

Phenotypic Characterization of Chinook Salmon in the Yukon River Subsistence Harvest



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Phenotypic Characterization of Chinook Salmon in the Yukon River Subsistence Harvest

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ABSTRACT

Subsistence fishers from the villages of the lower and middle Yukon River harvest Chinook salmon (*Oncorhynchus tshawytscha*) that they describe as *whitenose*, *blueback*, and *blackhead* salmon. Moncrieff and Klein (2003) speculated that these fish may represent distinct runs that may include Canadian origin fish. The run and harvest timing of these types of fish are reportedly predictable, which implies they may be different stocks. If these fish can be identified as separate stocks, direct phenotypic identification of fish stocks could prove to be a useful fishery management tool, with implications for studies in fish biology, stock status and trends, and harvest monitoring. This project combined traditional ecological knowledge (TEK) to classify Chinook salmon sampled from a test fishery in the lower Yukon River, with the scientific method of genetic analysis to determine stock of origin. The phenotypes of sampled fish were identified by a technician from the village of Marshall on the Yukon River. Using allozyme baseline data, *blackhead* and *whitenose* Chinook salmon phenotypes did not appear to subdivide into large regional groups of US versus Canadian origin stocks. This may be because phenotypic identification of the salmon was not verified by multiple observers or because phenotypes are not strongly correlated with large-scale stock groups. Therefore, the use of these phenotypes does not appear to have an immediate management application for large-scale aggregates. A goal of this project was to learn how Yukon fishers characterize phenotypes of Chinook salmon and to learn through TEK specific information regarding each phenotype including run quality, run timing, spawning, meat quality and local uses. Additional Yukon River Chinook salmon phenotypes identified in this study include: *whitenose*, *blueback*, *blackhead*, *blacknose*, *red king* and *grayback*.

Key Words: *Blackhead*, *blacknose*, *blueback*, Chinook salmon, *Oncorhynchus tshawytscha*, mixed-stock analysis, king salmon, phenotype, subsistence fishery, Yukon River, *whitenose*.

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INTRODUCTION

Subsistence fishers from communities along the lower and middle Yukon River describe different groups of Chinook salmon (*Oncorhynchus tshawytscha*) based on coloration, flesh quality, and other characteristics (Moncrieff and Klein 2003). Further, they describe the timing, order, and in some cases, spawning distribution of these groups. Chinook salmon support important subsistence and commercial fisheries throughout the Yukon River drainage. Management of this species includes meeting escapement goals and providing for a subsistence priority in the Alaskan portion of the Yukon River and allowing sufficient passage of Chinook salmon into the Yukon Territory, Canada. If the phenotypic groups of Chinook salmon are associated with stocks of Chinook salmon used in management, direct phenotypic identification of fish could prove to be a useful fishery management tool with implications for studies in fish biology, stock status and trends, and harvest monitoring.

Color, morphology, and run timing have all been used by local fishers to describe groups of Pacific salmon that are associated with genetic stocks or stocks used in management. For example, the Ahtna of the Copper River region in Alaska have extensive knowledge of salmon distribution (Simeone and Kari 2002). They know which species are headed for which spawning streams and the typical timing of the runs. The Upper Copper River Ahtna have named all of the runs of Chinook and sockeye salmon (*O. nerka*) that spawn in the tributary streams above the Sanford River and these names are similar to the salmon stocks recognized by the Alaska Department of Fish and Game (ADFG). Coloration associated with sexual maturation has also been used to describe stocks of salmon. For example, fall-run Chinook salmon in the lower Columbia River often enter in two stages of maturation. *Tule* Chinook salmon enter in an advanced stage of maturation with dark-colored skin and often lighter colored flesh (Myers et al. 1998). These fish tend to spawn soon after reaching the spawning grounds. *Bright* Chinook salmon enter the river well before spawning and retain their ocean silver coloration longer.

On the Yukon River, fishers in Alakanuk, St. Mary's and Holy Cross identify three runs or groups of Chinook salmon (Moncrieff and Klein 2003). In Alakanuk, three runs were identified but only one was named (*whitenoses*) to the researchers. In St. Mary's, three runs were identified as *king salmon*, *blacknoses*, and *whitenoses*. In Holy Cross, three runs were also identified but as *super fish*, *whitenoses*, and *bluebacks*. In Nulato, two runs of Chinook salmon were described but neither was named to the researchers. In these communities, Chinook salmon are often classified as one of the before mentioned and are identified as separate runs or groups. In Holy Cross, the *blueback* Chinook salmon were described as dark blue with wide stomachs. They are called the *best kings* and have solid, firm meat. In St. Mary's, the *whitenose* Chinook salmon were described as big kings with less oil, drying faster.

Scale pattern analysis (SPA; described in JTC 1997), genetic data from allozyme loci (Wilmot et al. 1992; Templin et al. 2005) and single-nucleotide polymorphism loci (SNPs; Smith et al. 2005), and radio telemetry (Eiler et al. 2004) have been used to identify the stock of origin of Chinook salmon sampled from the Yukon River and to gain an understanding of the run timing of stock aggregates. SPA and genetic data from allozyme and SNP loci can identify stock aggregates corresponding to lower (US), middle (US), and upper basin (Canada) components. Comparisons of estimates using these techniques are generally concordant (Smith et al. 2005; Templin et al. 2005; US/Canada

Yukon River Joint Technical Committee 1997). Radio telemetry indicates that Canadian (Klondike, Stewart and White Rivers) and Tanana River Chinook salmon enter the Yukon drainage first, followed by lower Yukon River stocks. This study also indicated that Canadian-origin fish enter the river throughout the run.

