life history, which can take up to five years between marking and recapture.

The fall and spring marking events include fish from the same parent (brood) year. Fish are captured, marked by clipping the adipose fin, and a coded wire tag is injected into the soft tissue of the snout. The recapture event includes sampling returning adults over the next five years for adipose finclips. The proportion of adipose finclips in the recapture event, coupled with the total number marked, is used to estimate juvenile abundance leaving the Chilkat each spring. Because there are two tagging groups for each parent year, fall and spring abundance can be estimated and the two population estimates compared to estimate overwinter juvenile survival. Over the past 15 years, 8.5 percent of Chilkat Chinook salmon have been marked as juveniles, with fall abundance ranging from 270,000 to 670,000 fish and spring abundance ranging from 105,000 to 280,000 fish.

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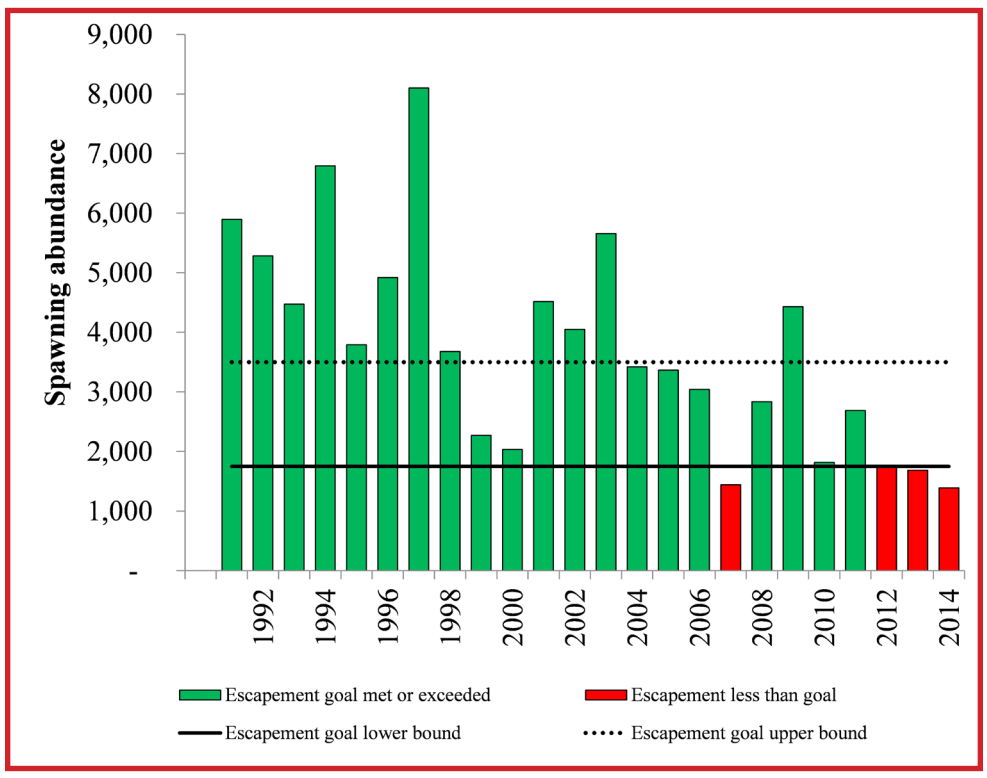

Figure 2.—Chilkat River Chinook salmon spawning abundance, 1991–2014.

CHILKAT RIVER *(continued from page 3)*

Overwinter survival has ranged from 21 percent to 53 percent, and marine survival has ranged from 1 percent to 5 percent, with the lowest marine survivals occurring most recently.

Juvenile Chinook salmon were tagged in fall of 2013 (20,000) and spring of 2014 (1,900), representing the 2012 brood year. Marine rearing and adult escapement data will be collected over the next five years, resulting in full production estimates including marine harvest and survival.

Harvest

Chilkat River Chinook are harvested in commercial marine, sport, and local subsistence fisheries. Marine harvest is estimated from coded wire tag recovery, a creel survey of the spring marine boat fishery harvest in Chilkat Inlet, and the Chilkat marine and freshwater subsistence fisheries harvest.

Coded wire tag research in the Chilkat River drainage. © ADF&G.

In years of low abundance and missed escapement goals, harvest data are critical for fisheries management and stock conservation. A full run reconstruction on Chilkat River Chinook incorporates adult spawning escapement combined with marine harvest to estimate total return. Fall and spring juvenile abundance are estimated and compared to estimate overwinter survival. Finally, spring juvenile abundance is compared with total return to estimate marine survival.

Subsistence

In 2014, the Department of Fish and Game interviewed commercial and subsistence fishers in the Chilkat River watershed with an emphasis on Haines and the Native Village of Klukwan. Local and traditional knowledge of Chinook migration, behavior, health, abundance, inriver habitat, and perceived reasons for decline was compiled and is being compared to historical data and for potential explanations of the decline. Changes observed in the local marine and freshwater environments over the past decade and over the course of each fisher's residency were documented, and possible impacts of these changes will be analyzed.

Interviews with fishers included mapping contemporary and historical fishing locations for Chinook. Preliminary results show that a majority of fishers perceive a significant decline in Chinook salmon over the past 15 years, with most of the decline occurring over the past three to five years. Commercial, sport, and subsistence fishers attribute much of the decline in Chilkat Chinook to environmental changes over the last 20 years. Many commercial fishers believe water temperatures are warming, leading to different fish behaviors (e.g., fish hitting their nets at deeper depths and with less velocity, and catching smaller fish). Commercial fishers also note an increase in orca and humpback whales from Berners Bay to Sullivan Rock, which they say has a negative impact on the number of salmon they catch. Many subsistence fishers also spoke of physical changes along the river, including those caused by heavy boat traffic and road maintenance, and inriver changes making it difficult for adult Chinook to access their spawning grounds and for smolt to reach the ocean. Lastly, all fishers note physical changes in Chinook salmon, such as spots in meat, yellow livers, and abnormally soft meat.

The collection of local ecological knowledge from longtime area fishers is critical to understanding the Chilkat Chinook run. Once analyzed, data will illustrate how those most intimate with the resource perceive the current state of the resource and how to sustain the run in the future.

Mark-recapture research for population estimation

How many fish are there? Fisheries managers are tasked with maintaining wild salmon stocks to assure sustained yields for subsistence, sport, and commercial fisheries. This means managers must make sure that adequate numbers of spawning adults return to sustain salmon production. But how do you tell how many adults escaped or how many juveniles were produced or hatched? For many stocks, returning adults are counted using a weir or sonar, but sometimes these methods are not possible or practical. In these cases, the tool of choice is often the "mark-recapture" technique.

Very simply, a mark-recapture project works like this:

To begin, you need to define the population of interest. For instance, it could be the spawning population in the Taku River or the number of juvenile salmon leaving the system to rear in the ocean. You must then sample the population and mark as many individuals as possible. In doing so, you need to try and capture fish that are representative of the entire population. This is often referred to as the "marking event." Marks can be as simple as finclips, but they can also include tags such as radio tags, coded wire tags, or spaghetti tags, just to name a few.

Next, the marked fish are released and allowed to thoroughly mix with unmarked fish.

After mixing, you must then recapture some of these marked fish by sampling the population again and looking for the presence and absence of marks. This is often called the "recapture event." If a large enough fraction of the population was marked, you will recapture some marked fish.

Finally, you can estimate the total population abundance with some very simple math. For instance, if you marked 1,000 fish in the marking event and then sampled 1,000 fish in the recapture event and found that 100 were marked (10%), then because you know the percentages of marked fish must remain the same between the two events, the total population abundance must be 10,000 (1,000 x 1,000/100). Although presented simply here, mark-recapture research is often more complex.

Copper River

James W. Savereide, Corey J. Schwanke, Steve D. Moffitt, and Richard E. Brenner, Fishery Biologists, and Davin Holen, Subsistence Program Manager

The Copper River is a glacially dominated system located in Southcentral Alaska and is the second largest river in Alaska in terms of average discharge. It flows south from the Alaska Range, Wrangell, and Chugach Mountains and empties into the Gulf of Alaska, slightly east of Prince William Sound (Figure 1). The Copper River Chinook salmon stock comprises six major spawning stocks (Chistochina, Gulkana, Tazlina, Klutina, Tonsina, and Chitina rivers). The Chinook salmon stock supports a commercial drift gillnet fishery near the mouth of the river, plus inriver subsistence (fish wheel and dip net), personal use (dip net), and sport fisheries. Since 1999, the Copper River drainage has sustained an average run of around 71,000 Chinook salmon; however, in recent years the run has declined to an average of about 54,000 Chinook salmon. This same pattern of declining runs is consistent with observations for many of the Chinook salmon runs across Alaska.

To understand the processes affecting production of Chinook salmon in the Copper River and to better facilitate management of the fishery, additional information regarding adult and juvenile abundance, stock composition of the harvest, and traditional knowledge of the fisheries is needed.

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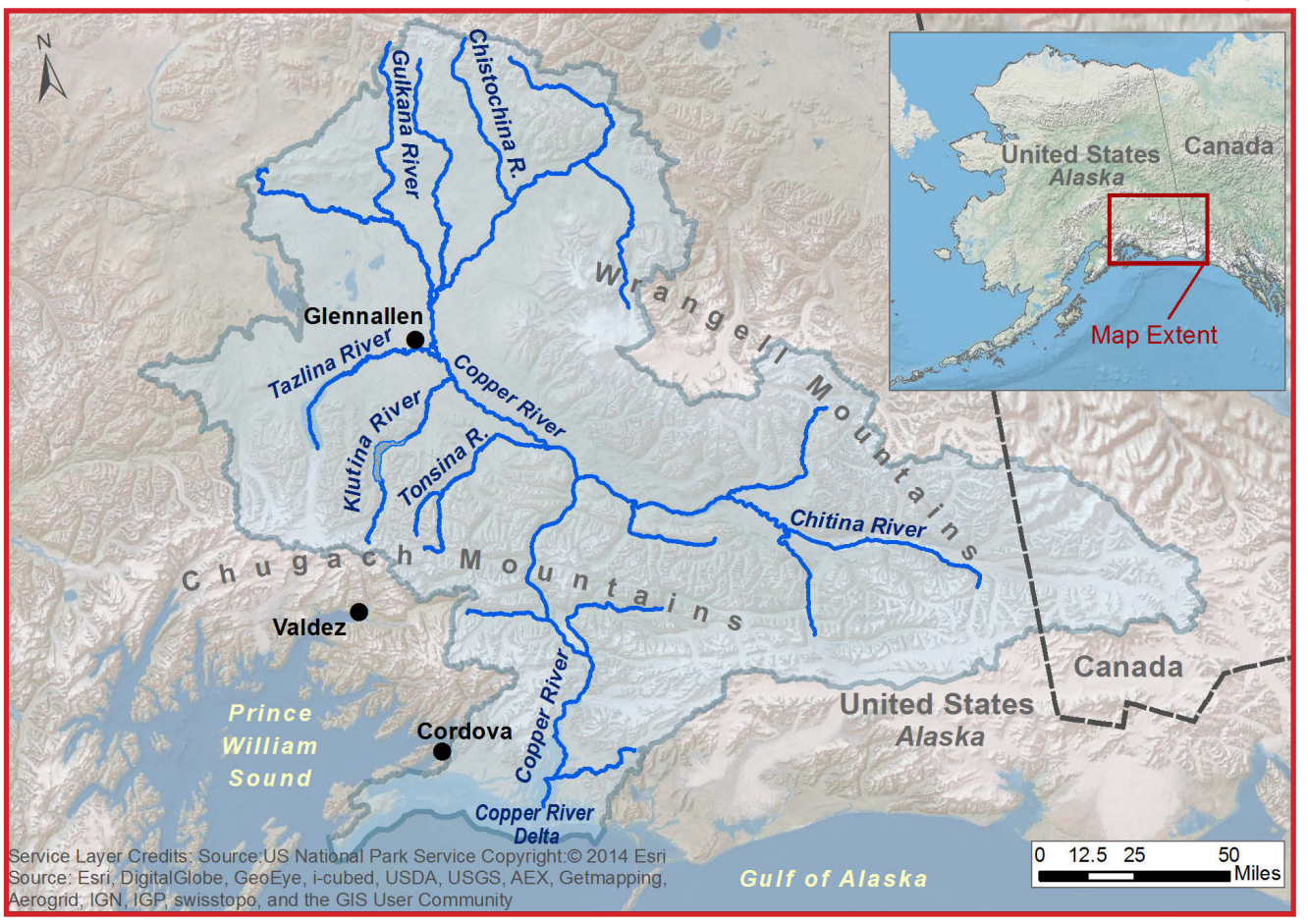

Figure 1.—A map of the Copper River drainage and major spawning tributaries.

COPPER RIVER *(continued from page 4)*

Researching an important stock in the Copper River

Capturing Chinook salmon smolt with beach seine for a mark-recapture project. © ADF&G.

The Alaska Department of Fish and Game, in partnership with the Bureau of Land Management, uses a counting tower to monitor Chinook salmon escapement on the Gulkana River. Chinook are visually identified and counted as they migrate upstream over white panels on the river bottom. The Gulkana River was selected for monitoring because the stock makes up a significant portion of the total Copper River escapement and plays a vital role in the subsistence, commercial, personal use, and sport fisheries.

The Gulkana River Chinook salmon distribution project was initiated to estimate the proportion of Chinook spawning below the counting tower. In this project, radio tags are inserted into Chinook salmon in the lower Gulkana River near the confluence with the Copper River. The radiotagged fish are tracked by a series of radio towers and aerial flights to estimate the proportion of the escapement below the counting tower. Age, sex, and length data are also collected from all captured fish to characterize and evaluate the health of the escapement. Future work plans are to increase the number of radiotagged Chinook salmon.

What's happening to juvenile Chinook salmon?

The first phase of a two-phase multi-year juvenile Chinook salmon project got underway in 2014. In phase one, Chinook salmon juveniles will be captured, injected with a coded wire tag, and marked using an adipose finclip; then, after rearing in the marine environment from one to five years, returning adults will be inspected for those marks. When adults are harvested in the various mixed stock marine fisheries, the coded wire tag information will be used to identify stock of origin.

Currently, there is no concrete information on the outmigration timing of Chinook salmon juveniles from the Copper River, but a pilot research project indicated that migration was minimal at ice-out and picked up steadily until early June when sampling ceased. Additionally, juveniles were still present in the lower reaches of the major tributaries into early June. In the spring of 2014, crews sampled for four weeks using beach seines and minnow traps on the Copper River Delta, the Copper River mainstem near the Chitina airport, and in the lower reach of the Tonsina River. A total of 2,361 Chinook salmon juveniles were captured when sampling ended in mid-June. This work indicates that juvenile migration was minimal before ice-out.

Whose Chinook salmon are those?

To provide stock-of-origin information, genetic samples were collected in 2013 and 2014 from Chinook salmon commercially harvested within the Copper River District. Chinook were sampled for age, sex, and length data with 1,098 genetic samples collected in May and June 2013 and 1,631 samples taken in May and June 2014. Genetic sampling conducted in 2013 accounted for 82 percent of that year's total commercial harvest of Copper River Chinook salmon. A mixed stock analysis will be completed after the 2015 samples are collected and genotyped. Collections of coded wire tags from the commercial harvest will begin in 2015, and this information will be used in part to estimate the harvest of Copper River Chinook salmon, as well as contributions of coded-wire-tagged Chinook salmon recovered in these fisheries destined for other Pacific Coast locations.

