Ecosystem-based Chinook Salmon *Oncorhynchus tshawytscha* Management Plan of the Susitna River Drainage

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Abstract

The fishery is Susitna River chinook salmon (*Onchorhynchus tshawytscha*) fishery on the Northern Cook Inlet. It is the largest in size of all Pacific salmon species. Management of the fish, like any other natural resource in the state of Alaska, is controlled by the Alaska constitution. The requirement is to manage to achieve maximum benefit to the citizens of the state and to preserve the species by establishing and maintaining maximum sustained yield. Present to a lesser extent in the Susitna River drainage is the coho salmon (*Onchorhynchus kisutch*). Sockeye salmon (*Onchorhynchus nerka*) are a major contributor to the fisheries of the Upper Cook Inlet and the Susitna River system tributaries. Burbot (*Lota lota*) are a fish species present not of commercial significance. Present also in the Susitna River basin is the rainbow trout (*Onchorhynchus mykiss*). It is not managed for commercial harvest. Also inhabiting the drainage without commercial significance are Arctic grayling (*Thymallus arcticus*). The Susitna River chinook salmon fishery is one of the largest fisheries in Alaska and provides much of the world with salmon. It brings a large amount of revenue for the state and its citizens. Because of the large amount of fish and for the enjoyment, many sport fishermen go out and by fishing supplies and licenses so as to ensure that they catch a trophy fish. Years ago, an evaluation took place for the feasibility of using a dam in the Susitna River drainage to produce hydroelectric power. Although not yet built, new interest exists in developing the project. Some of the potential difficulties for the chinook salmon is overexploited, habitat loss, dams, and development. If the Susitna River hydroelectric project is completed, special care should be taken to not endanger the chinook salmon production of the drainage.
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Fishery

**Description of Fishery**

The fishery discussed in this paper is Susitna River chinook salmon (*Oncorhynchus tshawytscha*) fishery (Personal Communication Sechrist, 2011). Harvesters include: commercial fishers, sport fishery, incidental catches by troll fishermen, bears, and predatory birds. Many species of fish and other animals are in the area but just a few are mentioned here and the focus of this paper is chinook salmon management (ADF&G, 2011).

**Role of Various Target Species**

The main role of the chinook salmon and other fish is to reproduce and keep their species going. Management of the fish species, like any other natural resource in the state of Alaska according to the state constitution (Alaska State Constitution, 1959), is to manage to achieve maximum benefit to the citizens of the state.

**Geographically Defined Systems of Organisms**

The chinook salmon is not geographically defined; they are interrelated with other salmon across Alaska. This is true for the other salmonid species.

**Environmental Process**

The only environmental process occurring is erosion from the Susitna river

([http://library.thinkquest.org/26026/Science/environmental_processes.html](http://library.thinkquest.org/26026/Science/environmental_processes.html)).
**Fish**

**Chinook Salmon (Oncorhynchus tshawytscha)**

The main fish managed in the Susitna River drainage is the biggest of all Pacific salmon species, chinook salmon (see figure 1) (Shields, 2010) (ADF&G, 2010, October), also called king salmon. It measures on average 36 inches and exceeding 30 pounds. Presently the record mass for a king salmon is 97.25 pounds (http://en.wikipedia.org/wiki/King_Salmon). Salmon spend around three months developing as eggs before they hatch. After hatching they spend a couple of years in the river where they go from the stage of alevin then to parr, where they gain vertical dark stripes down their dorsal side. At the final stream stage, they are called young smolts. At a certain time, the smolt gathers at the mouth of the river in a school and begins their metamorphosis into salt water salmon. When ready, the young new salmon swim out into sea and spend many years swimming around in the Bering Sea and the Gulf of Alaska. Some chinooks return early within their first year or two. These salmon are about half the size of a regular king salmon and are known as jacks. They are usually thrown back by sport fishermen, but are kept by commercial fishers. The average time for a chinook salmon to spend in the ocean is 3 to 4 years, growing bigger each year; some have been known to spend up to eight years at sea. When fully mature (see figure 1), they return to the original river where they were hatched. At this point, they undergo another metamorphosis back into fresh water fish so as to return to the spawning grounds. Once they get back to their natal stream, they breed and lay their eggs. After spawning, they generally die within a week, fertilizing the stream and creating a nutrient-rich environment for the new infant salmon that are about to hatch (Fish Ex Quality Seafood, 2010).
Coho Salmon (*Oncorhynchus kisutch*)

