Photo by Terry Thompson © ADF&G

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Chinook Salmon Research Initiative

Ed Jones, Chinook Salmon Research Initiative Coordinator

Welcome to our first digital edition of the Chinook News, a publication of the Alaska Department of Fish and Game. This edition will highlight Chinook salmon research projects on the Yukon and Nushagak rivers and throughout Southeast Alaska. Each of these projects received funding, derived in part, from the Chinook Salmon Research Initiative. This Initiative was designed as one of the largest and most comprehensive fisheries research programs in Alaska's history.

Alaska has hundreds of Chinook salmon stocks and is perfectly suited to study these resilient fish across a wide geographic range. But, to design a manageable statewide project, twelve Chinook stocks were chosen in 2012 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.

In total, $15 million dollars was appropriated by the Alaska legislature which allowed for numerous Chinook salmon research projects over the last three years. This has increased our confidence in estimates of adult spawning abundance, juvenile production and improved our understanding of stock-specific harvests in our marine fisheries.

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

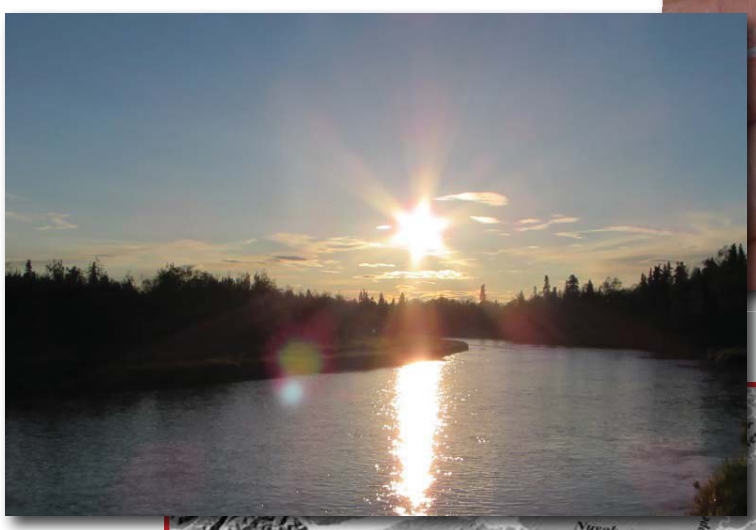
This information ultimately strengthens our confidence in estimates of abundance allowing for more responsive management measures, meaning, when productivity allows, fishers will be afforded opportunity; and when productivity is poor, fish will be passed through to meet necessary spawning requirements to ensure sustainable salmon populations in to the future.

Nushagak River Chinook Salmon Research

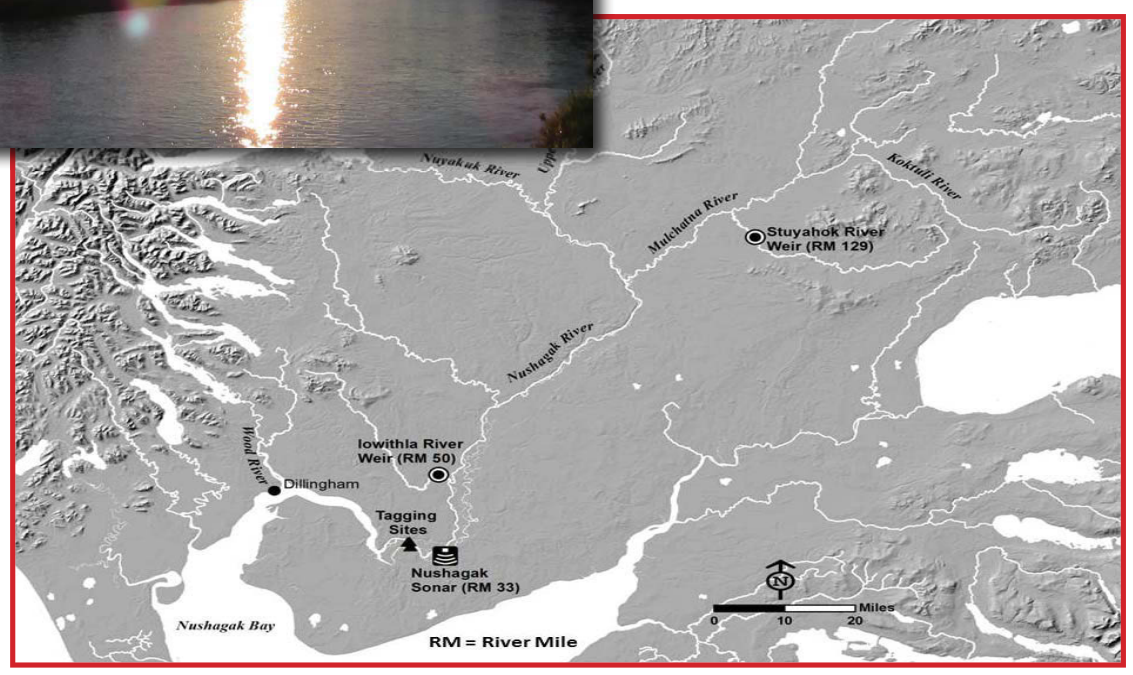
Charles Brazil, Fishery Biologist, Division of Commercial Fisheries