Gathering information from local residents

Chinook salmon stocks are important for communities along the Copper River and in Prince William Sound at the mouth of the river. Looking at recently collected information, researchers identified a data gap in our understanding of local knowledge and harvest trends at the mouth of the Copper River. To address this gap, a project funded by the Initiative entitled "The intersection of commercial fisheries and the subsistence way of life in Cordova, Alaska" recorded the salmon harvest for home use by gear and permit type, identified factors that influence harvests and use of Chinook salmon, and documented local observations of Chinook that can inform management. Over the course of the summer in 2014, interviews were conducted in Cordova with fishers, managers, and enforcement officers. An additional survey is in development which will be given to a random sample of 200 Cordova households in February 2015.

Karluk River

Tyler B. Polum and Jeff A. Wadle, Fishery Biologists

The Karluk River is located on the southwest end of Kodiak Island (Figure 1) and contains one of only two native populations of Chinook salmon found on the Kodiak Archipelago. From its source at the outlet of Karluk Lake, the Karluk River flows 22 river miles to its terminus at the Karluk Lagoon. Just upstream from the Karluk Lagoon, a weir used for counting Chinook salmon has operated annually since 1985 (Figure 2). The Karluk River stock of Chinook salmon has traditionally supported a large sport fishery, and significant indirect harvests occur in the commercial sockeye salmon fishery and in a subsistence fishery in the Karluk Lagoon. While stocks of sockeye, pink, and coho salmon seemingly remain healthy, the escapement of Chinook salmon in the Karluk River declined drastically beginning in 2007 and has remained low to this day.

At this time, the Alaska Department of Fish and Game is bolstering the information we have about adult Chinook salmon, but we need more information about the spring outmigration of Chinook juveniles from the Karluk River. Juvenile sockeye are counted annually at the lake outlet, but Chinook are not seen in significant numbers in this project. In 2009, the department and Kodiak National Wildlife Refuge conducted a study on the Karluk River in an attempt to document the location and abundance of rearing juvenile Chinook salmon. In 2014, the Initiative began a similar project with the goal of assessing the feasibility of capturing juvenile Chinook salmon for use in juvenile abundance and coded wire tag studies.

Bolstering information on returning adult Chinook salmon

Chinook salmon escapement has been monitored at the Karluk River weir since 1985 (Figures 2 and 3). In the past, age, sex, and length composition and other biological data were collected from individual fish using a trap incorporated into the weir. With Chinook Salmon Research Initiative funding, department staff are again collecting this important information to allow for estimates of age, sex, and length to bolster our understanding of this salmon run.

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Figure 1.—Location and map of the Karluk River drainage.

KARLUK RIVER *(continued from page 5)*

Figure 2.—The Karluk River weir.

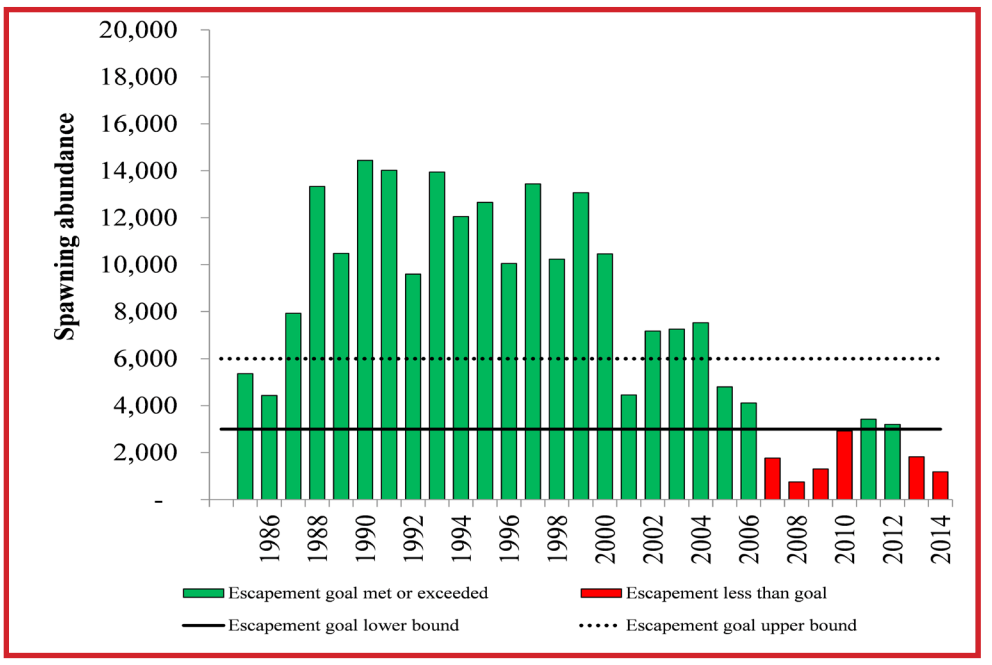

Figure 3.—Karluk River large Chinook salmon spawning abundance, 1985–2014.

Tracking down juvenile Chinook salmon

If you're going to study them, you have to find them first. While sockeye salmon juvenile abundance has been researched on several occasions over the years, a directed Chinook salmon juvenile abundance project has not been conducted on the Karluk River. Previous work on juvenile Chinook salmon in the Karluk River suggests fish are likely rearing in the river's lower portion, well below the lake, and it is also known that the vast majority of adult Chinook spawning occurs below the lake. Feasibility work in 2014 captured only 31 juvenile Chinook salmon in the drainage over several days of effort, and all of these fish were caught in the lower river using minnow traps. However, department staff caught 99 juvenile Chinook salmon in a single day while seining in Karluk Lagoon (Figure 2), suggesting this may be where the bulk of the juvenile production rears.

Kenai River

Adam M. Reimer, Fishery Biologist, and Malla Kukkonen and Bronwyn E. Jones, Subsistence Resource Specialists

Located on the northern Kenai Peninsula in Southcentral Alaska (Figure 1), the Kenai River features two distinct Chinook salmon runs, an early run in May and June and a late run that starts in early July. The river is famous for its large Chinook salmon and in May 1985 produced the standing world-record sport-caught Chinook, a 97-pound, 4-ounce fish. The Kenai River Chinook's importance to sport anglers is one reason it was chosen as an indicator stock for the Chinook Salmon Research Initiative.

In recent years, spawning abundance for Kenai River early- and late-run Chinook has hovered at or near historic lows (Figure 2). Early-run escapement goals have fallen short despite numerous inseason management actions, while late-run goals have been achieved only after significant inseason restrictions to commercial, personal use, and sport fisheries. Recent low returns have highlighted the need for accurate counts of spawning Chinook and those harvested prior to spawning.

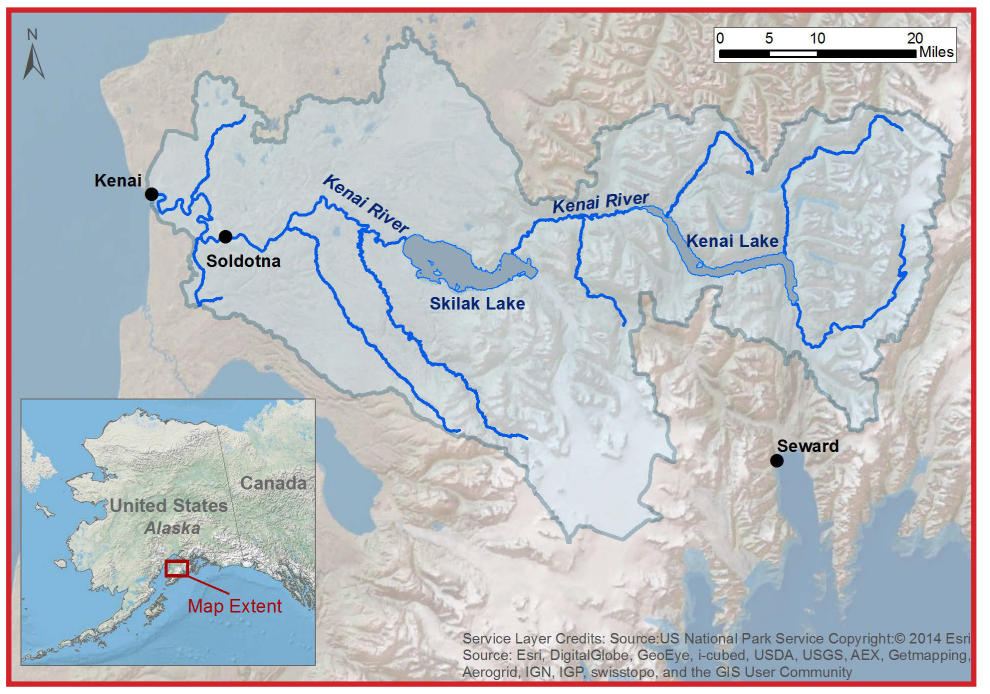

Figure 1.—The Kenai River drainage.

Newer, better ways to count

To improve Kenai River Chinook counting methods, the Alaska Department of Fish and Game identified a new sonar site at river mile 13.7 and brought in the new Dual-Frequency Identification Sonar - Adaptive Resolution Imaging Sonar (DIDSON-ARIS). The new site is located upstream of tidal influence, which eliminates blind spots created by rising tides, yet remains downstream of most Chinook spawning areas. In 2012 and 2013, only 2.4 percent and 4.2 percent of the mainstem spawning population spawned downstream of river mile 13.7, making it a far more reliable location than the original site downstream at river mile 8.6.

In addition to the sonar counts, genetic mark-recapture estimates of abundance have been conducted since 2007. This method estimates the proportion of Chinook traveling to each spawning destination by comparing the genetic profiles of fish sampled inriver to the genetic profiles of fish from each spawning destination. Since the number of Chinook in tributary spawning destinations with weirs is known, the total number can be estimated from the relative proportions in each spawning area (see "Mark-recapture research for population estimation" on page 4).

Gathering local and traditional knowledge

Early in 2014, the department used local knowledge provided by fishers and residents familiar with the Kenai River watershed to document perceived changes in the abundance of Kenai River Chinook salmon.

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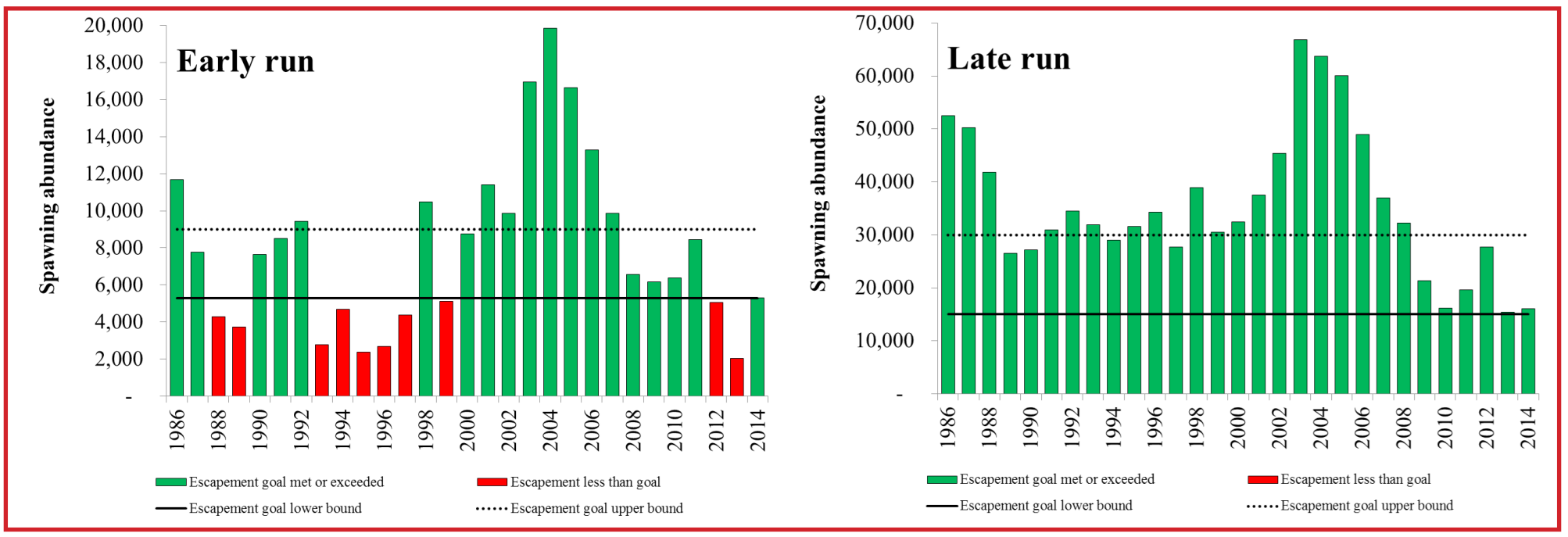

Figure 2.—Kenai River Chinook salmon spawning abundance, 1986–2014.

KENAI RIVER *(continued from page 6)*

Chinook are the first salmon to arrive each spring and have traditionally been an important source of food and income for local residents. The social-ecological relationships between local residents, the Kenai River watershed, and Kenai River Chinook have developed and changed through time. Understanding the social and economic impacts resulting from fishery and watershed changes is important. Local and traditional knowledge can provide novel and essential perspectives, lending a greater understanding of how natural systems have changed over the years and the effects of these changes on human and fish populations.

During the spring and summer of 2014, researchers completed 26 interviews with people who have a long history of participation in one or more of the Kenai River Chinook salmon fisheries, including subsistence, personal use, commercial, and sport. The majority of respondents described exponential development and increased human population occurring around the watershed during their lifetimes. Reports about the large size and unique character of the Kenai River Chinook attracted more anglers to the river starting in the late 1970s. Population growth and rapidly growing interest in Kenai River Chinook led to increased development and use around the river. All respondents noted the connection between increased human use and the escalating pressure on Chinook salmon and river habitat. Overall, respondents believe a combination of localized and open-ocean factors are impacting the health of Kenai River Chinook salmon.

Kuskokwim River

Kevin L. Schaberg, Fishery Biologist, and David M. Runfola and Hiroko Ikuta, Subsistence Resource Specialists

Kuskokwim River subsistence fishing, June 2014. © ADF&G. Photo by David Runfola.

The Kuskokwim River is Alaska's second largest river, draining approximately 50,000 square miles (Figure 1). Annual Chinook salmon returns support the state's largest subsistence harvest (averaging about 80,000 fish) and, when operating, an economically important small commercial fishery (about 3,000 fish). Projects are underway to estimate drainagewide spawning abundance, total run size, and to understand subsistence harvest patterns.

Estimates of Kuskokwim River Chinook spawning abundance were established for 1976 to 2013 (Figure 2). These estimates are coupled with harvest data in a model to calculate the total run for each year. The model was developed using information gathered during periods of average to above average production, so its usefulness during periods of poor production must be evaluated. Estimating the population size, annual variation in total run, and subsistence harvest patterns is essential to understanding what levels of harvest are sustainable during low abundance years like those observed since 2010.