For this project, a questionnaire was designed to clarify the characteristics of locally-described varieties of Yukon River Chinook salmon. In addition, Chinook salmon caught in gill nets used for species apportionment at ADFG's Pilot Station sonar project were identified by a local fisher as either *whitenose* or *blackhead*. Genotypes collected from these fish (Templin et al. 2005) were used to determine if these two phenotypes are correlated with genetic stock aggregates.

The objectives of this study were to:

- 1.) Collect tissue samples of *blueback*, *whitenose* or other Chinook salmon for genetic analyses;
- 2.) Determine if genetic differences exist between *blueback* and *whitenose* Chinook salmon;
- 3.) Estimate stock contribution to the mixture of *blueback* and *whitenose* Chinook salmon using phenotypic, genetic and scale pattern analyses;
- 4.) Collect age, sex, and length (ASL) data from Chinook salmon;
- 5.) Collect traditional ecological knowledge (TEK) on how Chinook salmon are characterized by fishers in Alakanuk, Emmonak, Holy Cross, and Nulato.

METHODS

Sampling and Analysis

Alex Coffee, a resident of Marshall on the lower Yukon River, was hired to identify the phenotype of Chinook salmon collected from species-apportionment gillnetting in 2003 at the sonar site at Pilot Station run by ADFG. Mr. Coffee was recommended by multiple people in Marshall for this position and, when interviewed, could clearly describe the types of Chinook salmon in his area and how villagers separate them. He learned these skills from elders in Marshall. Coffee and technicians at Pilot Station trained by him identified Chinook salmon as either *whitenose* or *blackhead*. The genetic results from this study describe the origin of these types sampled at Pilot Station, as identified by Alex Coffee and his crew.

All Chinook salmon caught in gillnets at Pilot Station were sampled for genetic analysis. For each fish sampled, capture date, fishing period (morning or afternoon), gillnet mesh size, right or left bank, area of the river, species, sex, length, phenotype, and scale sample for aging were recorded.

Genotypes for 14 allozyme loci for sampled Chinook salmon were provided by W. D. Templin, ADFG, Anchorage, AK (see Templin et al. [2005] for a description of the laboratory analysis to collect the genotypic data). Chinook salmon sampled in 2.5" and 4" mesh sizes were not included in the laboratory analysis (Templin et al. 2005). Separate stock composition estimates for *blackhead* and *whitenose* Chinook salmon were made using SPAM version 3.7b (Debevec et al. 2000) and the allozyme baseline described in Templin et al. (2005) to determine if Chinook salmon of these two phenotypes comprise different stocks. Contribution estimates were calculated for the following stock groupings: fine-scale: Lower Yukon (Andreafsky, Anvik, Nulato, Gisasa rivers), Middle Yukon (Jim River /Henshaw Creek, South Fork Koyukuk, Chena, Salcha rivers), Lower

Canadian Yukon (Klondike, McQuesten rivers), Pelly (Ross River, Blind Creek), Mid Canadian Yukon (Tatchun, Big Salmon, Little Salmon, Bear Feed, Nisutlin rivers), and Takhini (Takhini River); and large scale: Lower Yukon, Middle Yukon, and Canada. A likelihood ratio test (Reynolds and Templin 2004) was used to determine if the stock composition of the two phenotypic groups were significantly different. The null distribution for the likelihood ratio test was derived through 1000 bootstrap resamples of the mixture, following the recommendations in Reynolds (2002).

Age, length, and sex data for Chinook salmon where the phenotype could be identified were summarized. Mean lengths for female and male *blackhead* and *whitenose* Chinook salmon were compared using a two-tailed *t* test, $\alpha = 0.05$ (Zar 1984). Scales were used for aging salmon and reported using the European technique (Foerster 1968). Three scales were collected from each Chinook salmon. Scales were sampled from the area located on the left side of the fish and two rows above the lateral line on a diagonal from the posterior insertion of the dorsal fin to the anterior insertion of the anal fin. Scales were sent to the ADFG for processing. Lengths of Chinook salmon were measured to the nearest five mm from mid-eye to fork of the caudal fin (MEL).