The Nushagak River, located in Southwestern Alaska, flows over 200 miles from its headwaters into Bristol Bay near Dillingham. The Nushagak drainage has two main tributaries: the Nuyakuk River, draining Tikchik lakes from the west; and the Mulchatna River, flowing into the Nushagak River from the east. The Nushagak supports one of the largest wild runs of Chinook salmon in the world and these fish are important to the local subsistence, commercial, and sport users. Total run has ranged between 90,000 and 500,000 fish since 1975. Total harvest has averaged about 75,000 fish and fluctuated from 25,000 to 200,000 during the same time period. Harvest rates are viewed as healthy averaging about 30 percent with a high of 60 percent. Historically, out of the ten lowest total runs, seven of those have occurred since 2007, but the spawning goal has always been achieved, regardless.

Nushagak River. © ADF&G.



Axillary fin. Used with permission © Genevieve Anderson.



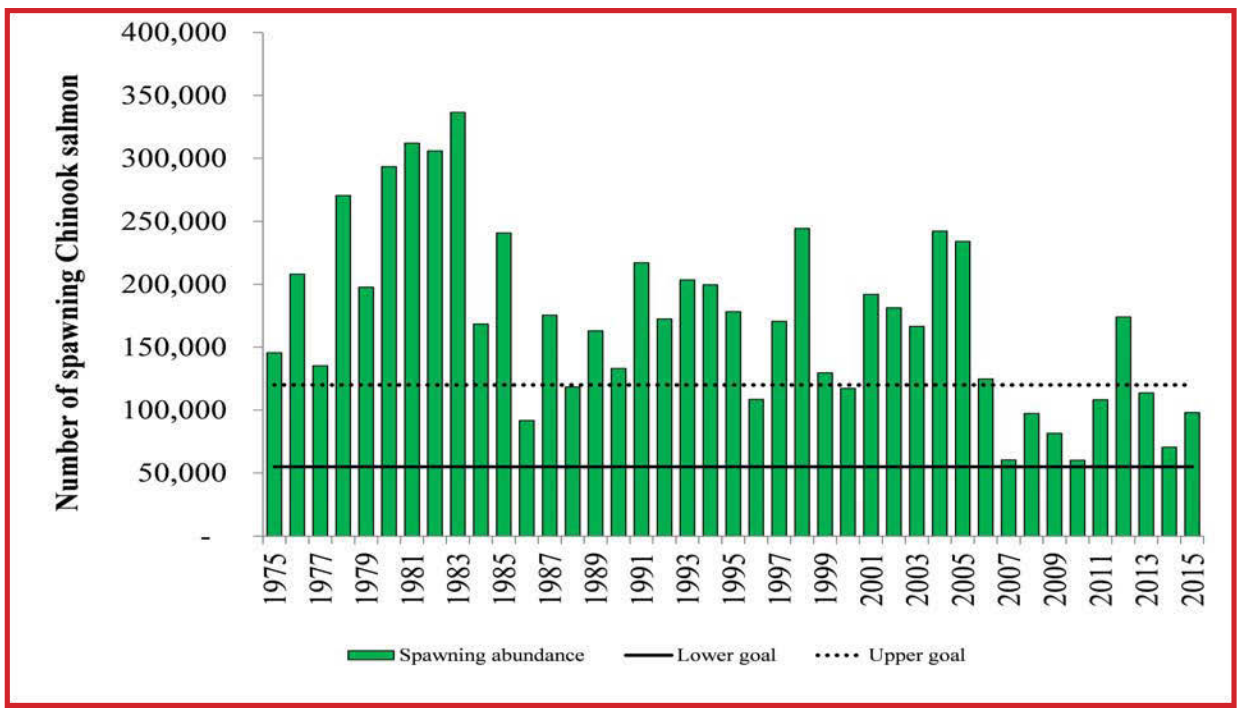
Tagging and escapement enumeration projects, Nushagak River Drainage