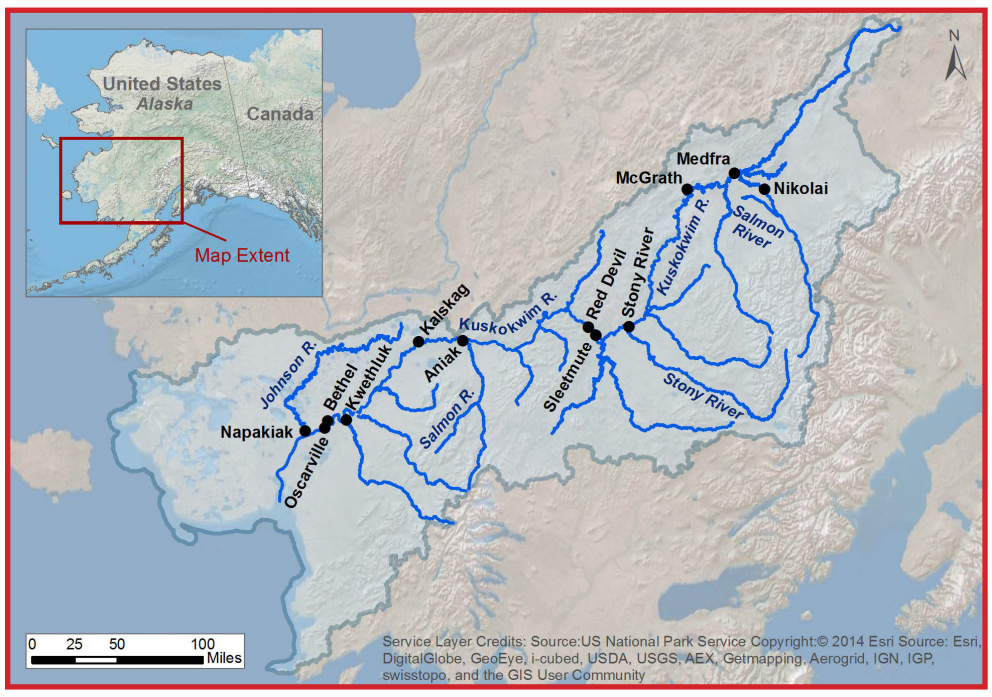

Figure 1.—Kuskokwim River watershed.

Adult spawning abundance

A mark-recapture project was implemented in 2014 to estimate adult spawning abundance for the middle and upper Kuskokwim River (see "Mark-recapture research for population estimation" on page 4). The department, in cooperation with the Kuskokwim Native Association, operated fish wheels and drift gillnets to capture and tag 304 adult Chinook salmon in the Kuskokwim near Kalskag. Radio and external plastic tags were used, and all fish were released alive and monitored during their upstream migration via tracking towers along the mainstem Kuskokwim. Four tributary weirs along with radio towers were used to monitor spawning abundance. Results from this project indicate tagged fish were distributed throughout the watershed, similar to distributions seen in prior years. A new weir will be installed in 2015 on the Salmon River of the Pitka Fork near Medfra.

In 2014, a project was conducted to see if Chinook spawning abundance could be estimated for the lower Kuskokwim River. By capturing and tagging salmon below where the majority of harvest occurs, information on harvest rates, timing, and inseason abundance can be gathered to benefit management decisions. Department staff and two fishermen, one from Bethel and the other from Kwethluk, used drift gillnets in the lower Kuskokwim River to assess the number of Chinook that could be caught. These fish were also fitted with radio tags to determine whether or not each fish successfully traveled farther upriver to spawn. In total, 92 Chinook were tagged, and preliminary information suggests that at least 85 percent migrated farther up the Kuskokwim to spawn.

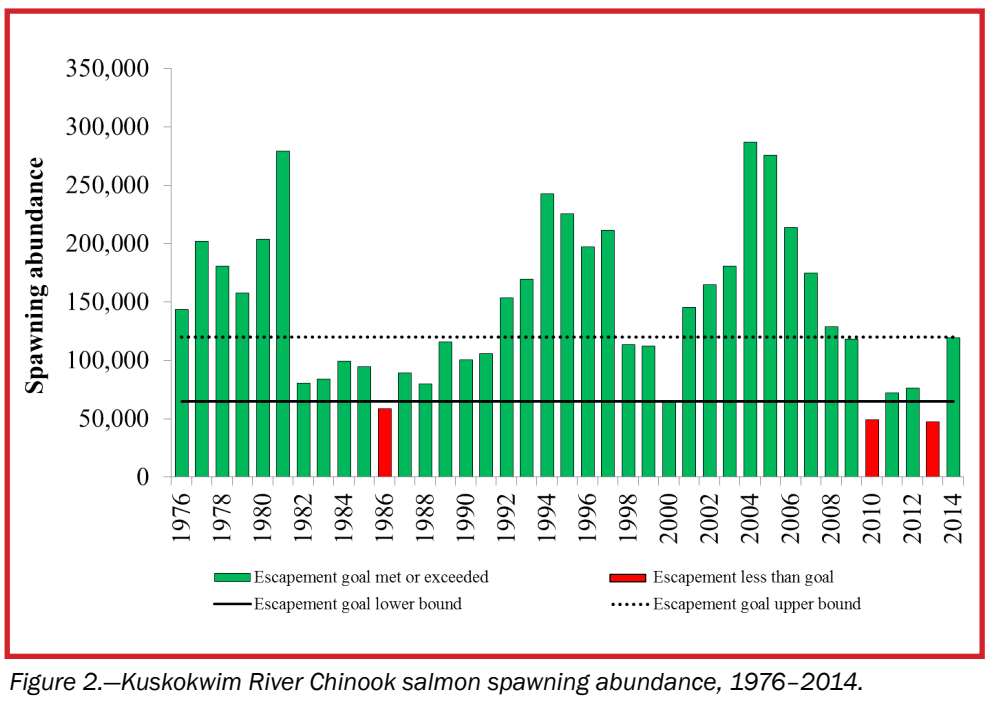

Figure 2.—Kuskokwim River Chinook salmon spawning abundance, 1976–2014.

This feasibility work also identified a site near the Johnson River as the most efficient location for capturing and tagging fish (Figure 1). As a result, in 2015, capture-and-release operations will be moved entirely to the lower river with the hopes that enough fish will be tagged and ultimately recaptured to produce a valid, drainagewide estimate of adult spawning abundance.

Inseason subsistence harvest reporting and estimation

The significance of the lower Kuskokwim Chinook subsistence fishery prompted a department project to determine the feasibility of obtaining inseason subsistence harvest estimates. Fifteen fishermen from Oscarville and Napakiak volunteered to record in June and July of 2014 the total number of each species of salmon caught, the type of gear used, and the length of time they fished. This allowed for an estimate of fishing effort, or the "catch per unit effort," based on the gear and how long they fished. An estimate of catch per unit effort can be used to calculate the total number of fish caught each day or even over the entire season if the total number of active fishers is known.

Fishers also shared their observations of run size and progress toward their seasonal harvest goal, which was important information used in management decisions in 2014.

(continued on page 8)

KUSKOKWIM RIVER *(continued from page 7)*

Local and traditional knowledge of freshwater aspects of Chinook salmon life cycle

This community-based research explores under-examined local and traditional knowledge of freshwater systems including spawning grounds, juvenile rearing habitats, and environmental factors that affect salmon spawning migration and reproduction. Communities were selected based upon their proximity to known Chinook spawning grounds that are or were monitored through weirs or sonars. Interviews were conducted in Aniak, Red Devil, Sleetmute, and Stony River, with hopes of including McGrath in 2015.

Patterns and trends in subsistence salmon fishing

This project explores community subsistence salmon fishery harvest patterns and trends in five communities—Aniak, Sleetmute, Stony River, McGrath, and Nikolai. It focuses on describing changes to household subsistence harvests related to social, economic, and environmental factors, and lends insight to the role of management in harvest trends.

Nushagak River

Charles E. Brazil and Ian K. Fo, Fishery Biologists, and Sarah M. Hazell, Subsistence Resource Specialist

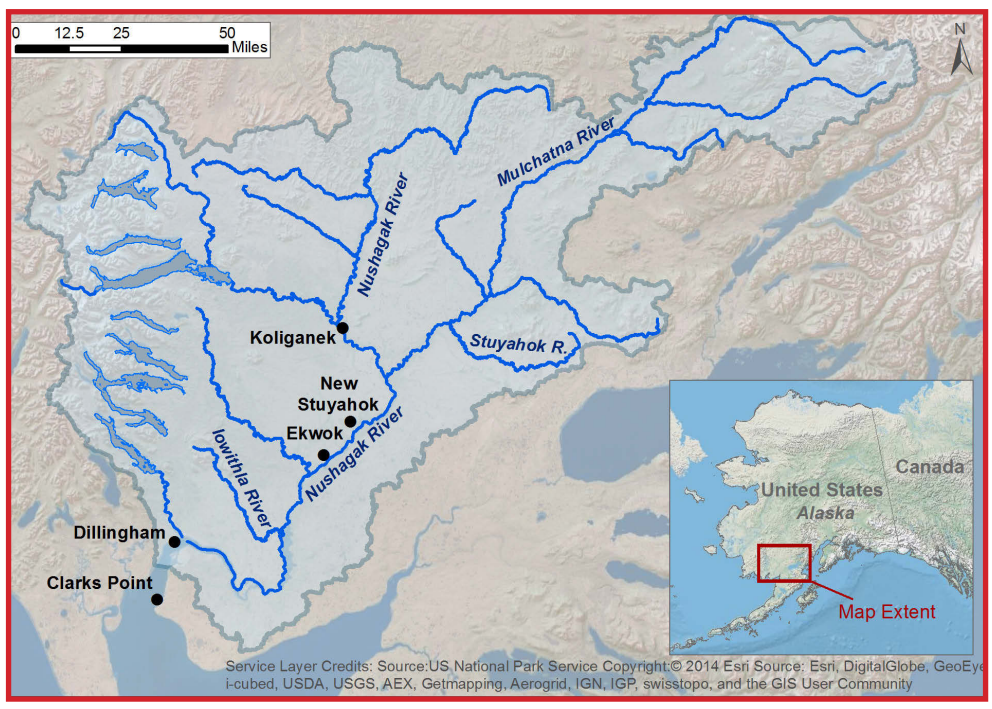

Figure 1.—The Nushagak River drainage, Bristol Bay, Alaska.

The Nushagak River is located in southwestern Alaska and flows 250 miles from its headwaters into Bristol Bay near Dillingham (Figure 1). The river supports one of Alaska's largest Chinook salmon runs, and returns are critical to subsistence, sport, and commercial users.

Gaining a greater understanding of adult abundance

Spawning escapement index counts on the Nushagak River began in the late 1960s and were initially conducted using aerial surveys, switching in the mid-1980s to Bendix sonar. In 2006, Bendix sonar was replaced with Dual-Frequency Identification Sonar (DIDSON). While DIDSON can count individual fish, migrations of multiple salmon species, including Chinook, occur simultaneously as counts take place. Species-specific counts are obtained by estimating the proportion of each species present in the river and applying them to the total sonar count. This is accomplished by test fishing with gillnets equipped with various mesh sizes just below the DIDSON counting zones. Because migrating Chinook travel both nearshore and offshore, some fish range beyond the reach of the sonar array and are not counted. As a result, Chinook salmon counts in the Nushagak River are considered indicies of abundance (Figure 2).

In 2014, the Chinook Salmon Research Initiative funded a mark-recapture project to determine adult spawning abundance. Drift gillnets and hook-and-line angling were used in the lower Nushagak to capture Chinook as part of the marking event. Chinook salmon were tagged with passive integrated transponders or PIT tags and also marked using a clip of the left axillary fin. Later, fish were examined for marks and tags at weir sites on the Iowithla and Stuyahok rivers (Figure 1) and during spawning grounds surveys at various tributaries. All captured Chinook were sampled for age, sex, and length information and then released in good condition. The total run in 2014 was 90,000 Chinook of which 70,000 fish were estimated to reach the spawning grounds. Although the harvest rate of 22 percent was higher than that seen since 2012, it was still well below the long-term average of 27 percent.

A successful feasibility study

Little information is currently available on juvenile Chinook salmon in the Nushagak River. Estimates of marine survival can be generated once juvenile abundance, total harvest, and escapement are known. To estimate juvenile Chinook salmon abundance, adequate numbers of juveniles must be marked. Capturing juvenile Chinook with baited minnow traps during the spring is a common strategy. Another method is to use seines to capture fish in the river's lower reaches as they migrate toward the marine environment. In 2014, the Initiative funded a feasibility project testing the efficiency of using either beach seines or minnow traps to capture juvenile Chinook salmon in the lower Nushagak River. In total, 821 juvenile Chinook were captured, the vast majority of which were caught with seines (783) and very few with minnow traps (38). As a result, when a full-scale juvenile mark-recapture project takes place (see "Mark-recapture research for population estimation" on page 4), beach seines will be the primary capture gear used in the lower Nushagak River.

Gaining knowledge from local residents

By means of Initiative funding, the Department of Fish and Game is examining contemporary subsistence harvest and local and traditional knowledge of Nushagak River Chinook salmon. Data, including number and location of Chinook caught and gear type used, are being collected on subsistence harvests through postseason household surveys in four Nushagak River communities. Through participant observation and respondent interviews with people from the communities of Clarks Point, Dillingham, Ekwok, Koliganek, and New Stuyahok, local and traditional knowledge is being recorded about potential environmental, climate-related, and other factors affecting Chinook salmon returns.

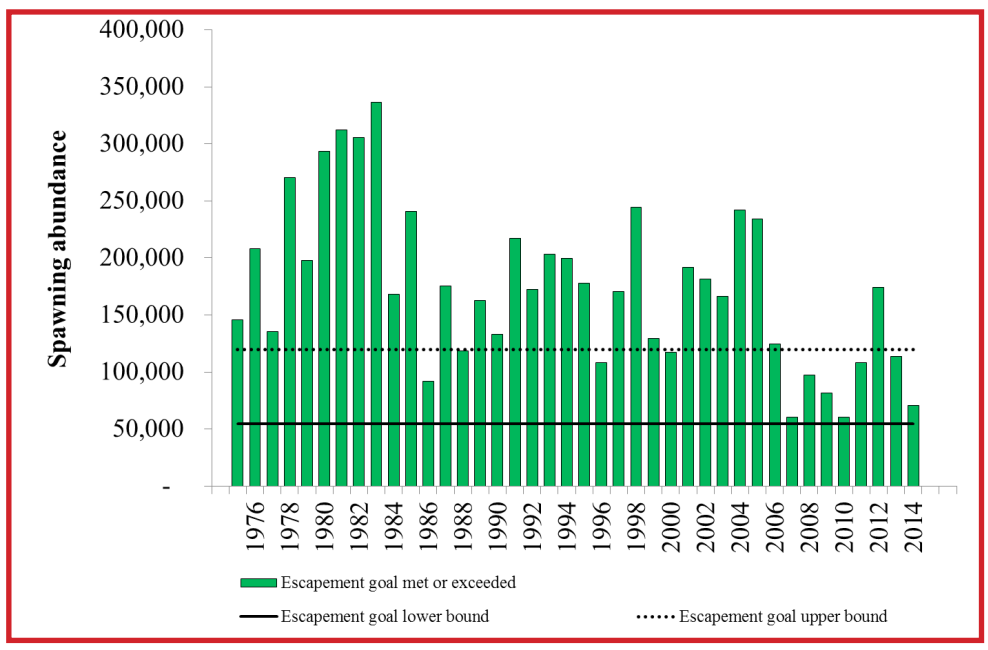

Figure 2.—Nushagak River spawning escapement index counts, 1991–2014.