Present to a lesser extent in the Susitna River drainage is the coho salmon. The average of a coho salmon (see figure 2) is around 8 to 12 pounds and measure 24 to 30 inches in length. On occasion some individuals are landed weighing more than 30 pounds (ADF&G, 2011, October). Typically during periods of high runoff, the salmon enter streams to breed. They release 2,500 to 4,500 eggs into a redd (nest) (ADF&G, 2011, October). They develop through the winter and hatch in May or June. When mature enough, they travel to estuaries and lakes and feed on other eggs and plankton until they become smolts. If they stay in rivers, they may spend one to three years there. They usually spend five years in a lake before swimming to the ocean. At sea, they may spend 6 to 18 months sometimes longer where they feed on smaller fish and squid (ADF&G, 2011, October). When ready they undergo a metamorphosis into freshwater fish so as to start the cycle over again.
Sockeye Salmon (*Oncorhynchus nerka*)

Sockeye salmon are a major contributor to the fisheries of the Upper Cook Inlet and the Susitna River system (see figure 3). Sockeye salmon, also called red salmon, spend one or two years in freshwater rearing lakes before migrating to sea where they only eat plankton. Sockeye adults normally are 18-31 inches long and 4-15 pounds in mass.

Major returns are to the Susitna’s Judd, Larson and Chelatna lakes (Fair et. al., 2010). They are managed with fish weirs, underwater cameras, sonar, foot, and aerial surveys.

![Sockeye Salmon](http://www.cookingwithcolor.com/food_encyclopedia/salmon.htm)

Arctic Grayling (*Thymallus arcticus*)

The Arctic grayling (see figure 4) is about 24 inches and weighs up to five pounds. The average life span for males and females is 32 years (ADF&G, 2011, November). It is also present in the Susitna River drainage but is not managed to any significant degree except relative to sport fishing. Throughout Alaska most of the stocks of Arctic grayling is healthy and isolated from many of the major threats. But where development and Arctic grayling coexist, threats include...
over fishing, mining, over fishing and agriculture. Forestry may impact the local populations as well.

Figure 4 Arctic grayling adult. (http://www.greateryellowstonescience.org/topics/biological/fish/grayling)

**Burbot** (*Lota lota*)

Burbot reside in the Susitna River drainage but are not specifically managed except for sport fishing and subsistence harvest. Burbot (see figure 5) typically live in lakes or large cool rivers and prefer water below 65 degrees (ADF&G, 2011, October). Its diet consists of other fish and occasionally crustaceans, aquatic insects, plankton, and fish eggs. The average age a burbot lives to 15; however, they sometimes live to be 20 (ADF&G, 2011, October). The average length is 24 inches; those living in cooler water grow slower and live longer. Some have been recorded at 24 pounds and measuring up to 43 inches (ADF&G, 2011, October). They become fully mature by age three or four (ADF&G, 2011, October).

Figure 5. Burbot resting on bottom. (http://en.wikipedia.org/wiki/Burbot)

**Rainbow Trout** (*Oncorhynchus mykiss*)

Present also in the Susitna River basin is the rainbow trout. It is not managed for commercial
Rainbow trout are up to 45 inches and up to 55 pounds (ADF&G, 2011, October). Their lifespan is 4-11 years (ADF&G, 2011, October). The biggest threat to steelhead and rainbow trout is the degradation of the natural habitat caused by human interactions and development. This includes roads, timber harvest, hydroelectric projects, mining projects, urbanization, and the loss of wetlands. Other threats are habitat loss, climate change, sport, commercial, and subsistence harvest. All of these can be easily controlled with a well developed management plan. Under federal and state law subsistence harvest of rainbow trout is allowed but only in designated areas. For recreational fishing rainbow trout along with steelhead are two of the most popular freshwater spot fisheries in Alaska (ADF&G, 2011, October).

**History**

**Historical Development**

The fishery started before statehood and has been used for subsistence fishing for many centuries (Fair et. al., 2010). Counts of fish spawning in the Upper Cook Inlet streams and rivers are made by foot and helicopter surveys (Fair et. al. 2010).

**Economic Importance of Fishery**

The Susitna River chinook salmon fishery is the largest fishery in Alaska (http://www.adfg.alaska.gov/sf/FishCounts/index.cfm?adfg=main.home) and provides much of the world with salmon (Fair et. al. 2010). It brings a large amount of revenue for the state and its citizens. Because of the large amount of fish and for the enjoyment, many sport fishermen (http://www.adfg.alaska.gov/index.cfm?adfg=fishingsport.main) go out and by fishing supplies and licenses so as to ensure that they catch a trophy fish. The taxes on these items go to help the state of Alaska.
Harvesting Types

Small subsistence-type fisheries harvest chinooks and sockeye from the area (Fair et al., 2010). Subsistence or personal use fisheries are dwarfed by the commercial and sport fisheries. The commercial and sport fisheries (http://www.adfg.alaska.gov/index.cfm?adfg=fishingsport.main) are the largest in the area.