In the Nushagak River, measures of Chinook salmon spawning abundance were originally made using aerial surveys that began in the late 1960s and continued until 1978. Then in 1979, estimates of inriver run strength were made using sonar operated 30 miles upriver of Dillingham. While sonar can count individual fish, there are multiple species of salmon migrating in the river while counting is occurring. Therefore it is necessary to estimate the proportion of each species present in the river and apply those proportions to the total sonar count to arrive at species-specific counts. This is accomplished by test-fishing with gillnets immediately below the sonar.

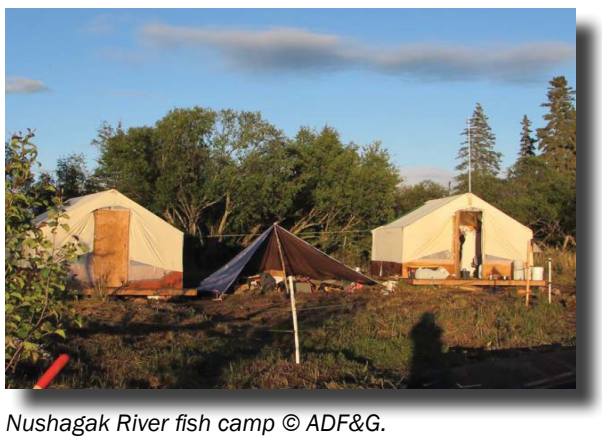
In the summer of 2015, the department partnered with the Bristol Bay Science and Research Institute through LGL Alaska Research Associates to conduct a mark-recapture study to estimate the inriver run of Chinook salmon in the Nushagak River. This study resulted in an independent estimate of inriver run numbers for comparison to the sonar count. Event one of this two-event mark-recapture study marked nearly 2,500 Chinook salmon in the lower Nushagak River. Fish were captured using non-lethal drift gillnets and by rod and reel angling. All healthy fish were marked with a passive integrated transponder, or PIT tag, dart tags, and with a clip of the left axillary fin, a small fin located next to the pelvic fin.

Fish tagged at Scandinavian Slough and near the Nushagak Sonar were sampled for age, sex, and length information. Preliminary results show 44 percent of the fish had spent three years in the ocean, and 41 percent had spent two years in the ocean, and 62 percent were males. As part of event two of the mark-recapture study,

Nushagak RIver escapement from 1975 to present.



over 4,000 Chinook salmon were sampled and counted through weirs placed across the Iowithla and Stuyahok rivers and through rod and reel sampling and carcass recovery efforts at various other tributaries. All fish were checked for the presence of marks applied during event one and sampled for age, sex, and length information. Of the total, about 2 percent possessed marks previously applied during event one and preliminary data indicates 56 percent of the fish had spent two years in the ocean, 34 percent had spent three years, and about 74 percent were males. On average, fish sampled throughout the project were about 30 inches in length. The preliminary 2015 inriver run estimate from the mark-recapture project is 127,000 Chinook salmon, approximately 1.3 times greater than the sonar count of 98,000. Interestingly, the same work performed in 2014 resulted in an inriver run estimate of 91,500 Chinook salmon, again, approximately 1.3 times that of the sonar count of 70,500.



Nushagak River fish camp © ADF&G.