Stikine River

Philip J. Richards and Troy A. Jaecks, Fishery Biologists, and Joshua T. Ream and Rosalie A. Grant, Subsistence Resource Specialists

The Stikine River originates in northern British Columbia and flows into the Inside Passage near Wrangell and Petersburg in central Southeast Alaska (Figure 1). It is the largest river system by volume in Southeast and supports an average run of 40,000 large (28 inches and greater in length) Chinook salmon. Being a trans-boundary river, fisheries management on the Stikine River falls under the Pacific Salmon Treaty, and harvest shares are jointly agreed to between the U.S. and Canada. Commercial and sport fisheries in Southeast Alaska are managed by the Alaska Department of Fish and Game, and the subsistence fishery is managed by the U.S. Forest Service. Canadian commercial, Aboriginal, and sport fisheries are managed by the Department of Fisheries and Oceans Canada.

While management duties are split between the two countries, Chinook salmon research on the Stikine River is conducted cooperatively between the department, Fisheries and Oceans Canada, and Tahltan First Nation. Research projects to monitor adult escapements have taken place annually since the early 1970s. Over the past 40 years, adult returns have ranged from 10,000 to 80,000 large fish, with an escapement goal range of 14,000 to 28,000 large fish. Juvenile tagging studies indicate that after leaving freshwater, these fish rear in the Gulf of Alaska and Bering Sea. Mature adults typically return after three to four years at sea and spawn in the Stikine's upper reaches in Canada. In general, the harvest rates of Stikine River Chinook are relatively low, around 15 to 20 percent. Since 2005, however, harvests of up to 50 percent of the run have occurred in directed fisheries when larger returns allow.

Annual escapements over the past 20 years have been within or above the escapement goal range in all years except 2009 but like other stocks in Alaska, has recently experienced a decline in productivity (Figure 2). Data from the highly successful juvenile and adult Chinook salmon research projects indicate the recent decline in productivity began in 2007 and is mostly due to poor marine survival.

(continued on page 9)

STIKINE RIVER *(continued from page 8)*

Stock assessment work on Stikine River Chinook provides valuable information such as when and where fish are harvested, juvenile abundance, marine survival, preseason and inseason run projections, and spawning abundance. This critical information is used to manage fisheries where Stikine River Chinook are harvested with the objective of achieving the escapement goal.

Adult spawning abundance

Mark-recapture projects to estimate the spawning abundance of Stikine River Chinook have occurred annually since 1996. The marking event runs from May to early July when returning adults are entangled with drift gillnets in the lower river. Fish are then tagged with individually-numbered external tags and released to continue their spawning migration. In the recapture event, tagged adults are potentially recaptured in the Canadian commercial fishery or at a tributary weir. The proportion of marked fish encountered in the various recapture locations along with the total number of marked fish are then used in part to estimate escapement (see "Mark-recapture research for population estimation" on page 4). An estimated 26,000 large Chinook spawned in 2014.

In 2015, the Chinook Salmon Research Initiative will continue to fund the adult mark-recapture project as well as a radio telemetry project. These projects will help answer several ongoing questions regarding mark-recapture assumptions and the behavior of returning Chinook salmon.

Juvenile abundance

Mark-recapture research to estimate the abundance of juvenile Chinook salmon in the Stikine River drainage has occurred annually since 2000. Although annual adult mark-recapture projects happen over a period of a few months, juvenile projects last over several years as fish from a single cohort rear in the ocean from one to five years. In the marking event, juvenile Chinook leaving the Stikine in April and May are captured using beach seines and minnow traps and marked by clipping the adipose fin. These fish also have a coded wire tag injected into the soft tissue of the snout. In the recapture event, returning adult fish are sampled inriver for the presence or absence of the adipose fin. The proportion marked, and the total released with marks, are used in part to estimate juvenile abundance.

Attempts are made to sample at least 20 percent of all Chinook harvested in Southeast Alaska marine waters from the commercial troll, drift gillnet, subsistence, and sport fisheries. Fish are sampled for biological information, and those missing adipose fins have their heads removed and sent to a lab for dissection. Those fish possessing coded wire tags associated with the Stikine River, coupled with information on each cohort's coded wire tag-marked fraction and total harvest and sampling rates, are used to estimate total harvest of Stikine-origin Chinook salmon. The estimated harvests of each cohort, as well as estimates of the number that escaped to spawn across the five years, are then used to reconstruct the complete adult return and estimate marine survival. Juvenile abundance since 2000 has ranged from 1.6 million to 4.5 million and marine survival has ranged from 0.6 percent to 3.9 percent, with the poorest marine survivals occurring most recently. In 2014, some 42,000 Chinook salmon juveniles representing the 2012 brood year (cohort) were marked with adipose finclips and tagged with coded wire tags. Over the next five years, information on this cohort will accumulate, allowing for marine harvest, survival, juvenile abundance, and full run reconstruction estimates.

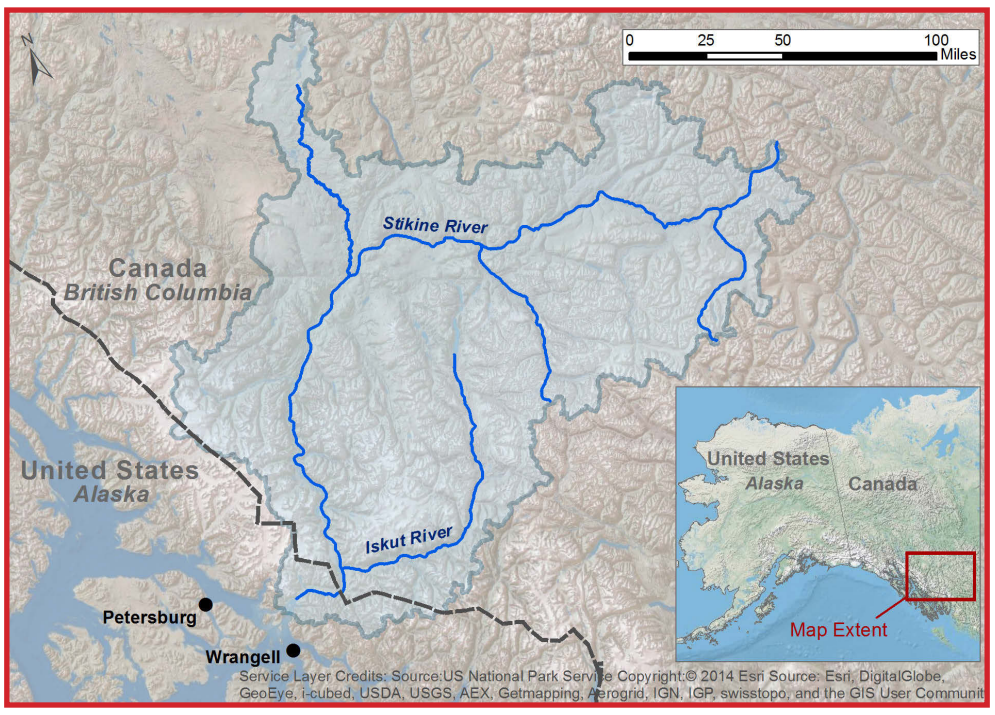

Figure 1.—Stikine River drainage of northwestern British Columbia and Southeast Alaska.

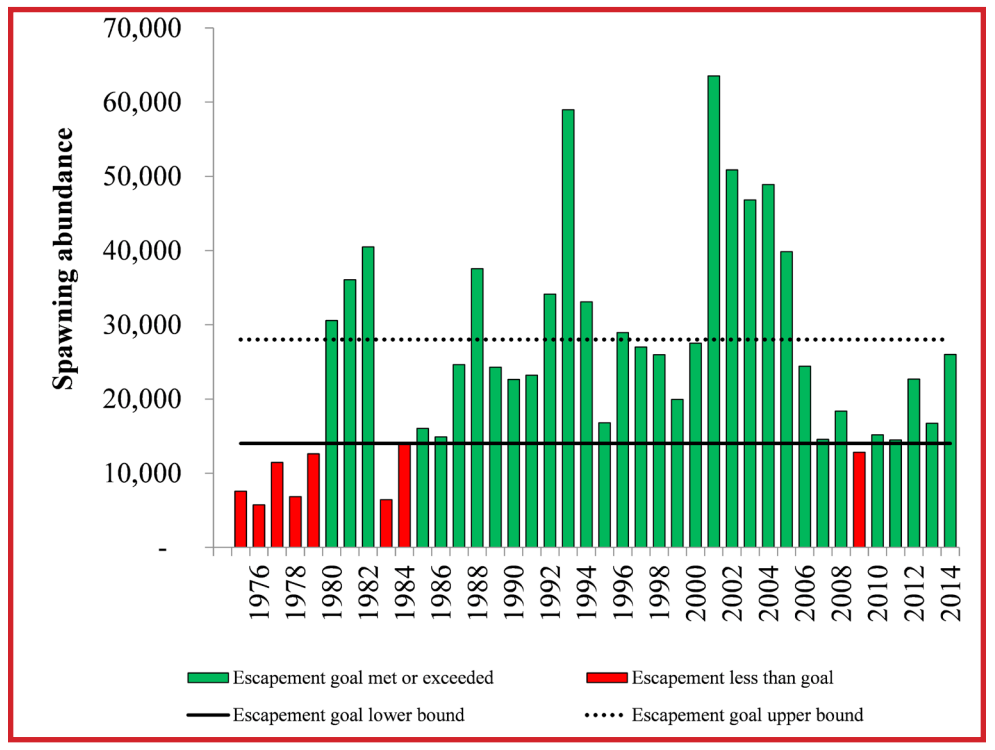

Figure 2.—Stikine River Chinook salmon spawning abundance from 1975 to 2014.

Subsistence

The department, with funding from the Initiative, conducted interviews in Petersburg and Wrangell to collect local and traditional knowledge about Stikine River Chinook migration, behavior, health, predation, abundance, and habitat.

(continued on page 10)

Chinook Glossary

When talking fisheries management, a lot of specialized terms can be thrown around with the assumption that everyone knows what they mean. If that's not the case, here is a handy guide to fisheries management jargon:

Brood year—for a particular salmon, the year in which its parents spawned (when the salmon egg was fertilized).

Creel sampling—information or biological samples collected by biologists from an angler's catch while the angler is still on or near the water where the fish was caught.

Cohort—salmon from the same stock that are all from the same brood year.

Escapement—the number of adult salmon that migrate to the spawning grounds.

Escapement goal—a management objective (usually expressed as a range) for the number of adult salmon that migrate to the spawning grounds to sustain the population into the future.

Genetic baseline—a library of distinct genetic markers or genes obtained from a particular salmon stock that can be used to identify individuals belonging to either a particular stock or region.

Index—a measure that indicates relative size of the escapement but does not estimate the actual escapement count. For example, the number of salmon counted on an aerial survey of a tributary may be used as an index of escapement for the entire river.

Mixed stock fishery—a fishery that harvests fish from a mixture of stocks. These fish may be different ages, sizes, species, or even from different geographic regions. For example, Chinook harvested in Cook Inlet are considered a mixed stock fishery because they represent a variety of stocks from Cook Inlet and elsewhere.

Productivity—the number of fish produced per salmon. Estimates of productivity may focus on the number of smolt produced or the number of adults produced.

Return—for a particular stock, it is the total number of mature salmon from a single brood year surviving to adulthood (includes both harvest and escapement over multiple years).

Run—for a particular stock, it is the total of the number of mature salmon representing multiple brood years surviving to adulthood (includes both harvest and escapement in a single calendar year).

Run reconstruction—a way of figuring out the number of salmon that spawned (escapement) and the number that returned to spawn for each brood year so that estimates of productivity can be made. In addition, for a particular cohort, if the number of smolt, the number harvested, and the number of returning adults that escape to spawn are known, then fishery managers can estimate marine survival.

Stock—a group of fish of the same species that breed and reproduce in a given area; for example, the Chinook salmon that return to the Nushagak River are considered a stock.

Smolt—a stage of salmon development when juveniles switch from living in freshwater to migrating to saltwater.

Subsistence fishery—a traditional fishery that fulfills people's need for food.

STIKINE RIVER *(continued from page 9)*

A sample of subsistence, commercial, and sport fishers were asked to describe their historical observations including how their fishing practices have changed to accommodate changes in Chinook abundance. In addition, fishers were asked what reasons they thought caused the Chinook decline and what management strategies they thought best for the Stikine River Chinook stock. Preliminary analysis reveals most interview respondents perceived stressors including increased marine mammal predation, a severe decline in herring populations, the efficiency of modern commercial fishing gear, and the duration of local fishing derbies, as well as natural cyclic patterns. These adaptations and observations are being compared to biological data and if changes to production of other marine and freshwater species are occurring, they will be discussed and correlated with the Chinook salmon decline.

Susitna River

Richard J. Yanusz, Fishery Biologist, and Davin L. Holen, Subsistence Program Manager

The Susitna River drains into upper Cook Inlet north of Anchorage, with an unknown size of Chinook salmon run since no comprehensive harvest and escapement programs have ever been conducted (Figure 1). The only drainagewide escapement estimate was done in 1985 when an Alaska Department of Fish and Game mark-recapture project (see "Mark-recapture research for population estimation" on page 4) estimated a Chinook escapement of about 114,000 fish greater than 16 inches in length. Today, the department monitors Susitna drainage Chinook escapements annually with helicopter surveys on 12 clearwater tributaries and a weir on the Deshka River. These surveys provide an index of escapement rather than a complete census.

Most of the Susitna River Chinook harvest occurs in the inriver sport fishery. A directed set gillnet commercial fishery stages off the mouth of the Susitna, and the Tyonek subsistence fishery takes place in marine waters about 20 miles from its mouth. The contribution of Susitna River stock to these directed fisheries has never been estimated, but total harvests are relatively small compared to the sport harvest. The department received an Alaska Sustainable Salmon Fund grant in 2014 to sample some of these Cook Inlet marine harvests and build upon an established genetic baseline for Chinook stocks throughout Cook Inlet.

Seeking a greater understanding of adult abundance

Radiotagging projects in select Susitna River tributaries provide much needed information to reconstruct and annually monitor the drainagewide inriver run abundance of Chinook salmon. In recent years, the department has conducted the following:

- In 2012, crews operated fish wheels in the mainstem Susitna River, upstream of the Yentna River confluence, to capture Chinook for radiotagging; fish were then tracked to locate spawning sites.
- In 2013, Chinook were radiotagged on the mainstem Susitna and Yentna rivers to estimate abundance and identify spawning locations.
- In 2014, Chinook were again radiotagged on the mainstem Susitna and Yentna rivers, and dart tagged on the Yentna River, to estimate abundance and identify spawning locations.

The department plans to estimate the drainagewide inriver abundance again in 2015 and 2016.

Finding juvenile Chinook salmon

Exploratory juvenile Chinook salmon work was conducted in fall 2013 using funds provided by a $2.5 million state legislative appropriation for Susitna salmon research. Prior to this work, the department conducted smolt-marking feasibility studies from 1993 to 1997 that found Willow Creek (a Susitna River tributary) stock the most suitable to describe the marine harvest of upper Cook Inlet Chinook. During 1997–2002, juvenile Chinook salmon in Willow Creek were marked with coded wire tags and a weir operated to estimate the marked fraction for returning adults. Salmon harvests were sampled as far away as Kodiak Island, and the contribution of Willow Creek Chinook to marine commercial and sport fisheries was shown to be intermittent and low.

From 1981 to 1985, the department operated the Susitna River Aquatic Studies program as part of the environmental assessments for a proposed hydroelectric project at Devils Canyon, which included juvenile salmon sampling, but not drainagewide abundance estimates. At present, the department is focusing efforts on estimating the drainagewide escapement for adults.