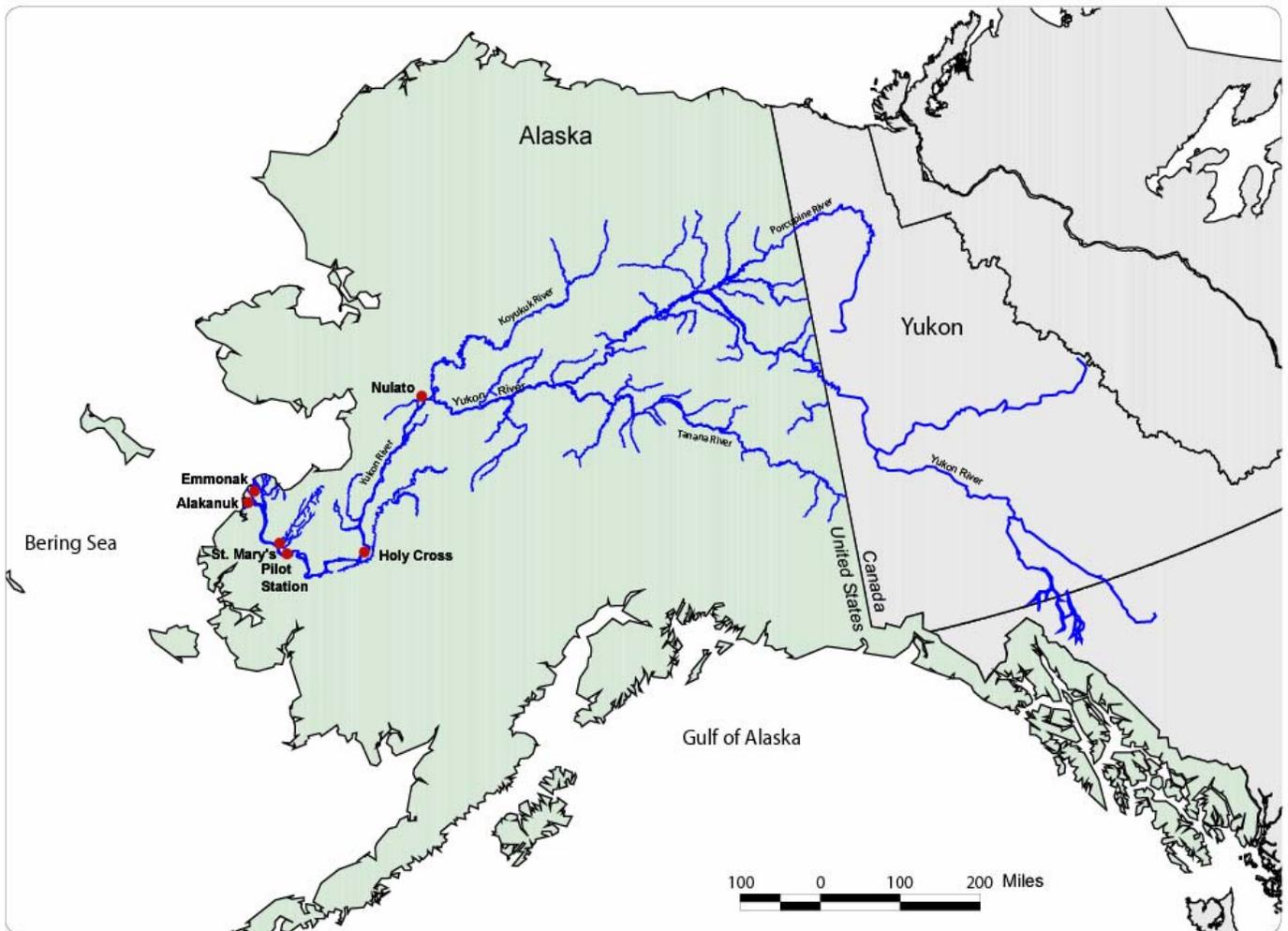


Figure 1. Map of the Yukon River Drainage and villages where interviews were conducted.

Traditional Ecological Knowledge and Characteristic Description

Information summarizing the characteristics of *whitenose*, *blueback*, and *blackhead* Chinook salmon from Moncrieff and Klein (2003) were entered into a Microsoft Access® database to provide a baseline for this study. Key respondent interviews with fishers were used to gather new information about what types of Chinook salmon occur in their areas and characteristics used to classify them. The questionnaire (Appendix A) was created to walk a knowledgeable fisher through the body parts of a salmon that were mentioned in Moncrieff and Klein (2003) as significant in describing a *whitenose*, *blueback*, *blackhead*, or other varieties of Chinook salmon. This questionnaire was used throughout the project any time a key respondent was questioned about the types of Chinook salmon in their area.

Key respondent interviews were conducted in several ways. The first was partnering with the U.S. Fish and Wildlife Service (USFWS) Refuge Information Technician (RIT) program. Through this program, RITs interviewed fishers in their area using the questionnaire during in-season subsistence harvest monitoring surveys in the summer of 2003. There was an RIT training in May of 2003 to review the questionnaire.

Second, YRDFA hired local research partners in the communities of Alakanuk (located 17 river miles [RM] from the mouth of the Yukon River), Emmonak (RM 21), Holy Cross (RM 279) and Nulato (RM 484) to conduct the survey with local fishers and knowledgeable elders. Third, in summer 2004 we traveled to Alakanuk and Holy Cross to interview fishers. A research partner in Alakanuk was contracted to assist with the interviews and conducted the follow-up, sharing the results with each participant and recording their feedback. In Holy Cross, a YRDFA board member provided introductions and guidance. Finally, opportunistic interviews took place with fishers in Anchorage or at meetings related to the Yukon River. All interviews were added to the Microsoft Access® database.

Disposable cameras were provided to each of the RITs and to the YRDFA technician at Pilot Station to photodocument *whitenose* and other varieties of Chinook salmon while the technicians were interviewing fishers.

RESULTS

Sampling and Analysis

The YRDFA technician worked with the ADFG crew at Pilot Station to sample 630 Chinook salmon between June 10 and July 17, 2003. He identified 393 *whitenose* and 209 *blackhead* Chinook salmon, and 28 were unknown. Daily catch rates indicate that *blackhead* and *whitenose* Chinook salmon are mixed throughout the run (Figure 2). *Blackhead* Chinook salmon were initially more numerous, but after June 14, *whitenose* Chinook salmon were more common. The highest catches of *blackhead* salmon occurred on June 11 and 15 and the highest catches of *whitenose* Chinook salmon on June 14 and 18.