Life at the Weir

Fish weirs have been traditionally used as a tool to either trap or direct fish movement through river systems. In the modern era they have become a vital tool for the assessment and management of salmon populations throughout Alaska. Operated in some the most remote and scenic areas of Alaska, the weir presents unique challenges and experiences. Throughout the summer, the work load revolves around salmon migration. After the initial labor of installation, the frequency and abundance of salmon moving upstream will determine the amount of attention required from the weir crew which normally consists of two to three technicians. Daily operations entail passing fish through the weir, age, sex, and length sampling, cleaning debris from the weir, inspecting the weirs for holes, radio and phone contact with the area office, and basic camp maintenance. Working on a weir can best be described as getting paid to camp and applying fisheries science in some of the greatest places in Alaska. This does not mean it is easy. When the fish are in high abundance and during installation and break down of the weir the days are long and strenuous. When the work is finished, or when the shift is over, technicians are free to explore the area around them or just rest, relax, eat, and sleep. The location of the weirs often places technicians in areas of abundant outdoor activities, including hiking, boating, wildlife viewing, swimming, and fishing. Safety is paramount in all activities and the department provides training and equipment necessary to properly prepare crews for extended time in the field. Salmon weirs are an essential tool for the department to assess, study, and manage salmon populations in Alaska. Working on a weir project can be an exciting, fun, and educational time where outdoor living and fisheries science collide to make for rewarding and memorable experiences.

Juvenile Yukon River Chinook Salmon Abundance and Ecology

Katie Howard, Fisheries Scientist, Division of Commercial Fisheries

Large vessels and trawls have been used for a number of years to survey the northeastern Bering Sea for Yukon River juvenile Chinook salmon. These surveys have provided important information such as run forecasts to managers, and subsistence and commercial fishers. Over the past two years, research funded through the Chinook Salmon Research Initiative has been testing whether a smaller vessel (approximately 60 feet in length) and trawl could be used to collect these data, but at lower cost than when using a large vessel (approximately 120 feet in length or more). This work has shown it is possible to collect these data at less than half the previous cost, though some modifications to the survey design are necessary to accommodate the smaller vessel.

Data collected from these surveys has also provided new insights into the early marine life history of juvenile Yukon River Chinook salmon. When combined with data collected using other funding sources, research showed that the average juvenile Yukon River Chinook salmon length increased over 200 percent in the first few months at sea. While impressive, this was the lowest increase found among the other species of salmon sampled from the Yukon. Coho salmon length increased approximately 300 percent, and pink and chum salmon length increased up to a whopping 400 percent during their first few months in the marine environment. We've also gathered new information on diets of juvenile Chinook salmon and how those diets are different in particularly warm years. Over time it may be possible to understand how diet may affect survival of juvenile Chinook salmon.

This work also sheds light on what factors might affect the abundance of juvenile Chinook salmon in a particular cohort. We found that the production (number of returns per spawner) generated from a given spawning event appears to be determined before September of a cohort's first year in the ocean. This information is important and suggests that the differences between good and bad years are likely caused by something that happens sometime between when the eggs are laid in gravel and September of a fish's first year in the ocean, typically two years later.

ADF&G and Alaska Pacific University researchers retrieving the catch during the 2015 trawl survey on ADF&G's R/V Pandalus. *© ADF&G. Photo by Sean Larson*

Salmon captured during the marine trawl survey, from top to bottom: pink salmon, chum salmon, sockeye salmon (Norton Sound origin), Chinook salmon, and coho salmon. © ADF&G. Photo by Katie Howard.

Recent information has shown a pronounced uptick in juvenile Yukon River Chinook salmon abundance, which should translate into improved adult Chinook salmon runs down the road. Current measures of juvenile abundance give a leading indicator of productivity, and this information can be used to predict runs three years into the future. The current expectation for the Yukon River Chinook salmon run in 2016, based on the juvenile data collected 3 to 4 years ago during trawl surveys, is for a run similar to last year and a modest increase from previous years. The runs in 2017 and 2018 should see an even larger improvement and may be adequate to provide increased subsistence opportunity compared to recent years. The information gathered from these vessel trawl surveys is being shared with fishermen and managers to assist with preseason planning and development of appropriate management strategies.