Waterway System

The Susitna River drainage basin (see figure 7) consists of the area from Cook Inlet near Mt. Susitna (see figure 8) on the south, northward to Mt. McKinley (Denali), eastward through the Talkeetna Mountains up to Susitna Lake, Lake Louise and generally southward to Cook Inlet.

Figure 7. Location of Susitna River drainage basin depicted in black relative to the state of Alaska. (www.pilotfriend.com/world_facts/world/maps4/Alaska.htm)
Lake Louise

Lake Louise is located at 62°19’60”N 146°30’0”W ([http://en.wikipedia.org/wiki/Susitna_River](http://en.wikipedia.org/wiki/Susitna_River)). Its maximum depth is 155’, the shoreline length is 22 miles, the surface acre is 16102’ and the elevation is 2362’ ([http://en.wikipedia.org/wiki/Susitna_River](http://en.wikipedia.org/wiki/Susitna_River)). The fish species present are arctic grayling, burbot, and lake trout.

Susitna Lake

Susitna Lake is connected to Lake Louise and the Tyone Lake which drains into the Susitna River. It is located at 62°25’0”N 146°40’0”W. Its maximum depth is 120’, the shoreline length is 29 miles, the surface acre is 9462 acres, and the elevation is 2361’. The species present in the lake are burbot, lake trout, and whitefish.

Susitna River

Susitna River is 313 miles in length and its maximum elevation is 2500’. The Susitna River is one of South-central Alaska’s premier sport fishing area with significant runs of chinook salmon and coho salmon.

Su-Hydro Project Overview

Years ago, an evaluation took place for the feasibility of using a dam in the Susitna River drainage to produce hydroelectric power (see figures 9 & 10). Although not built previously, new interest exists in developing the project. The Alaska Center for the Environment (ACE) supports the state’s goal for 50% of all of the electricity to be produced by renewable sources by 2025. How to achieve this goal was never clarified by the legislature and the goal’s vagueness has helped renew the possibility of the Susitna River mega-hydroelectric project. However, before committing $4.2 billion dollars to a single project, we must know about the alternative in order to make the best decisions for Alaska’s energy future. ACE is currently assessing the feasibility of developing a diverse renewable energy portfolio that would achieve the state’s 50% of electricity by 2025 without developing the Susitna mega-hydroelectric project. (ACE)

Figure 9. Susitna Valley Map
http://images.townnews.com/frontiersman.com/content/articles/2011/10/11/local_news/doc4e93ddae1f48a058652245.jpg
**Su-Hydro Project Pros**

It provides one possible way to produce 50% of the state’s electricity from renewable resources without extracting any coal or other mined natural resources. These renewable energy solutions are important for Alaska’s economic future. The project could displace some gas-powered turbines as they retire. (ACE)

**Su-Hydro Project Cons**

Although it would help Alaska’s people greatly, the project would cause a negative impact on an important river system and a 39-mile long swath of wildlife, fish, wilderness, and riparian habitats along the subsistence, sport, and commercial lifestyles and industries it supports. The Susitna River is a vital corridor for anadromous fish such as the coho salmon that access clear water tributaries for spawning. By putting all of the state’s “energy eggs” into one basket, it creates a risk to ratepayers and utilities should that single source fail or go offline. The project would provide an excessive amount of power that could support multiple new industries and extractive projects that carry environment risks. An earth embankment style dam has a price of approximately $4.5 billion, which would preclude the possibility of many other less controversial and more easily permitted projects. Existing transmission infrastructure is inadequate and would need to be upgraded at a possible additional cost of $1 billion in order to accommodate energy output from the Susitna River. Due to big infrastructure and capitalization cost and size of the project, in order to keep power affordable, the State would need to subsidize the project with several billion dollars which creates a hidden cost and makes Susitna’s power artificially cheap. The social impact of a sudden yet short-lived economic boom of construction could penetrate and exacerbate the boom-bust cycles and dependence on a big infusions of development that have dominated Alaska’s economic history. A $2.25 billion appropriation would be by far the
largest appropriation in the state’s history and would constitute an enormous subsidy to energy intensive industries such as mining. It is unclear what the actual lifespan of this project is would be due to the glacial siltation, increased glacial melt from climate change, subsequent reductions to runoff and flow. Before assuming this risk, the state needs to know more about alternatives to understand if the Susitna River is really the best option for our future. (ACE)