The stock composition estimates for Chinook salmon sampled at Pilot Station sonar indicated that fish assigned as *blackhead* and *whitenose* by the Pilot Station crew comprise Chinook salmon stocks originating from all parts of the Yukon River (Figure 3). The stock compositions of

blackhead and *whitenose* Chinook salmon did not differ ($P=0.525$) when compared using a likelihood ratio test. Further, though the *whitenose* phenotype appeared more common than the *blackhead* phenotype for Chinook salmon stocks originating from lower Yukon River tributaries (Andreafsky, Anvik, Nulato, and Gisasa rivers) and the *blackhead* phenotype appeared more common in the middle Yukon River (upper Koyukuk and Tanana rivers), confidence intervals for the estimates for the phenotypes for these regions were overlapping (Figure 3).

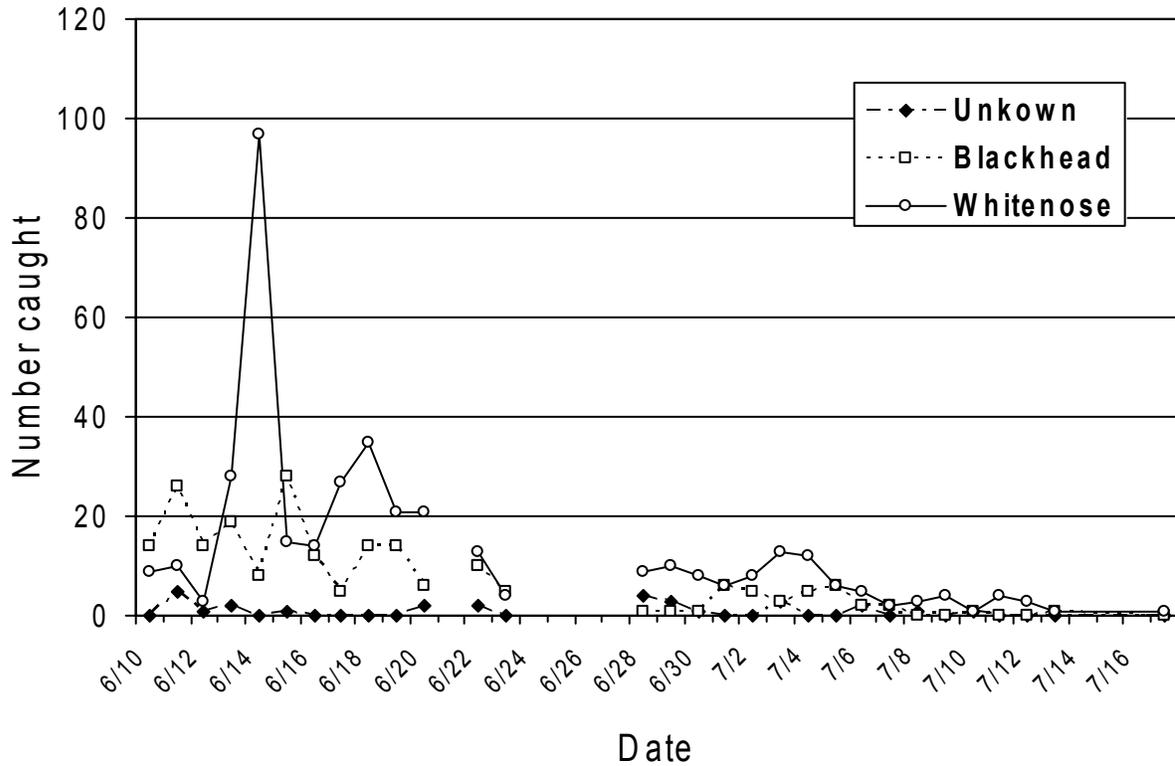


Figure 2. Daily catch rate of Chinook salmon captures at the Pilot station sonar site, 2003.

Mid-eye to fork lengths (MEL) of female Chinook salmon sampled at Pilot Station ranged from 530 to 1005 mm MEL and males ranged from 380 to 990 MEL (Table 1). Lengths of female and male *whitenose* and *blackhead* Chinook salmon were compared at respective age groups (Table 1). We found no significant difference in lengths in these pairwise comparisons ($P \geq 0.407$).