Gaining knowledge through talking to local residents

The only subsistence fishery for Chinook salmon in Cook Inlet is the marine subsistence set gillnet fishery in the Tyonek subdistrict, about 20 miles southwest of the Susitna River. The Alaska Board of Fisheries has set the harvest for this fishery at 750 to 2,750 Chinook. Most participants in the subsistence fishery come from Tyonek with the remainder from other Cook Inlet communities.

Based on past studies and concerns by fishery managers and Tyonek residents about the declining abundance of Chinook salmon, the Alaska Sustainable Salmon Fund provided funds to collect genetic data from fish harvested in the subsistence fishery to pair with local knowledge of Upper Cook Inlet Chinook salmon stocks. In 2014, department staff collected genetic samples in Tyonek during subsistence fishing periods. Harvesters were asked which stock they thought the salmon belonged to, the degree of certainty of their observations, and about salmon characteristics they look for when determining stock identification. Two more years of data collection are anticipated.

Fish wheel on Yentna River. © ADF&G.

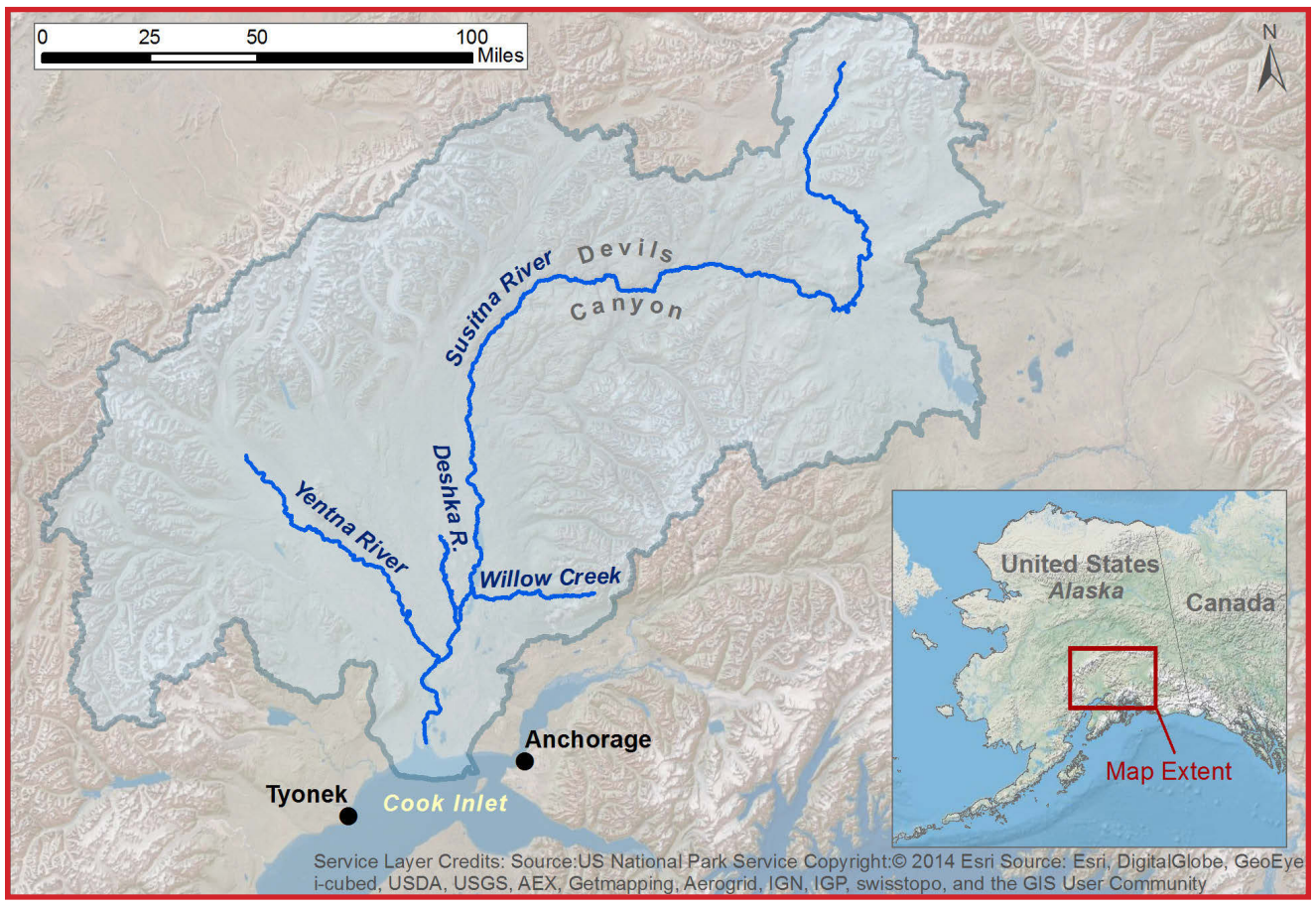

Figure 1.—The Susitna River drainage in Southcentral Alaska.

Inserting a radio tag. © ADF&G.

Taku River

Jeffery T. Williams and Philip J. Richards, Fishery Biologists

Originating in northern British Columbia, the Taku River flows into Taku Inlet 25 miles northeast of Juneau, and is the third-largest river system by volume in Southeast Alaska, and supports an average run of 40,000 large (28 inches and greater in length) Chinook salmon (Figure 1). Because the Taku River crosses an international boundary, fisheries management falls under the Pacific Salmon Treaty and harvest shares are jointly agreed to between the U.S. and Canada. In the U.S., fish are typically harvested in terminal marine sport and commercial fisheries near Juneau and are managed by the Alaska Department of Fish and Game. In Canada, inriver commercial, Aboriginal, and sport fisheries are managed by the Department of Fisheries and Oceans Canada. As part of a coastwide effort to rebuild depressed Chinook salmon stocks, directed Taku River Chinook fisheries were closed from 1976 until 2005. Since then, the U.S. and Canada allowed directed Chinook salmon fishing during years of high abundance.

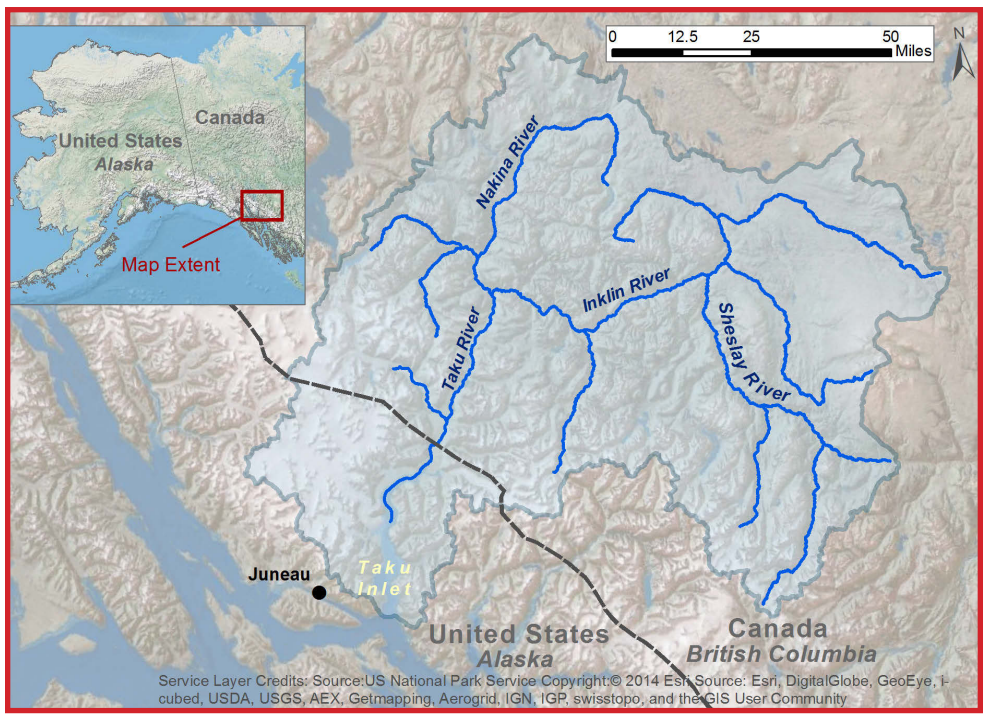

Figure 1.—The Taku River drainage of northwestern British Columbia and Southeast Alaska.

While management duties are split, Chinook salmon research on the river is conducted cooperatively among the department, Fisheries and Oceans Canada, and the Taku River Tlingit First Nation. Research projects to monitor adult abundance have occurred annually since the early 1970s, and juvenile abundance projects have occurred annually since 1993. Annual escapements over the past 30 years have been within or above the escapement goal range of 19,000 to 36,000 large fish in all but three years: 1999, 2007, 2013 (Figure 2). This stock, like others in Alaska, has recently experienced a decline in productivity that smolt and adult Chinook salmon research indicates is mostly due to poor marine survival. In general, research shows that Taku River Chinook are harvested at relatively low rates of around 10–15 percent per year. However, since 2005, during years of high abundance, directed Chinook salmon fisheries in Alaska and Canada have harvested up to 40 percent of the run.

This research provides valuable information such as where and when Taku River Chinook are harvested, juvenile abundance, marine survival, preseason and inseason run projections, and spawning abundance. Biologists use this information to manage fisheries in an effort to achieve spawning escapement goals.

Adult spawning abundance

Mark-recapture projects to estimate the abundance of spawning Taku River Chinook salmon have been conducted in 1989, 1990, and annually since 1995 (see "Mark-recapture research for population estimation" on page 4). Marking extends from late April to early July when returning Chinook salmon are caught in the lower river using fish wheels and tangle gillnets. Fish are then tagged with individually numbered exterior tags and released to continue their spawning migration. Tagged Chinook are then potentially recaptured in Canadian fisheries or on their spawning grounds using weirs, nets, rod and reel, and surveys on foot for salmon carcasses. The proportion of marked fish encountered in the various recapture locations is then used to estimate escapement. An estimated 23,500 large Chinook spawned in 2014, above the 19,000 minimum escapement goal.

Juvenile abundance

Taku River drainage juvenile Chinook salmon abundance research has occurred annually since 1993. These are also mark-recapture projects, although they take several years to complete since adult fish from a single cohort return over multiple years. As juvenile Chinook migrate out of the Taku River in April through early June, they are captured using minnow traps and beach seines. Captured smolt are then marked by clipping the adipose fin, and a coded wire tag is injected into the soft tissue of the snout.

Taku River estuary. © ADF&G.

Sorting juvenile Chinook salmon and clipping adipose fins before coded wire tagging. © ADF&G.

During the recapture event, Taku River Chinook are captured in marine and inriver commercial, sport, and subsistence fisheries. Like many other Chinook salmon populations, Taku River Chinook rear at sea for one to five years, and information accumulates annually on each tagged cohort as fish are caught and sampled throughout their migration. An intensive sampling program in Southeast Alaska attempts to examine at least 20 percent of all Chinook harvested in marine waters. Major Chinook salmon fisheries include commercial troll, drift gillnet, and sport fisheries. Fish are sampled for age, sex, and length, and those missing adipose fins have their heads removed and sent to a lab for dissection. The fraction of fish marked with adipose finclips in these fisheries is used in combination with adult sampling information to estimate juvenile abundance. In addition, the fraction of these fish possessing a valid coded wire tag is used to estimate adult harvests in the marine commercial and sport fisheries. The estimated harvests of each cohort, as well as those that spawned across the five years, are then coupled to reconstruct the complete adult return and estimate marine survival. Juvenile abundance has ranged from 1.0 million to 3.5 million fish since 1993, and marine survival has ranged from 1.3 percent to 6.1 percent. In 2014, 24,000 Chinook smolt representing the 2012 brood year were marked with coded wire tags. These juveniles began as eggs in 2012, hatched in the spring of 2013, and after spending a year maturing in the river, migrated to the ocean in the spring of 2014. It will take five years before final marine harvest and juvenile abundance estimates from the 2014 tagging effort are realized.

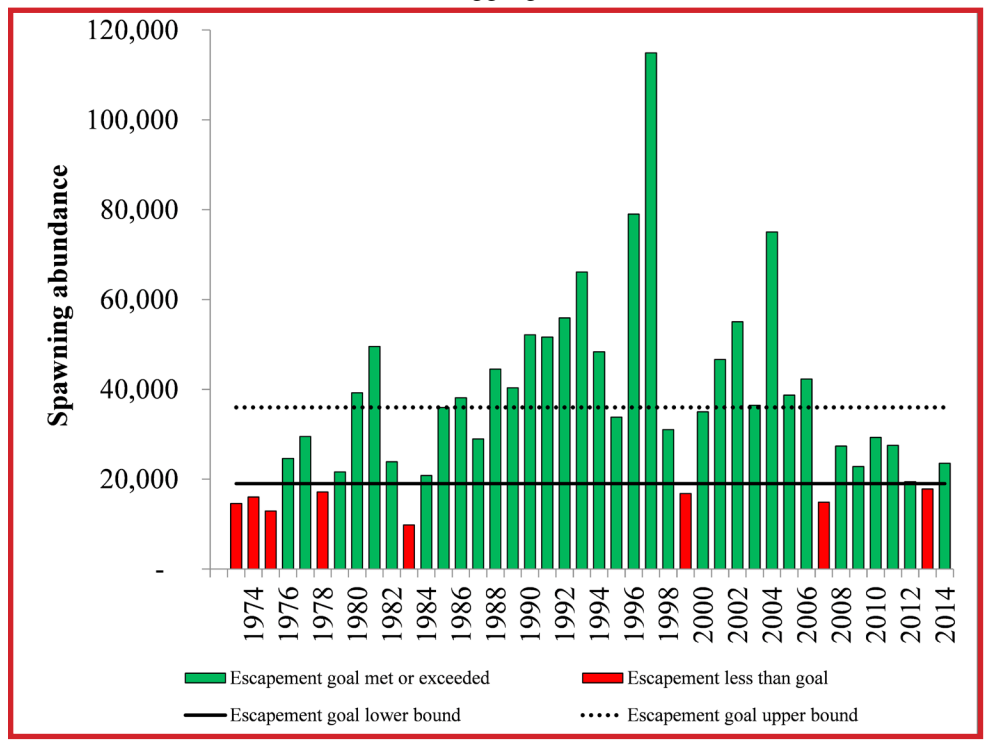

Figure 2.—Taku River Chinook salmon spawning abundance, 1973–2014.

Unuk River

Todd A. Johnson and Philip J. Richards, Fishery Biologists

For the past 20 years, Unuk River Chinook salmon stock assessment projects have provided estimates of adult and juvenile abundance, juvenile overwinter survival, marine harvest, and juvenile-to-adult marine survival. These projects are extremely challenging and time consuming, but this work has taught us more about Unuk River Chinook than any other wild stock in Alaska, making it a logical choice for inclusion in the statewide Chinook Salmon Research Initiative.

The Unuk River, located approximately 50 miles northeast of Ketchikan, originates in British Columbia and flows into Behm Canal (Figure 1). It is also the largest Chinook salmon producer in Behm Canal, producing runs averaging about 5,500 large Chinook (28 inches and greater in length).

Juvenile tagging studies indicate that after leaving freshwater, these fish rear primarily in the inside waters of Southeast Alaska; however, tagged fish have been recovered off the coast of Vancouver Island, in the Gulf of Alaska, Bering Sea, Cook Inlet, and around Kodiak. With few exceptions, sport fishing for Chinook in Southeast Alaska does not occur in fresh water. The marine terminal area near the Unuk River has also been closed to sport and commercial salmon fishing for the past 40 years to help protect this stock and neighboring wild Chinook stocks.