© ADF&G. Photo by Sarah Webster

The next steps in this research are to refine the small vessel survey design in 2016 and to seek opportunities to continue surveying juvenile Yukon River Chinook salmon in the northeastern Bering Sea to better understand causes of mortality at this critical life stage. Continuation of this research would ensure that run size forecasts would continue to be available to managers and stakeholders. Additionally, with this new survey capacity developed through the Chinook Salmon Research Initiative, we are actively seeking external funding to use this less expensive survey platform to gain new insights on Kuskokwim and Nushagak river Chinook salmon stocks that presumably rear in the southeastern Bering Sea. The Kuskokwim River is the largest subsistence Chinook salmon fishery in the state and the management tools and insights gained from this type of work could be of great benefit to stakeholders, comparable to that seen for Yukon River fisheries.

Chinook salmon captured at the same survey station. Juvenile Chinook salmon show the greatest differences in size at capture than any other species, likely representing multiple ages of fish that leave freshwater (1- and 2-year old fish). Most juvenile Chinook salmon leave freshwater as 2-year old fish and resemble the bottom fish at capture. © ADF&G. Photo by Katie Howard.

Southeast Alaska Chinook Salmon Stock Assessment

Philip Richards and Brian Elliott, Fishery Biologists, Division of Sport Fish

ADF&G staff drift gillnetting for Chinook salmon on the lower Taku River © ADF&G.

With the signing of the Pacific Salmon Treaty with Canada in 1985, Chinook salmon management and research in Southeast Alaska became a significant department focus. For over 20 years, Chinook salmon projects in Southeast provided estimates of adult and juvenile abundance, marine harvest, and juvenile-to-adult marine survival which allows for a full run reconstruction of a year class cohort. Because budgets and personnel were prioritized many years ago, today the Chinook programs on the Chilkat, Taku, Stikine, and Unuk rivers, referred to herein as the Southeast indicator stocks, are second to none. Data, as has been gathered for the Southeast indicator stocks, helps us understand:

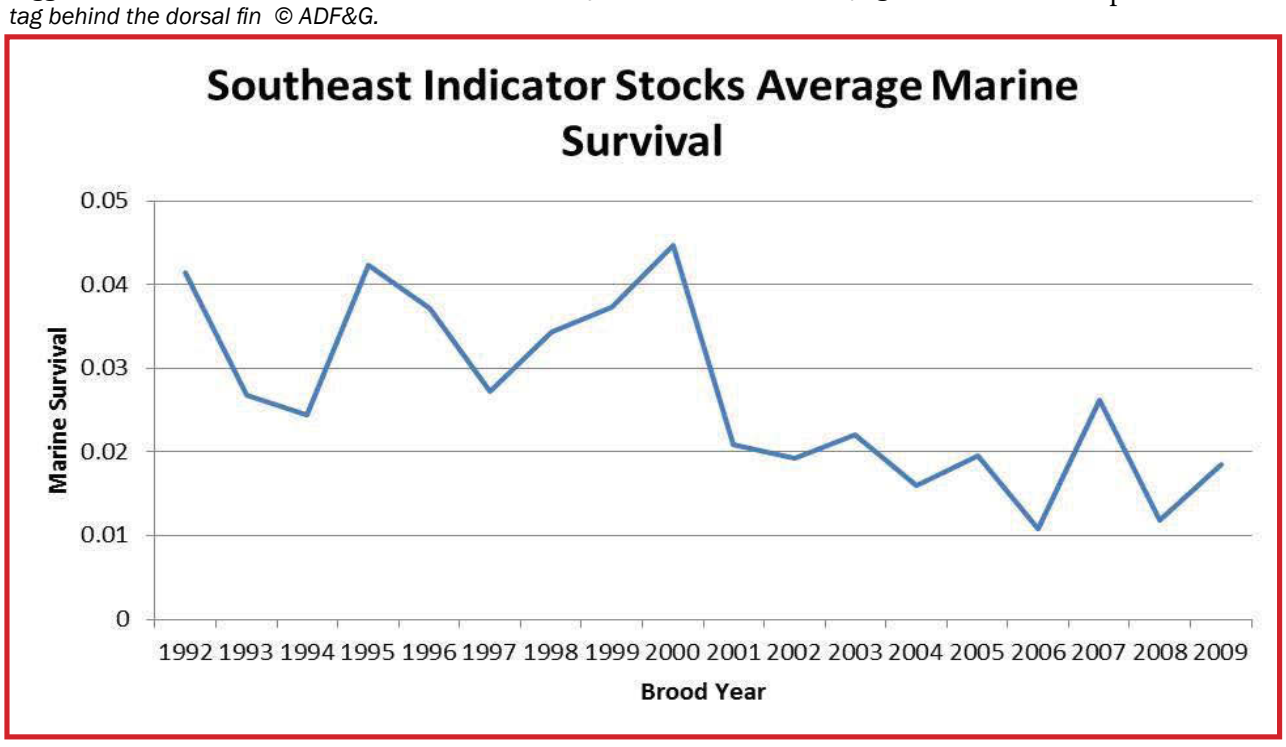
1) how many juveniles "smolt" are produced annually
2) marine survival (juvenile to adult survival rate)
3) how many fish are harvested
4) when and where fish are harvested
5) where juveniles rear in freshwater
6) where fish rear in the ocean
7) how many fish spawn
8) where fish spawn, and
9) the age, sex, and size of both spawning and harvested fish