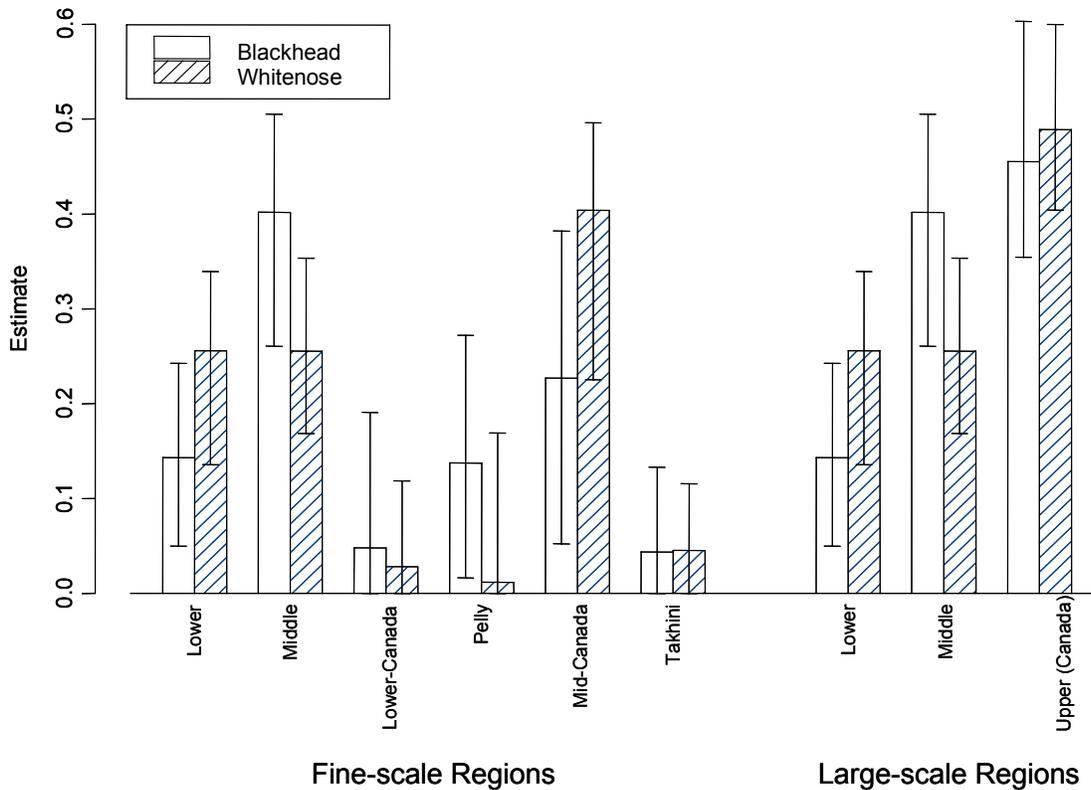


Figure 3. Stock composition estimates for Chinook salmon stock aggregates sampled from the Yukon River at Pilot Station sonar. Chinook salmon were divided into two phenotypic groups, *blackhead* and *whitenose*, by Alex Coffee and Pilot Station technicians. Stock groups are as follows: Lower (Andreafsky, Anvik, Nulato, Gisasa), Middle (Jim/Henshaw, South Fork Koyukuk, Chena, Salcha), Lower Canada (Klondike, McQuesten), Pelly (Ross, Blind), Mid Canada (Tatchun, Big Salmon, Little Salmon, Bear Feed, Nisutlin), and Takhini (Takhini). Error bars are 90% symmetric confidence intervals calculated from 1000 resamples of the baseline allele frequencies and mixture genotypes.

Table 1. Lengths (mid-eye to fork length) at age of *whitenose* and *blackhead* Chinook salmon sampled at Pilot Station, Alaska in 2003.

Age	Female MEL				Male MEL			
	N	Mean	SE	Range	N	Mean	SE	Range
<i>Whitenose</i>								
1.1					2	397.5	17.5	380-415
1.2					26	514.2	7.1	425-595
1.3	62	745.8	7.0	530-850	120	721.1	5.7	520-875
1.4	88	858.0	6.2	735-1005	59	839.1	7.9	675-990
1.5	1	975			3	943.3	23.3	920-990
<i>Blackhead</i>								
1.2					5	540.0	24.2	485-605
1.3	30	748.3	8.9	645-850	44	713.3	7.5	630-815
1.4	67	863.2	7.0	700-985	36	838.2	9.2	710-935
1.5	6	895.8	12.9	850-930	1	930		

Traditional Ecological Knowledge and Characteristic Description of Salmon by Community

This section details the results from the qualitative questionnaire from 18 interviews of residents of Alakanuk, Emmonak, Holy Cross, and Nulato. The results are presented by community starting at the mouth of the river. In each community the types of Chinook salmon identified are described and presented in a table.

Alakanuk: In Alakanuk, three types of Chinook salmon were identified (Table 2): *First Ones*, *blacknoses*, and *whitenoses*. Alakanuk participants did not talk about *blueback* Chinook salmon. Not all participants mentioned the *First Ones* and participants who were not aware of the *First Ones* described the *blackheads* as the first run.

The following highlights the three types of Chinook salmon identified in Alakanuk by six key respondents. Table 2 presents all of the information gathered.

- *First Ones* –“The old people say these fish arrive before breakup.” There were a lot of these in the past and less today. In Alakanuk, the *First Ones* were well described as a unique group of Chinook salmon. They are said to have a “dark spot under their chin” and to sometimes arrive before the ice moves out. They are fatter, bigger, richer and oilier than other Chinook salmon.
- *Blacknose* – These Chinook salmon were described as the first to arrive or as the middle group. They spawn “all the way up” or in Canada. They are the most numerous.
- *Whitenose* – These Chinook salmon are “supposed” to be the main run. They are said to spawn in gravel beds as the river meets the mountains. The *whitenoses* are bigger fish, averaging 30 pounds. They have a white nose that protrudes one to two inches and may begin to hook with teeth (likely a description of a kype, hooked snouts with prominent teeth developed by male salmon prior to spawning).

Table 2. Phenotypic characteristics of Chinook salmon described by six fishers in Alakanuk.