Mature adults typically return after three to four years at sea and spawn in the tributaries of the Unuk. Adult escapements have been monitored since 1977 and have ranged from 956 to 10,541 large fish. Annual escapements from 1977 to 2011 have been within or above the escapement goal range of 1,800 to 3,800 returning large fish, but there has been a decline in productivity from 2012 to 2014, with escapements falling below the goal (Figure 2). Data from juvenile and adult Chinook research projects indicate this decline in productivity is mostly due to poor marine survival.

Adult spawning abundance

The spawning abundance of Unuk River Chinook has been estimated annually with mark-recapture projects since 1997 (see "Mark-recapture research for population estimation" on page 4). The marking event runs from mid-June to early August when returning adults are caught, tagged with individually numbered exterior tags, and released to continue their spawning migration. Later, from mid-July through early September, they are sampled on their spawning grounds in the recapture event. The proportion of marked fish found in the various recapture locations, along with the total number tagged during the marking event, are used to estimate spawning abundance. In addition to the mark-recapture project, aerial surveys of spawning abundance have been conducted every year since 1977. These surveys provide a secondary method for estimating escapements in the event the mark-recapture study fails to produce a valid estimate.

Juvenile abundance

Mark-recapture projects to estimate the abundance of juvenile Chinook in the Unuk River drainage have been conducted from 1982 to 1986 and each year since 1993. Unlike adult mark-recapture projects, it takes many years to gather marked and unmarked information as a single cohort returns and is caught and sampled in various marine fisheries after one to five years at sea. In the marking event, juvenile Chinook are captured in October and then again in April. These fish are marked by clipping the adipose fin and then tagged with a coded wire tag injected into the soft tissue of the snout. In Southeast Alaska, the goal is to sample at least 20 percent of all adult Chinook harvested in the various marine commercial, sport, and subsistence fisheries. These fish are sampled for biological information, and those missing their adipose fin have their heads removed

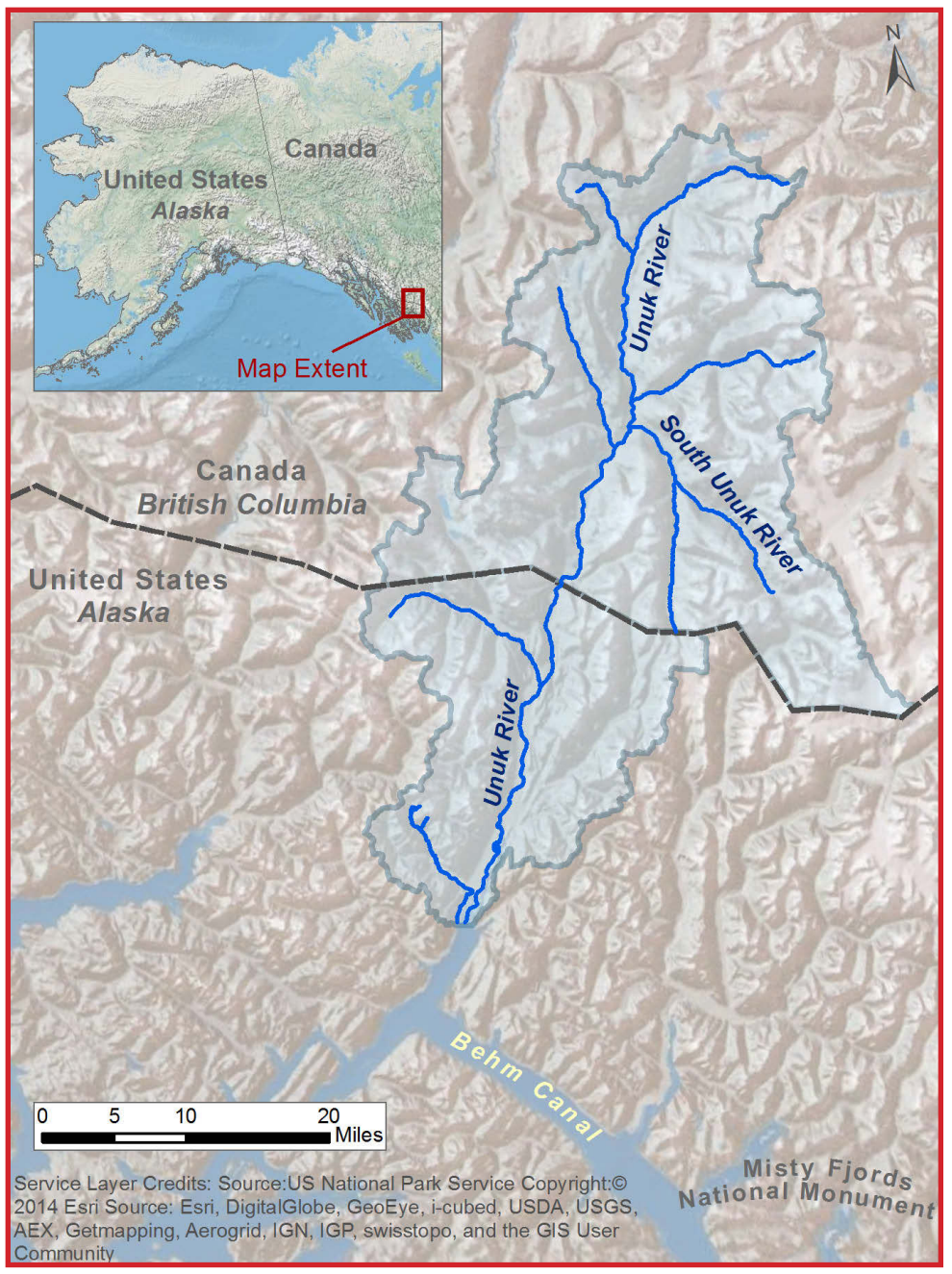

Figure 1.—The Unuk River drainage of northwestern British Columbia and Southeast Alaska.

and sent to the department lab for dissection, where they are checked for coded wire tags; valid tags are decoded to identify the fish's release location. The fractions of each cohort possessing coded wire tags as well as missing adipose fins are identified during the adult mark-recapture projects. The fraction of the fish possessing valid Unuk River tags is used to estimate marine harvests, and the fraction marked with adipose finclips is used to estimate smolt abundance.

From 1992 to 2009, juvenile abundance has ranged from 165,000 to 754,000 fish. Juvenile overwinter survival in freshwater has ranged from 26 percent to 80 percent, and marine survival (juvenile to adult) has ranged from 0.7 percent to 3.9 percent, with the poorest marine survivals of less than 1 percent occurring most recently. In the fall of 2013, just over 12,500 juveniles were tagged, and in April 2014, nearly 12,300 juvenile Chinook were tagged, each representing production from the 2012 brood year. Over the next five years, these fish will return to spawn, and final marine harvest and juvenile abundance estimates will be complete in 2019.

Harvest

Unuk River Chinook are harvested primarily in marine mixed-stock fisheries of Southeast Alaska. Harvests of Unuk River Chinook have ranged from 822 to 2,720 fish in commercial and sport fisheries from 1998 to 2013, with harvest rates ranging from 17 percent to 64 percent. Since 1998, the commercial troll fisheries in Southeast Alaska have averaged 58 percent of the annual harvest with sport fisheries averaging 26 percent and gillnet fisheries averaging 10 percent of the harvest. The remaining six percent is a combination of purse seine, terminal fisheries, cost recovery fisheries, ocean trawl, and mixed net fisheries. The harvest rate on this stock averaged 26 percent from 1998 to 2008 and increased during the recent period of poor production (2009 to 2013) to an average of 39 percent with a high of 64 percent in 2012. In recent years, this information has been used by managers to modify commercial and sport fisheries in areas where Unuk River Chinook are harvested, resulting in more restrictive management of the spring troll and Ketchikan area sport fisheries to help protect this stock and increase the likelihood of attaining the escapement goal.

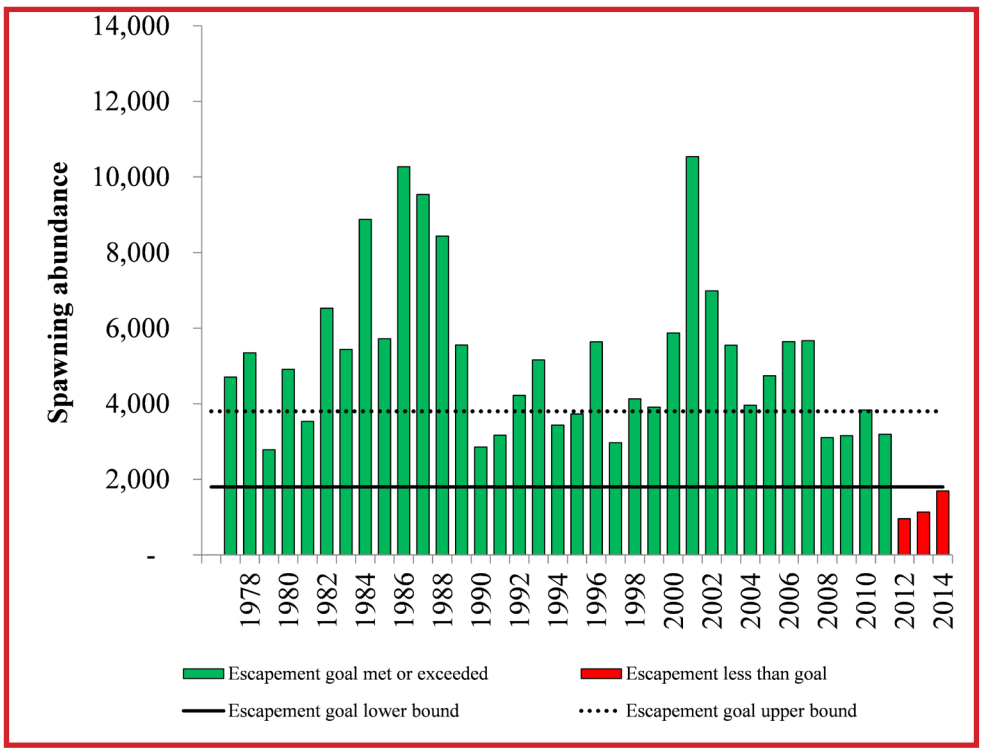

Figure 2.—Unuk River Chinook salmon spawning abundance, 1977–2014.

Woody debris common along the Unuk River. © ADF&G.

Yukon River

Kathrine G. Howard, Fishery Biologist, and Caroline L. Brown, Subsistence Resource Specialist

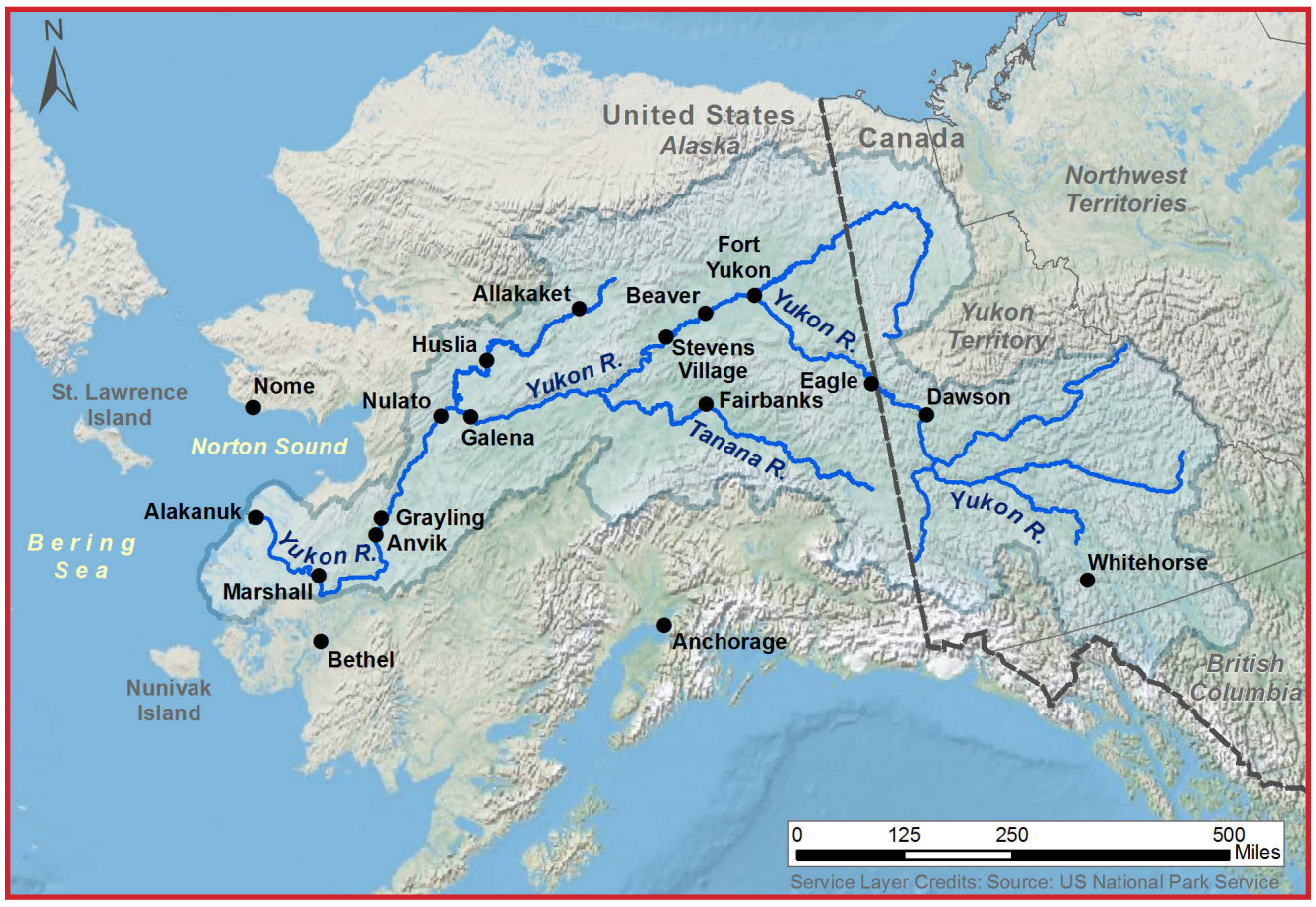

Figure 1.—The Yukon River drainage spanning Alaska and parts of the Yukon Territory and British Columbia, Canada.

The Yukon River is the largest in Alaska and the fifth largest river drainage in North America, crossing Alaska, the Yukon Territory, and even reaching into British Columbia (Figure 1). Yukon Chinook migrate up to 2,000 miles to either spawn as adults or to enter the ocean as juveniles. Migration distances in the ocean are unknown, though these fish are known to rear in the Bering Sea for two to five years before returning to spawn.

In recent years, Yukon River Chinook runs have been about half as large as in the 1980s and 1990s. In 2013, spawning goals for Canadian-origin fish were not achieved, and low run numbers have led to closed commercial Chinook salmon fisheries, severe restrictions on subsistence harvest, and limitations for commercial fisheries targeting other species that incidentally catch Chinook.

In 2014, the Chinook Salmon Research Initiative provided opportunities to collect information on juvenile abundance and ecology, as well as traditional knowledge from subsistence users, in order to fill knowledge gaps, build better management tools, and gain new insights into what drives production cycles over time.