Alternatives to Su-Hydro Project
ACE developed an internal analysis and lay of the land in the late 2010 that assessed whether or not achieving the 50% goal by 2025 without a mega-hydroelectric project. It may seem almost impossible to do, but there is a possible chance for a study titled the Railbelt Regional Integrated Resource Plan (RIRP), which was released in 2010 and recommended the Chakachamna hydroelectric project over the Susitna hydroelectric project. However, the Alaska Energy Authority (AEA) chose to disregard the RIRP recommendation and is publicly supporting Susitna instead. Although the RIRP also stated that for the Railbelt “the renewable requirement cannot be met without Susitna if the Chakachamna is not available”, several scenarios presented within the RIRP do not come close to reaching the 50% goal without a mega-hydroelectric project. (ACE)
**Multispecies Management Plan with Defined Goals**

According to Article 8, section 3 of the Alaska State Constitution (Alaska State Constitution, 1959), “Wherever occurring in their natural state, fish, wildlife, and waters are reserved to the people for common use.” This ensures that all resources of fish must be available for the common use of the people of the state; preventing the termination of sport, commercial, or subsistence fishing from the people. However, also to be considered is that stated in Article 8, section 4, “Fish, forests, wildlife, grasslands, and all other replenishable resources belonging to the State shall be utilized, developed, and maintained on the sustained yield principle, subject to preferences among beneficial uses.” Paying particular attention to the fact that fish populations must be maintained, the entire population may not be overfished to extinction.
Keeping these in mind, in the event of a disaster to a fishery, the fish populations must be conserved and maintained for future use while at the same time being available for the common use of the Alaskan people in order to be in line with the Alaska Constitution.

As a real life situation is the incident that occurred in 2010 (Shields, 2010). According to the 2010 fish count 3,434,000 fish ran through the Susitna River (Shields, 2010). The Deshka River had 18,500 fish run through their weir however, 10,000 more were expected to go through. It had an escapement count far below average, where usually it is the largest chinook salmon run in the region. The total harvested was 9,631 fish or 70% of the average harvest of 15,900 (Shields, 2010).

For conservation the commercial fishery was restricted from a 12 hour fishing period to a 6 hour fishing period. Sport fishing was restricted to no bait. It was the first time the season had been closed in that part of the river. This is a reasonable and realist conservation strategy and would also be used in our hypothetical situation.

Besides humans, other predators would need to be managed. If salmon were to drop to critical levels, the bear population would need to be regulated. One possibility is increasing the max harvest on grizzly bear to two bears per season in the particular area. By doing this the bear population would be kept at a reasonable level so as not to cause over competition amongst the animals. Another idea would be to imply a predator control program in the area, However, this is not the wisest of options for the fact that it could through the ecosystem of the area off balance.

Another predator to control would be the seal and sea lion population. An example of this is in Oregon where the California sea lion population being reduced at the mouth of the Columbia River to allow more salmon to pass. This is an applicable state management plan to Alaska, but the U.S. Federal government may not allow it. If the salmon population came to a
critically low level the seal and sea lion population would have to be reduced. This would be done to aid in the salmon’s recovery. In the end the seal and sea lion meat could be distributed to the people.

**Associated Problems or Potential Difficulties**

Some of the potential difficulties for the chinook salmon is overexploited, habitat loss, dams, and development (McCain, 2000). As the fishing industry improves and becomes very efficient at harvesting fish, the high demand for seafood have people taken more fish than necessary out of rivers, lakes and oceans. Without enough fish in our rivers, lakes and oceans, the development of chinook salmon comes to a threatening stop and there wouldn’t be enough fish to reproduce for the next generation (McCain, 2000). As more and more of our cities and towns close proximity to water sources are being expanded, it causes more of the chinook salmon’s habit to disappear (McCain, 2000). Along with the disappearance of their habit, their mating grounds go with it. As the bulldozers push down trees, the sediments in the soil get into the water, which is unhealthy to the fish. It gets into their gills and pollutes the air way system, causing them to suffocate. As the sewage, mining waste, acid rain, fertilizers, and pesticides concentrate get into the water it eventually ends up in the estuaries and the food web (McCain, 2000). As well as the expansion of cities and towns, the construction of dams slows the flow of the water and often gets in the way of fish going up stream to their mating grounds, which slows down development.

**Interview: Commercial Fishery Information Officer Commercial Fisheries Division Alaska Department of Fish & Game**

One representative ADF&G was interviewed to find out more about the Susitna River chinook salmon fishery and its management (Personal communication Katie Sechrist, November 11, 2011).
1Q: “What is the net size regulation for chinook salmon in the Cook Inlet?”
1A: “The max net size for chinook salmon is 6 in.”