Characteristics	Phenotype		
	<i>First Ones</i>	<i>Blacknose</i>	<i>Whitenose</i>
Arrival time	First to arrive, may arrive before breakup	First to arrive, or middle group	Arrives middle or last part of June, last to arrive, or third group
Spawning location		Spawns in Canada	Spawns close to St. Mary’s, below Mt. Village, in the Andreafsky and Atchuelinguk rivers, Pilot Station area
General description	Dark spots under their chin	Tip of nose is black, dark heads	White nose, nose protrudes 1-2 inches
Color	Really black and dark colored, greenish color near fins	More silvery body, green back	Silver but not in same way as <i>blackheads</i> , darker, has green tint and darker dots
Meat description	Fattest, biggest, richest, oiliest	Second fattest, meat is better	Leanest, thinner than regular kings, more fat in belly, meat is not as good as <i>blacknose</i> salmon

Emmonak: In Emmonak, the Chinook salmon were described as arriving in two to three groups. The first group to arrive in Emmonak, in early June, includes *First Ones*, *bluebacks*, and/or *blackheads* or *blacknoses*, followed by *whitenoses* and *red kings*.

The following highlights the information found on the five types of Chinook salmon identified in Emmonak by four key respondents. Table 3 presents all of the information gathered.

- *First Ones* – These are the Chinook salmon that arrive first in Emmonak and are the fattest. Very little description was provided for *First Ones* in Emmonak.
- *Bluebacks* – These Chinook salmon come in spurts mixed with *blackheads*. They have the most energy, bouncing off nets, are quicker and have smaller hearts. Their backs are darker, thus the name *bluebacks*. Participants in Emmonak seemed to disagree in their level of fat descriptions of the *bluebacks*. About half said that they were “really fat” and the other half described them as “less fat and lighter.”
- *Blackheads/ Blacknose* – These Chinook salmon have less oil than *bluebacks*. The *blackheads* and the *blacknoses* will be described as the same fish in this report as this term was used interchangeably by participants in Emmonak. This group is said to spawn in Canada and to be compact fish, smaller than *whitenoses*. The main difference between the *bluebacks* and the *blackheads/blacknoses* is that the *blackheads/blacknoses* are described as the thinnest Chinook salmon and as having less oil than *bluebacks*. The meat of both varieties is described as firm but, the meat of the *blackheads/blacknoses* was described as the most firm and darkest color red or orange.
- *Whitenose* – Some described *whitenoses* as the second run of Chinook salmon and others described them as the third run of Chinook salmon. They were described as traveling slower and not going far. They may have teeth.
- *Red King* – They are larger when they have eggs. They have lots of teeth and can have hook noses (kype). These fish were also described as the thinnest, having the least oil and fat. This description is typical of salmon near spawning.

Some participants in Emmonak described the *whitenoses* as the second run and other described them as the third run. This discrepancy is probably due to different ways of counting the runs. One fisher might count the *bluebacks* and the *blackheads* as one run and another may count them as two separate runs.

Bluebacks and *whitenoses* were described very differently in Emmonak in terms of their energy level (Table 3). Other differences between the *bluebacks* and *whitenoses* in Emmonak include:

- Size – *bluebacks* are smaller than *whitenoses*.
- Meat color – *bluebacks* have firm, red/orange meat. *Whitenoses* have soft, pink meat.
- Arrival time – *bluebacks* arrive before *whitenoses*.
- Spawning location – *bluebacks* spawn in Canada, *whitenoses* spawn in the US.
- Color – *bluebacks* have dark blue backs. *Whitenoses* have a white nose and a grey, blue or black back.

Table 3. Phenotypic characteristics of Chinook salmon described by four fishers in Emmonak.

Characteristics	Phenotype				
	<i>First Ones</i>	<i>Bluebacks</i>	<i>Blackheads/ Blacknose</i>	<i>Whitenose</i>	<i>Red King</i>
Arrival time	First	Right after break up – early June	Right after break up, mixed in first group	Late June & early July, after the <i>blueback</i> run, mid point of the season, last run, second or third run	Arrive with <i>whitenoses</i> , midpoint in season, second group
Spawning location		Spawns in Canada	Spawn in Canada	Spawns in US	Spawns in Andreafsky River
General description		Blue backs, darker backs More compact, wider in belly than long	Back is blue/black More compact, wider in belly than long	White nose, back is gray, others say back is blue or usually black. Longer than they are wide	All red, mostly on back, not on belly
Level of fat	fattest	Some say really fat, other say less fat and lighter	thinnest	Really fat, the fattest	Least fat
Size		Smaller than <i>whitenoses</i>	Smaller than <i>whitenoses</i>	Big huge kings, the largest, biggest	Not big, smallest
Meat description		Red/orange, firm	Darkest color red/orange, firm	Pink, big and soft	Orange, firm
Uses		Dried, strips, canned, salted	strips	Dried, salted, canned, strips, slabs like chums cut crosswise	Slabs like chums cut crosswise

Responses from Alakanuk and Emmonak were compared to assess if the *blacknoses* described in Alakanuk are the same fish described in Emmonak (Table 4). Fish identified as *blueback* and *blackhead* by Emmonak fishers are similar to those described as Alakanuk *blacknoses*. They all arrive early in the season, spawn in Canada and have good meat. Emmonak is only four miles upriver from Alakanuk so these could be the same fish swimming upriver. Further interviews would be needed to determine if these descriptions represent the same fish.