Pilot inseason monitoring of subsistence salmon harvests

Subsistence harvest data are currently being collected through surveys of fishing households. Local residents have been asked to provide a running total of their salmon harvest to managers throughout the season. These data may assist inseason management and ultimately provided a total drainagewide estimate of harvest. Data collection began in 2013 in Grayling to develop survey methods and provide a preliminary assessment of costs and community response. In 2014, a second year of data collection was done in two other communities—Marshall and Nulato—that built on the 2013 results. The value of a third year of data collection in other communities is currently being assessed.

Local and traditional knowledge of the Chinook salmon life cycle in freshwater

Sharp declines in Chinook abundance have caused severe hardships for communities in the Yukon River watershed. Sustainable salmon management during periods of low abundance is difficult when there is a lack of knowledge about underlying causes. Initiative funded research will explore local traditional knowledge of spawning grounds, juvenile rearing habitats, and other environmental factors affecting adult salmon migration and reproduction in fresh water. The communities of Anvik, Huslia, Allakaket, and Fort Yukon were selected based on their proximity to Chinook spawning grounds that have been monitored through weirs or sonars.

Collection of local and traditional knowledge can provide important insights to fishery managers and involves subsistence users in fisheries research. It can also provide long-term data to fisheries managers and scientists and aid in understanding environmental changes that influence cycles in populations of salmon.

Patterns and trends in subsistence salmon fishing

In response to weak Chinook salmon runs, Chinook subsistence harvest has been severely reduced, commercial fishing for Chinook has been closed since 2008, and the commercial opportunities for summer chum salmon have been restricted to avoid incidental harvest of Chinook. A postseason survey was used to estimate community level harvests, which revealed highly variable annual harvests. This project explored subsistence harvest patterns and trends in six communities: Alakanuk, Marshall, Nulato, Galena, Beaver, and Eagle with the goal of identifying factors that change subsistence salmon harvests and to improve management.

Participating tribal councils helped established research protocols and draft the survey and interview guide. The next step, funded in part by the North Pacific Research Board, took this information back to previously interviewed households to discuss household harvest histories. Although fishery managers may not be able to control the causes of decline in Chinook production, understanding harvest patterns may allow managers the ability to provide more sustained harvests while ensuring spawning abundances. This information may also assist regulatory boards in exploring alternatives for salmon fishing regulations, such as addressing reasonable opportunities for customary and traditional subsistence uses of Chinook salmon.

Juvenile Chinook salmon abundance and ecology

The National Oceanic and Atmospheric Administration (NOAA) and the department have teamed up to monitor juvenile Yukon Chinook salmon abundance, health, diet and distribution during a critical life stage: the first summer at sea. NOAA began this work in 2002, and it has allowed forecasts of future adult run sizes. Juvenile Yukon Chinook inhabit a huge area throughout the Northern Bering Sea, from Nunivak Island north to the Bering Strait, and west to St. Lawrence Island (Figure 1). A large boat and trawl net are usually needed to obtain information on these fish, but a large boat can be expensive and difficult to fund over time. This project explores the feasibility of using a smaller boat and trawl net to get the same information at about half the cost. If successful, this project will provide a more cost effective means of monitoring juvenile Yukon Chinook, provide information on factors affecting their marine survival, and predicting adult run sizes up to two or three years in advance, which should help fishers plan ahead for their subsistence and economic needs.

The 2014 Northern Bering Sea survey, which used a large boat and trawl net, also included the testing of a smaller trawl net and boat. Based on the initial findings, researchers are optimistic that surveys with a smaller boat and trawl net can be done. In general, the same size area was surveyed in a similar amount of time by the smaller boat as is typically surveyed using the larger boat. Juvenile Chinook salmon were caught using the smaller net, allowing various diet, distribution, and genetic information to be collected. However, based on direct comparisons of the catches between the large and small boats, it is clear the small boat had lower catch efficiencies. This winter, staff will work with trawlers and net manufacturers on modifications to the smaller net to potentially improve catch efficiencies.

In 2012, the juvenile Yukon Chinook salmon abundance index in the Northern Bering Sea was very low, resulting in poor returns of four year old Chinook in 2014. The 2012 juveniles will continue to return in 2015 and 2016 as five and six year old fish. In contrast, the 2013 juvenile abundance index was very high and should translate to improved numbers of four year olds in 2015.

Marine Sampling Kodiak and Westward

Matt B. Foster and Donn A. Tracy, Fishery Biologists

Within the Westward Region (Kodiak Island and Alaska Peninsula), the Karluk and Chignik rivers have been identified as Chinook Salmon Research Initiative indicator stocks for Chinook production. Marine harvest estimates for these stocks do not exist, and age, sex, and size information of nearby marine harvests is not well established.

Chinook salmon are harvested incidentally to directed commercial fisheries for sockeye, pink, coho, and chum salmon within Kodiak, Chignik, and Alaska Peninsula management areas (Figure 1). These areas represent extremely diverse geography and extend nearly 600 miles from Cape Douglas in the northern part of Kodiak Management Area to Scotch Cap on Unimak Island at the southern end of the Alaska Peninsula Management Area.

Since 1996, the average annual commercial Chinook salmon harvest is roughly 17,600 fish in Kodiak, 3,600 fish in Chignik, and 10,400 fish in the Alaska Peninsula.

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MARINE SAMPLING KODIAK AND WESTWARD *(continued from page 13)*

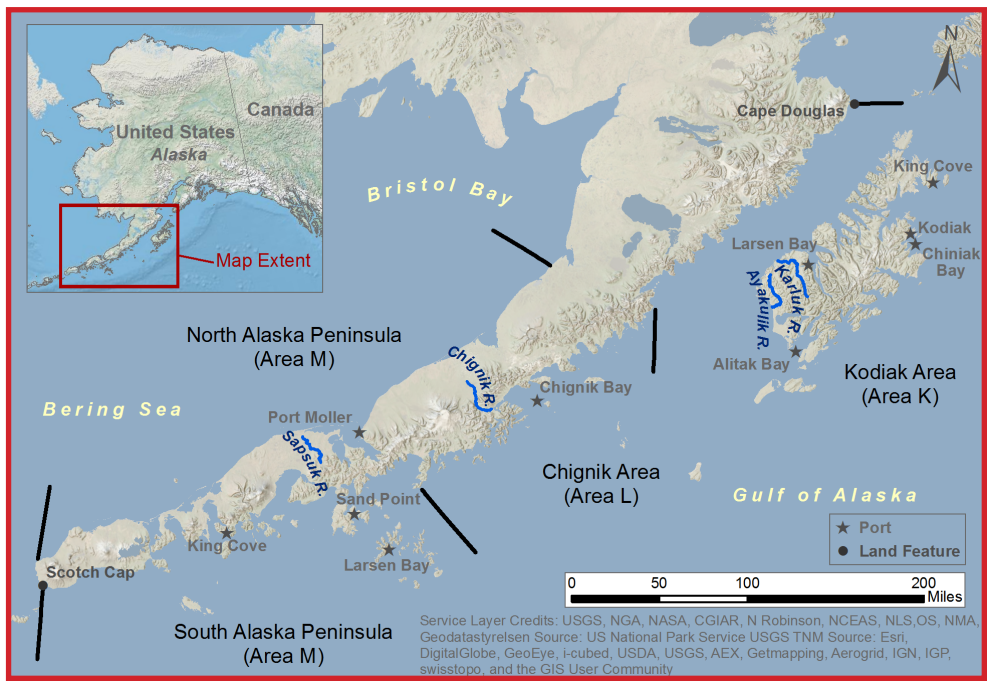

Figure 1.—Westward Region and commercial salmon fishery districts of Kodiak, Chignik, and Alaska Peninsula management areas.

While harvest of Chinook in the marine waters of the Westward Region has remained generally consistent, Chinook escapement estimates monitored via weirs on the major river systems of the Karluk, Chignik, Ayakulik, and Nelson (Sapsuk) rivers have demonstrated substantial reductions since 2005, often struggling or failing to reach their respective escapement goals.

Marine waters surrounding Kodiak Island Archipelago also support a popular Chinook sport fishery, which historically harvests an average of 6,600 fish each year, but over the last 10 years has averaged more than 8,000 fish. Much of this harvest, from guided and unguided anglers, comes from Chiniak Bay (Figure 1), which is adjacent to ports around the city of Kodiak. Significant numbers of Chinook salmon are also taken near the outlying villages of Old Harbor and Larsen Bay, and by numerous remote lodge operators. Although sport fishing for Chinook occurs year round in Kodiak marine waters, the vast majority of annual harvests are recorded between May and September, similar to the timing of commercial harvests.

Adipose finclipped Chinook were sampled in Kodiak marine waters in 1994, and 1997 to 1999. Valid coded wire tags from these fish indicated they represented stocks from British Columbia (predominantly from the western coast of Vancouver Island), Alaska (Cook Inlet, Kodiak, and Southeast), Oregon, and Washington.

Genetic stock identification of the Chinook catch in the Westward Region commercial and sport salmon fisheries had never been conducted before 2014. Scientific knowledge of when these fish are caught, and where these fish are from, for both local and non-local Chinook salmon in these catches is of regional and statewide importance. Currently, these harvests cannot be reliably attributed to wild stocks (local or regional) or hatchery stocks. A combination of detailed coded wire tag and genetic sampling information will be necessary to accurately estimate stock compositions of these harvests.

The principal objective of Initiative research efforts is to sample tissue for genetic stock identification, biological information, and recover heads from adipose finclipped fish in the marine commercial and sport fisheries in the Kodiak, Chignik, and southern and northern Alaska Peninsula areas (Figure 1). Beginning in 2014, collection of data to determine population age structure and genetic stock of origin was conducted by sampling Chinook commercially harvested throughout the Westward Region and by sport anglers dockside at harbors in the city of Kodiak, and occasionally at other locations.

Key biological parameters needed for management of Chinook salmon fisheries and assessment of marine productivity include stock composition and age structure of the harvest. Fishery managers, members of the Board of Fisheries, and user groups will all benefit from increased knowledge of these parameters, since future stock of origin assignments to area harvests will enable more precise estimates of abundance and productivity for individual Chinook populations, ultimately helping to ensure long-term sustainability of the resource.

Marine sampling of Chinook salmon in the commercial fisheries of the Westward Region was conducted in 2014. Sampling took place in the ports of Kodiak, Larsen Bay, Alitak, Chignik, Sand Point, King Cove, and Port Moller. In the Kodiak Management Area, nearly 3,300 Chinook salmon were sampled for age, sex, and length and genetic tissue. Of those fish, 14 percent were found to have an adipose finclip and the heads were then collected for coded wire tag analysis. In the Chignik and Alaska Peninsula Management areas, approximately 2,100 Chinook were sampled for age, sex, and length information and genetic tissue. Of those fish, 3 percent were found to have an adipose finclip and the heads were collected for coded wire tag analysis.

Marine sampling of Chinook salmon in the sport fisheries around Kodiak was also conducted in Kodiak and Larsen bays in 2014, and 417 Chinook were sampled for age, sex, and length and genetic tissue. Of those fish, 15 percent were found to have an adipose finclip and the heads were collected for coded wire tag analysis.

Genetic extraction and analysis have yet to be completed on this large set of data, but information regarding the stock of origin of Chinook salmon possessing an adipose finclip and coded wire tag has already been determined. Preliminary results are similar to historical data suggesting high abundance of fish from Washington, British Columbia, and Oregon, with lower abundance of Alaska-origin stocks. While coded wire tags deliver important information regarding presence of predominantly hatchery stocks, genetic information will provide further detail on stock composition results.

Marine Sampling Cook Inlet

Barbi Failor and Anthony A. Eskelin, Fishery Biologists

Chinook salmon returning to the Kenai and Susitna rivers in Southcentral Alaska are harvested in several Cook Inlet marine and inriver fisheries. Recent low Chinook returns have increased concerns about harvests of these stocks. Each year, researchers estimate run sizes in these rivers through weirs, creel surveys, harvest sampling, or mark-recapture techniques as they strive to achieve adequate escapement levels. However, stock-specific harvest information in marine fisheries is needed to understand productivity, assist in the development of brood tables for long-term stock assessment, and for adjusting escapement goals in these river systems. Recent advances in genetic stock identification techniques allow for discriminating between Chinook stocks in mixed stock fishery samples. These advancements have led to the development of a genetic baseline for Cook Inlet Chinook salmon.

Figure 1.—Collection of genetic tissue for use in stock identification. © ADF&G. Photo by Terry Thompson.

Marine sport sampling

Beginning in 2014, funding from the Chinook Salmon Research Initiative allowed for sampling of the marine sport fishery in central Cook Inlet from April through August, and out of Homer year-round. Annual sport harvest from these two fisheries has averaged over 8,900 fish since 2010. Due to limited coded wire tagging, attempts to estimate stock-specific harvests of Chinook in the central and lower Cook Inlet marine sport fisheries have been unsuccessful. Since the 1990s, Chinook from both fisheries have been periodically sampled for biological information and coded wire tags, but not for genetic stock identification. Genetic sampling will provide stock composition and harvest data within four genetic reporting groups:

- Susitna River (Yentna and Susitna rivers, and Western Cook Inlet)
- Kenai River (Kenai River mainstem and tributary)
- Other Cook Inlet (Cook Inlet from Turnagain and Knik arms, Kasilof, Anchor, and Ninilchik rivers, and Deep and Stariski creeks)
- Outside Cook Inlet

During the summer fishing season, department staff are stationed at each of the major fishing access points at the Homer Harbor, and Anchor Point and Deep Creek tractor launches. The goal is to contact returning sport anglers to collect fishing effort information; biological samples from Chinook catches including age, sex, length, and genetic tissue samples (Figure 1); and the heads of any Chinook missing an adipose fin (possibly indicating a coded wire tag). In addition, sampling occurs during weigh-in at two annual Homer king salmon derbies, in March conducted by the Homer Chamber of Commerce and in October hosted by the Homer Elks Lodge.

The Cook Inlet marine sport sampling effort included more than 1,200 angler interviews encompassing 5,300 angler-days of fishing in 2014. Over 2,400 sport-harvested Chinook were sampled for biological information and approximately 2,140 genetic samples were collected. Of 357 heads collected, 201 or 56 percent possessed no coded wire tag, 15 percent were of British Columbia origin, 13 percent from Washington, 10 percent from Oregon, and 6 percent from Southeast Alaska.

Marine commercial sampling – Eastside set gillnet

Since 1966, the Eastside set gillnet commercial fishery, located along the eastern shore of upper Cook Inlet between Ninilchik and Boulder Point, has harvested an average of about 9,500 Chinook salmon (Figure 2). These fish represent about two-thirds of all Chinook caught in the upper Cook Inlet commercial fishery.

(continued on page 15)

MARINE SAMPLING COOK INLET *(continued from page 14)*

However, from 2012 to 2014, harvests were the lowest on record, averaging approximately 1,900 fish annually. During and after commercial openings, biological samples are collected from Chinook salmon delivered to processing plants from each area of the fishery. Age, sex, and length information has been gathered since 1987 and tissue samples for genetic analysis have been collected since 2010, with increased sampling effort occurring in 2013–2014.

Results from genetic analyses of samples gathered in 2010, 2011, and 2013 showed that, on average, the Kenai River mainstem population composed 69 percent of the commercial harvest, followed by 29 percent for the Kasilof River mainstem population. Kenai River tributaries composed less than 1 percent of the harvest, and all other Cook Inlet populations combined composed a little over 1 percent of the harvest. Due to low sample sizes, genetic analysis of the 2012 samples was not possible.