With any stock assessment project the priority is to estimate the number of fish that come back to spawn each year. For the Southeast indicator stocks, spawning abundance is estimated using mark-recapture projects and observer counts. In addition, marine sport and commercial harvest studies coupled with juvenile tagging programs take place. More detailed information on the nuts and bolts of these efforts can be found in the Chinook News – Winter 2015 publication.

Like other Alaskan Chinook salmon stocks, juveniles from the Southeast indicator stocks typically spend two years in freshwater before migrating to the sea in April and May. After rearing in the ocean from one to five years, mature Chinook salmon return to their natal freshwater systems from April to August. And although these Chinook salmon enter their freshwater systems over a span of several months, spawning takes place during a much shorter period of time between late July and early September. After eggs are deposited, they will incubate throughout the fall and winter and fry will typically emerge from the gravel in February. These fry then rear for just over a year before migrating to the sea as spring smolt.

Spawning abundance is estimated for many Chinook salmon stocks along the coast. The estimates for the Southeast indicator stocks are considered some of the best and most reliable having taken place consistently over a lengthy period of time. But what makes the stock assessment program for the Southeast indicators unique among all others is the ability to estimate the number of juveniles leaving each system on an annual basis, and when coupled with tagging studies, the ability to estimate stock specific marine harvest and marine survival.

Tagged Chinook salmon from the lower Taku River ready for release; note blue spaghetti tag behind the dorsal fin © ADF&G.



Average marine survival from 1992 to 2009. Note: Data are only available through the 2009 brood year. Adult Chinook salmon from brood year 2009 returned to their natal streams to spawn in 2014 and 2015 as five and six year olds, allowing fishery researchers to determine marine survival for the 2009 brood year. Subsequent brood years (2010 and later) are still rearing in the ocean and have not yet returned.

ADF&G staff seining for Chinook salmon smolt in the lower Taku River © ADF&G.

Many years of tag recovery information has shown that Chinook salmon from the Chilkat and Unuk rivers primarily rear in and around Southeast Alaska whereas Chinook salmon from the Taku and Stikine rivers rear in the Gulf of Alaska and Bearing Sea. These fish are primarily harvested in commercial troll and gillnet fisheries and sport fisheries in Southeast Alaska and harvest rates for these stocks are healthy and average around 20 percent.

Research for the Southeast indicator stocks has shown that juvenile abundance has fluctuated normally; however, the recent downturn in production was due to poor marine survival and for some reason fish have been dying at higher rates than normal after migrating to the ocean. Historically marine survival averaged about four percent for the Southeast indicator stocks; however, in recent years it has dipped below two percent. In other words, for every 100 juveniles that migrate to sea, less than two fish have returned to spawn as adults, less than half of the historical average.

Detailed stock assessment information like what is gathered for the Southeast indicator stocks is rare and takes time, money, and patience to gather. In 2015 the department was once again able to continue the research for the Southeast indicator stocks funded in part through the Chinook Salmon Research Initiative and this work will take place again in 2016.