Table 4. Comparison of phenotypic characteristics of *blueback* and *blackhead/ blacknose* Chinook salmon from Alakanuk and Emmonak.

Characteristics	Phenotype		
	Alakanuk <i>blacknoses</i>	Emmonak <i>bluebacks</i>	Emmonak <i>blackheads/ blacknoses</i>
Arrival timing and order	First to arrive or middle group	Right after breakup	First group, right after breakup
Spawning location	Spawns in Canada	Spawns in Canada	Spawns in Canada
Description	Tip of nose is black, dark heads, more silvery body, green back	Blue, darker back, more compact, wider in belly than long	Back is blue/black, more compact, wider in belly than long
Meat description	Second fattest, meat is better than other Chinook salmon	Some say really fat, others say less fat and lighter. Firm red/orange meat.	Thinnest. Meat is firm and darkest color, red/orange.

Emmonak and Alakanuk fishers both described that *whitenoses* as arriving in late June, reportedly spawning in the US and having less than the best meat. Table 5 provides a comparison of Alakanuk and Emmonak fishers observations of *whitenoses*.

Table 5. Comparison of phenotypic characteristics of *whitenose* Chinook salmon from Alakanuk and Emmonak.

Characteristics	Phenotype	
	Alakanuk <i>whitenose</i>	Emmonak <i>whitenose</i>
Arrival time	Middle June or last part of June. Last to arrive, third group.	Late June/early July, after <i>blueback</i> run, mid point of the season, second or third run
Spawning location	Spawns close to St. Mary's, below Mt. Village, Andreafsky R., Atchuelinguk R. Pilot Station area.	Spawns in US
Description	<i>Whitenose</i> , nose protrudes 1-2 inches, silver but not in same way as <i>blackheads</i> . Darker, has green tint and darker dots.	White nose, back is gray, some say back is blue or black. Longer than wide. Big huge kings, the largest.
Meat description	Leanest, thinner than regular king salmon, more fat in belly, meat is not as good as <i>blacknoses</i> .	Meat is soft and pink.

Holy Cross: Three types of Chinook salmon were identified by six key respondent interviews in Holy Cross (Table 6). Two of the participants described a group of Chinook salmon that they called the *First Ones*. All other study participants in Holy Cross described the first group of Chinook salmon as a type called *king salmon* or *regular old king salmon*. These two groups (*First Ones* and *king salmon*) are described together in the results section as their characteristics are nearly identical.

- *First Ones* or *King Salmon* –These Chinook salmon are called “the first run” or “regular old fish.”
- *Whitenoses* – Some say this is the second run of Chinook salmon in Holy Cross and some say this is the third run. They are good for eating.
- *Bluebacks* –Some say these are huge fish and others say these are the second biggest fish.

Table 6. Phenotypic characteristics of Chinook salmon described by six fishers in Holy Cross.

Characteristics	Phenotype		
	<i>First Ones/ King salmon</i>	<i>Whitenose</i>	<i>Blueback</i>
Arrival order and timing	First to arrive	Second run, arrive after <i>king salmon</i> and before <i>bluebacks</i>	Last run/ third run, arrive around 4 th of July
Spawning location	Canada		
Distinguishing feature and color	White and silvery, Doesn't have white nose in front, “regular old fish”	Really <i>whitenose</i> , dark or green skin	Darker colored, dark blue, back is blue and wider
Size and strength	Smallest, strong fish	Biggest, largest of all, strong fish	Huge fish, some say second biggest
Meat description	Less greasy	Harder to dry but some say dries faster. Greasiest but some say less greasy.	Less greasy, rich fish, harder and takes longer to dry. Dark red meat.
Uses	Used for strips	Used for blankets, flat fish, strips, and jarred fish.	Some say best fish, used for strips, bottled fish, half dried and freezing.

Nulato: Participants in Nulato provided information on where the varieties of Chinook salmon in their area of the river swim. They reported that *blueback* Chinook salmon swim on the south bank or middle of the river, while the *whitenose* Chinook salmon swim near Nulato on the North bank. They also reported that the *bluebacks* spawn in Canada but, did not report where the *whitenose* spawn. This spawning information could be related to where they swim as has been reported in previous reports (Moncrieff and Klein 2003). Four types of Chinook salmon were identified by two key respondent interviews in Nulato (Table 7).

- *Blueback*
- *Red King*
- *Whitenoses*
- *Grayback* – This Chinook salmon was mentioned by one of the two individuals interviewed from Nulato but no further description was provided. Therefore, it was not included in the tables.

Table 7. Phenotypic characteristics of Chinook salmon described by two fishers in Nulato.

Characteristics	Phenotype		
	<i>Blueback</i>	<i>Red King</i>	<i>Whitenose</i>
Arrival timing	First run	Second run	
Swimming location	Swims on south bank or middle of river		Swims near Nulato along north bank
Spawning location	Spawns in Canada	Spawns in Nulato River	
General description	“better fish”	Meat not as good but still good	Look run down
Color	Haven’t changed color yet. Like “ocean fish.” Skin is tinged blue with dots.	Back is turning red	White noses and skin is tinged red with dots
Uses		Smoked differently	Good for strips

Participants in Holy Cross reported that *whitenoses* arrive before the *bluebacks* while other communities report that *bluebacks* arrive before *whitenoses*. Table 8 compares the described arrival times of *whitenose*, *blueback* and *blackhead* Chinook salmon in Alakanuk, Emmonak, Holy Cross and Nulato. It appears that the *bluebacks* arrive early in Emmonak and arrive last in Holy Cross but, arrive first in Nulato. The *whitenoses* arrive toward the middle or end of the Chinook salmon season in Emmonak and Alakanuk but arrive in Holy Cross before the *bluebacks*.