Genetic analyses of Chinook samples collected in 2013 revealed that composition of harvest varied by area and time. In the Kenai and East Forelands sections, 94 percent of the July harvest was Kenai River mainstem fish; the rest were Kasilof River mainstem fish. Kasilof section harvest in late June–early July was 71 percent Kenai River mainstem fish, 14 percent Kasilof mainstem fish, 14 percent Cook Inlet Other, and less than 1 percent Kenai River tributaries. In mid- to late July, Kasilof section harvested 73 percent Kenai mainstem fish; the rest were Kasilof mainstem fish. In the Kasilof River Special Harvest area, 76 percent were Kasilof mainstem Chinook and the rest were Kenai River mainstem fish. In 2014, 42 percent of the Chinook salmon harvest was sampled, which will provide additional genetic stock composition by time and area once analysis is completed.

Marine commercial sampling – Northern District set gillnet

A directed set gillnet commercial fishery for Chinook salmon occurs throughout the Northern District of Cook Inlet including the mouth of the Susitna River. Beginning in 2014, this commercial fishery for Chinook was sampled during six set gillnet openers in the Anchorage, Soldotna, and Tyonek areas. Tissue samples were collected along with age, sex, and length data. In total, 774 Chinook salmon were sampled out of a total harvest of nearly 1,500 fish. Analysis of these data is still underway.

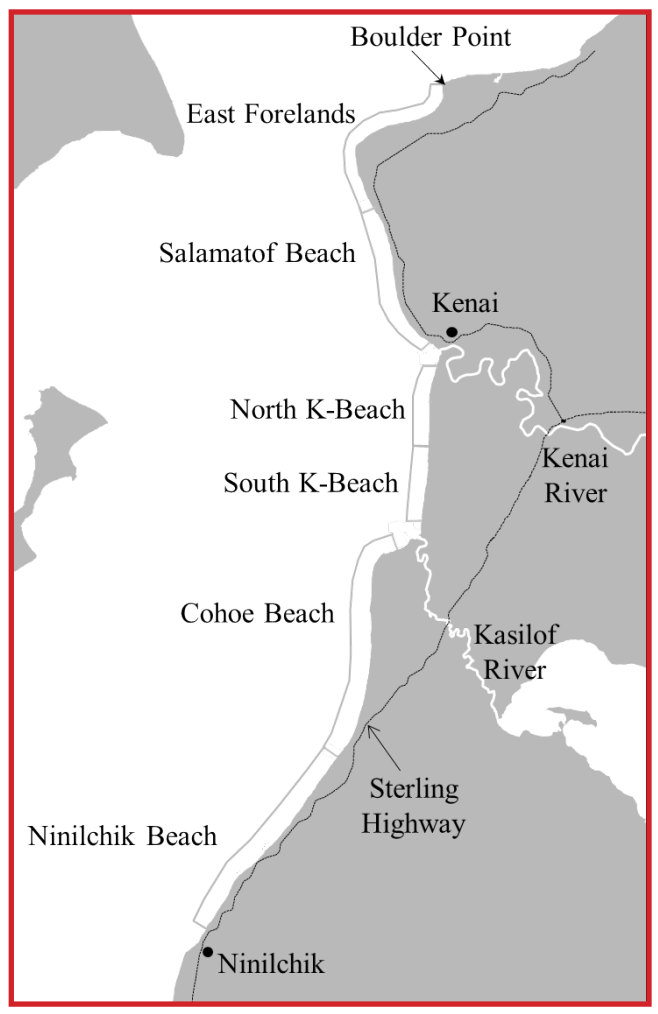

Figure 2.—Map of upper Cook Inlet Eastside set gillnet commercial fishery.

Marine Sampling Southeast Alaska

Mike J. Jaenicke and Anne M. Reynolds, Fishery Biologists

Chinook salmon are important and highly valued in the marine waters of Southeast Alaska where they've been harvested by commercial and sport fishers for decades. Over the last 100 years, the efficiencies of fishing vessels and gear have steadily improved, coinciding with the need for sustainable management of this internationally managed fishery. Sustainable management requires gathering data from various Chinook salmon fisheries in Southeast Alaska.

The Pacific Salmon Commission implemented the Pacific Salmon Treaty in 1985 to provide co-management of salmon resources, including Chinook, in the Pacific Northwest, Canada, Southeast Alaska, and the Yukon River. An abundance index is developed each spring to forecast the number of Chinook available for harvest in Southeast Alaska. The index is then used to calculate and determine the all-gear harvest limit for Chinook in the region. The Alaska Department of Fish and Game is responsible for managing Southeast Alaska Chinook fisheries to ensure catches stay within the all-gear harvest limit. To monitor sport and commercial marine fisheries, department staff sample harvested Chinook that have clipped adipose fins, an indicator that fish may have a coded wire tag. This information is used to estimate hatchery and wild stock contributions in the fisheries, which is important because most fish from Southeast's hatcheries are considered "add-on" fish and do not count toward the all-gear harvest limit.

Marine sport sampling

The Alaska Board of Fisheries provides allocation guidelines for the management of Southeast Chinook fisheries and all-gear harvest limits. In 1992, the board set the sport allocation at 17 percent of the combined sport and troll allocation, ultimately raising it to 20 percent in 1996. The total Chinook harvest in the sport fishery has ranged from fewer than 20,000 fish in the late 1970s to more than 80,000 in high abundance years. The number of sport harvested Chinook sampled for adipose finclips has increased from around 1,000 in the late 1970s to more than 20,000 in recent years. Sport sampling occurs at docks, sport fishing lodges, and boat launches throughout Southeast Alaska; the majority of the region's Chinook harvest consistently occurs in the Sitka area (Figure 1).

Technicians conducting field sampling efforts typically approach anglers and request permission to examine any Chinook they've caught. The heads of fish without adipose fins are collected and sent to the department's Mark, Tag and Age Laboratory in Juneau to determine whether or not coded wire tags are present. The tags identify when and where the fish were originally tagged as juveniles. Fish are also measured for length and scale samples are collected to determine age.

In 2004, staff began sampling tissue for use in genetic stock identification analyses. Because genetic information alone cannot identify whether or not a fish is of hatchery or wild origin, and because not all fish possess valid coded wire tags, staff in 2012 began collecting otoliths (ear bones) from the ports of Sitka and Craig. This was implemented because some hatcheries vary water temperatures to create unique patterns on the otoliths. Combined, these samples allow stock

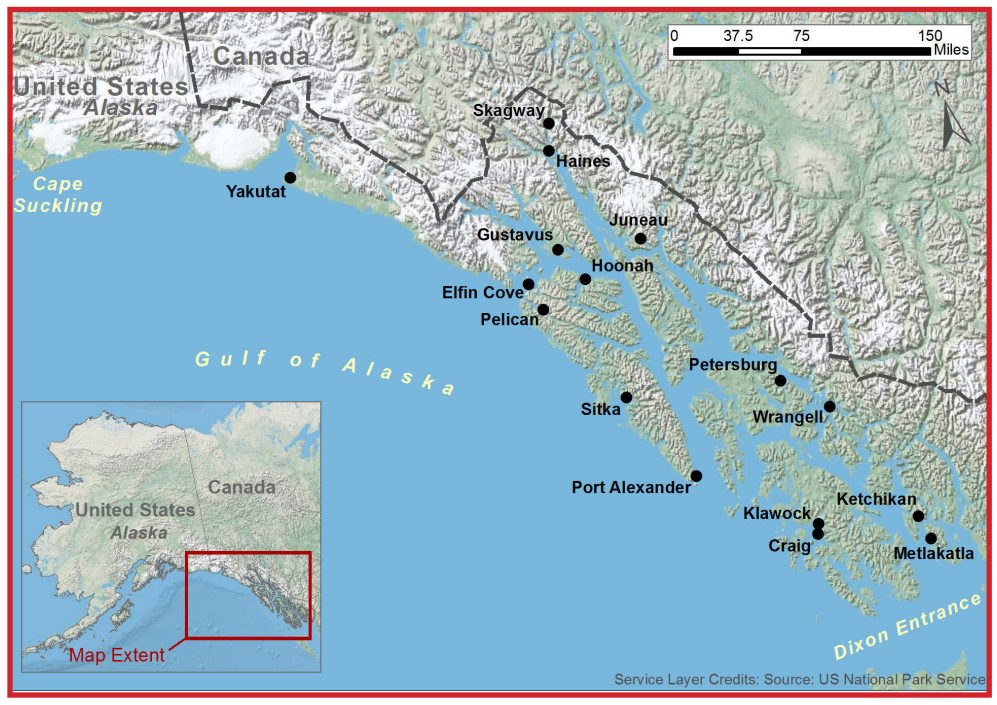

Figure 1.—Southeast Alaska.

composition estimates of the harvest by stock or stock group and by hatchery or wild origin.

Marine Commercial Sampling

Most Chinook harvested in Southeast Alaska are destined for British Columbia and the Pacific Northwest. Over the past three decades, salmon have been sampled at small buying stations and at large ports, where hundreds of thousands of pounds of seafood are processed daily. In 1982, adipose finclip and coded wire tag efforts increased along with the need to obtain biological information such as scales, sex, otoliths, measures of length and weight, as well as catch effort.

Port sampling in Southeast is part of a coastwide program to recover coded wire tags from harvested salmon. These tags, together with other biological and associated data, allow estimates of stock composition in marine commercial fisheries. An agreement among Pacific coast states and Canada assures that at least 20 percent of commercially caught Chinook will be sampled for the presence of coded wire tags. Southeast Alaska marine fisheries are managed to maximize the catch of Alaska hatchery-origin Chinook salmon and at the same time to minimize catches of wild Southeast Alaska Chinook. Without detailed marine sampling programs, accurate stock composition estimates of the catch and the Alaska hatchery "add-on" would not be possible.

In addition to coded wire tags, the Pacific Salmon Commission in 1999 began exploring whether genetic stock identification estimates of the Alaska commercial harvest could be included as part of the decision-making process. Advances in methods and technologies have increased the potential use of genetic stock identification for estimating harvest composition. Over the past several years, a genetic baseline containing information from 166 populations, ranging from the Situk River in northern Southeast Alaska to the Central Valley of California, has been used in the genetic stock identification program. This baseline continues to grow with additional population data from Alaska and Canada. Currently, genetic stock identification is used in the Southeast sport and troll fisheries and also the directed gillnet fisheries near the Taku and Stikine Rivers.

University of Alaska Fairbanks–Environmental and Ecological Studies

Milo Adkison, University of Alaska, Fairbanks

UAF researcher Ben Meyer and volunteer Evan Brashear finish a day of field work on the Yukon River near Eagle. © University of Alaska Fairbanks.

In an effort to understand the statewide reduction in Chinook salmon productivity, the University of Alaska is conducting five Chinook Salmon Research Initiative studies as well as several additional studies supported by other funding sources. The five initiative-funded studies are as follows:

1. What's the role of growth? A scale study (Megan McPhee, Milo Adkison, Franz Mueter)

Fish scales are like tree rings; wide bands signify faster growth, and narrow bands during winter allow us to age the fish and determine how fast it grew at each age. Fast-growing fish can better escape predators and access a wider variety of prey items, so their survival tends to be higher.

University staff are working with Alaska Department of Fish and Game's Mark, Tag, and Age Lab in Juneau to measure decades of historical scale samples from Chinook salmon populations around the state. These populations were chosen for both the length of historical sample record and geographic diversity. From these samples, we can ask the following questions:

- Has growth changed for stocks between phases of high and low productivity?
- If so, at what age? Is it freshwater growth, early marine growth, or growth in the open ocean?
- What environmental factors, such as temperature, ice-out date, and upwelling, are related to growth patterns?

2. Evaluation of growth, survival, and recruitment of Chinook salmon in Southeast Alaska rivers (Trent Sutton and Milo Adkison)

Juvenile Chinook salmon data allow us to separate processes in freshwater from those in the ocean. In a declining salmon population, abundant, large juveniles would signal that the problem is in the ocean, while scarce, skinny juveniles might indicate the opposite. Unfortunately, Chinook salmon juveniles are hard to sample; they're small fish in big rivers and are often migrating under spring ice. Southeast Alaska has several rivers where juvenile sampling has consistently occurred, so studying these data can provide valuable insights not available elsewhere.

In these rivers, in addition to studying the relationship between life-stage-specific growth and survival, we are looking at the juveniles. We're seeking to understand what determines when juveniles swim to the ocean, and how this timing and the condition of juveniles when they migrate affects their survival.

3. Health assessment of Chinook salmon of different life stages (Lara Horstmann-Dehn)

The health of fish can be assessed by looking at metabolomics (a unique chemical fingerprint), fatty acids, energy stores, and diet. Juvenile and adult salmon are being examined at a variety of life stages, from those rearing in the headwater streams, to juveniles feeding in the Bering Sea (courtesy of a NOAA project), and finally spawning adults. This health assessment study will identify potential nutritional or human caused stressors and critical development periods for Chinook salmon. Sampling began in spring 2014 with the collection of 30 juvenile Chinook salmon in the Chena River in collaboration with another University of Alaska project, detailed below "Freshwater predation mortality." We sampled 20 spawning adults on the Salcha River in collaboration with department hatchery fish-takes in July 2014, and received 17 juvenile Chinook and 20 juvenile chum salmon from the northern Bering Sea. Sample processing and analyses are currently underway.

4. The role of environmental processes in structuring the distribution of Chinook salmon spawning and rearing habitats across a large Alaska river basin. (Jeff Falke)

A valuable method for understanding the effects of a changing environment on rearing Chinook salmon is to do mapping and analysis of physical habitats in streams and rivers. Fluctuations in water temperature from year to year are of particular interest, both because of the large effect this can have on cold-blooded organisms such as fish, and because of rapid warming in high latitudes. Geographical information system mapping coupled with detailed field measurements of stream flow and water temperature are being used to develop a model to identify high quality rearing habitat for juvenile Chinook salmon across the Chena River watershed. The model is currently being validated through snorkel, minnow trap, and seining surveys, as well as environmental DNA water samples. This study will identify environmental factors influencing juvenile Chinook salmon abundances and demographic rates, such as hatching success and mortality, throughout the Chena watershed.

5. Freshwater predation mortality as a potential source of Chinook salmon declines in the Arctic-Yukon-Kuskokwim region. (Mark Wipfli and Lara Dehn)

To understand whether predation on juvenile Chinook salmon in freshwater is an important source of mortality, a broad scale diet study of predatory fishes is being conducted in the Arctic-Yukon-Kuskokwim region of Alaska. Specific objectives are as follows:

- Identify important freshwater predators of juvenile Chinook salmon.
- Determine if salmon are more vulnerable to predators during certain seasons or in particular habitats.
- Test whether size affects predation risk of juveniles.

Sampling began in the spring 2014 on the Chena and Tanana Rivers near Fairbanks, the Yukon River near Eagle, and the Unalakleet River. Sampling continued through fall 2014 until freeze-up and will commence after break-up of 2015 with an expansion to additional study sites as well as sampling of bird predators (mergansers). Sampling efforts have included the capture and collection of gut contents from predatory fish as well as documenting the presence and condition of juvenile Chinook salmon. The 2014 field season through August has yielded a total of 217 stomach content samples from Arctic grayling, burbot, Dolly Varden, and northern pike. Diet analysis is underway in the laboratory, and potential Chinook salmon prey in stomach contents are being identified and set aside for genetic analysis.

In a declining salmon population, abundant, large juveniles would signal that the problem is in the ocean, while scarce, skinny juveniles might indicate the opposite.

Chinook salmon fry in the Salcha RIver
© University of Alaska Fairbanks

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