2Q: “How much do they catch in an overall average?”
2A: “Over a 10 year period from 1999 to 2008 they caught an average of 16,687 chinook salmon.”

3Q: “Is there subsistence fishing on the Cook Inlet for chinook salmon?”
3A: “There are some subsistence fisheries on the Cook Inlet that target chinook salmon.”

4Q: “What type of environment are they in once they are in the Cook Inlet, going to back towards the spawning grounds?”
4A: “The chinook salmon have to deal with fisheries, whales, bears, Sport fisheries, and troll fisheries.”

5Q: “How do Troll fisheries affect the chinook salmon?”
5A: “Troll fisheries affect the population of chinook salmon from incidental catches. But due to fewer accidental catches it has been the third lowest decline on chinook salmon coming back.”

6Q: “What can affect the time of year the chinook salmon heading back to the spawning grounds?”
6A: “The only two things that can affect the time of year the chinook salmon comes back are El Niño and La Niña effects. If the water is warm from El Niño then the chinook will return early. If the water is cold from La Niña then they will return later.”

She also indicated that because the Susitna River is such a large and rugged river, it is not directly studied as much as the adjacent river such as the Deshka River is. Information received by studying the Deshka River is extrapolated to provide management information for the Susitna River fish. The results of this interview have been incorporated, where feasible into this paper.

**Personal Experience**

One of the authors, David Pomelow has personal and family experience with chinook salmon fishing on the Deshka River. Alaska is known for its fisheries, both commercial and sport fishing. Alaska has one of the world’s best game management programs, a lot of people around the world dream about coming to Alaska just for the hunting and fishing. It is a major tourist attraction and in order to keep it this way Alaskans need to manage the local fisheries like it has been. Alaska Department of Fish and Game stocks our lakes and has restrictions about bag limits
and seasons for fishing. This helps to maintain the fish population. Table 1 shows the number of chinook salmon.

Table 1 Chinook salmon count in 1995 in the Deshka River adjacent to the Susitna River (Fair et al., 2010). Number of fish is on the Y axis and month/day is on the X axis. Fish count on the Deshka River in 1995. In the middle of June the fish count was above 2,600 fish per day.

Table 2 is a of the chinook salmon fish count of 2010 in the Deshka River.

Table 2 Chinook salmon count in 2010 (Fair et al., 2010). Number of fish is on the Y axis and month/day is on the X axis. In June the daily count peaked at 2,750 per day.

The fish count has gone up by roughly 150 chinook salmon per day in the last 5 years. This means that our management is working so people that have dreamed their whole life can come and fish and also for the people of Alaska that depend on this fishery as a lifestyle and source of income. In these hard times of our economy it is important for people to have a job that they can depend on year after year to support families. If we keep this program going we should be able to have fishing for generations to come. Both of David’s grandfathers have been dreaming about coming to Alaska to fish their whole lives. They would both set aside money to
get the chance to fly from Maine to Alaska for a summer and enjoy the fishing in Alaska. If they had saved money their whole life to come to Alaska to experience the great Alaska and there was no fishing program and it had been fished out both his grandfathers would have been devastated. That never happened though because of the great management program that we have and both of them got to experience their lifelong dream (see figures 10-12).

Figure 10. Deborah Pomelow, 2011

A picture of a 40 pound chinook salmon that David Pomelow caught in Montana creek this past summer. Every day David didn’t work he would bring his brother and relatives to Montana creek for king salmon fishing. They had a blast and caught a lot of fish.

Figure 11. Chad, Lee, Gaylon
(Deborah Pomelow, 2011)
This is a picture of David’s little brother Lee, his dad Chad, and his grandfather Gaylon. Lee caught a nice chrome chinook salmon female that day where Gaylon caught a male that was more ready to spawn but it was his first king salmon so he kept it.

**Summary**

The Susitna River drainage basin has many species of fish. The most important one is the chinook salmon. The fishery for it is a commercial fishery done in Upper Cook Inlet and various sport fisheries in tributaries of the system or in adjacent areas. That fishery is the largest in the state. The state constitution requires it and all other natural resources be managed on a maximum sustained yield basis so as to produce maximum benefits to the citizens of the state. It appears that this is being successful as judged by numbers of fish available for sport catch in the adjacent Deshka River and the continuing commercial catch of Susitna River chinook. If the Susitna River hydroelectric project is completed, special care should be taken to not endanger the chinook salmon production of the drainage.
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