Table 8. Comparison of arrival timing and run order of *whitenose*, *blueback*, and *blackhead/blacknose* Chinook salmon at Alakanuk, Emmonak, Holy Cross, and Nulato.

Location	Phenotype		
	<i>Whitenose</i>	<i>Bluebacks</i>	<i>Blackheads /blacknose</i>
Alakanuk	Third group or last to arrive in middle or late June		First to arrive or middle group
Emmonak	Second or third run arriving in late June or early July, mid point of season, after <i>bluebacks</i> .	Right after break up, early June	Right after break up, mixed in first group
Holy Cross	Second run, arriving after <i>king salmon</i> and before <i>bluebacks</i>	Last run or third run, arriving around July 4.	
Nulato		First run	

Additionally, it should be noted that none of the participants in Holy Cross or Nulato mentioned *blackhead* or *blacknose* Chinook salmon. The *First Ones / king salmon* were described in Alakanuk, Emmonak, and Holy Cross, but not Nulato. *Bluebacks* were described in Emmonak, Holy Cross, and Nulato, but not Alakanuk. *Red kings* were described as a phenotype of Chinook salmon in Emmonak and Nulato but not Alakanuk or Holy Cross. *Whitenoses* were the only locally-described variety of Chinook salmon mentioned in every community in this study.

Photos of Chinook salmon were received from the YR DFA technician at Pilot Station and from the test fishery in Emmonak. A photo archive was created from these pictures and used during the summer 2004 field season with the interviews in Alakanuk and Holy Cross. Photographs from Emmonak illustrate the phenotypic characteristics of *whitenoses* (Appendix B).

In order to disseminate the preliminary results of this study, two Microsoft PowerPoint® presentations were given at the Alaska Chapter of American Fisheries Society meeting in November 2003 in Fairbanks, AK and at the YR DFA annual meeting in February 2004 in Allakaket, AK.

DISCUSSION

Descriptions of seven types of Chinook salmon made by interviewed subsistence fishers in the lower Yukon River were documented in this study. These include: *First Ones* or *king salmon*, *blueback*, *blacknose*, *blackhead*, *whitenose*, *grayback*, and *red king*. All villages surveyed (Emmonak, Alakanuk, Holy Cross, and Nulato) described a dark phenotypic group, called either *blueback*, *blackhead*, and *blacknose* salmon, and a light phenotypic group, called *whitenose* salmon. Descriptions of run order for these phenotypic groups were similar among three of the four villages, where the darker phenotypic group arrives first, followed by the *whitenose*. Local residents claim that the early running salmon, *First Ones* or *King salmon* and *blueback/blackhead/blacknose* salmon spawn “all the way up” or in Canada. There did not appear to be much consistency in the subsistence uses for the different types of Chinook salmon, though *whitenose* salmon were often described as having lighter-colored flesh than the darker types.

Sampling for Chinook salmon at Pilot Station began on June 10, 2003. At this time, both *blacknoses* and *whitenoses* were caught, and thus we were not able to determine which phenotype arrived first. However, following the observations of subsistence fishers in the lower river, the *blackhead* phenotypes were initially more abundant in 2003. Further, both radio-telemetry and genetic data show that Chinook salmon spawning in the Tanana River and in some Canadian tributaries have an earlier run timing than Chinook salmon in the lower river and other Canadian origin groups (Eiler et al. 2004; Templin et al. 2005).

Using allozyme baseline data, *blackhead* and *whitenose* phenotypes do not appear to subdivide into discrete regional groups of US versus Canadian origin. This may be because identification of phenotypes of the samples used for genetic analysis was not validated by multiple observers, or in fact, phenotypic groups are not strongly correlated with large-scale stock aggregates. In either case, phenotypic description of *whitenose* versus *blackhead* phenotypes likely does not have an immediate management application until reliability of identification of Chinook salmon to these phenotypic groups can be ascertained.

It is not clear what mechanism is responsible for the phenotypic differences described by the fishers. The phenotypes may be fixed differences, where the phenotype of the fish is unchanging and is due to either genetic or environmental factors or the phenotype of the fish change as the fish ages due to sexual maturation. Though the intent of the study was not to determine the cause of the phenotypic variation, the fisher descriptions have some consistencies with phenotypic changes due

to sexual maturation. For example, *blackhead/blueback* phenotypes are often associated with better quality meat with higher fat content than *whitenose* phenotypes (see descriptions from Alakanuk, Emmonak, and Nulato). Also, the onset of kype formation was mentioned in association with *whitenose* and *red king* phenotypes but never *blackhead/blueback* phenotypes. Finally, changes in phenotype as fish mature may explain the apparent inconsistencies in the order and timing observed among the villages (see Table 8).

CONCLUSIONS

- Physical characteristics used by subsistence fishers to identify Chinook salmon to seven locally described groups were documented: *First Ones or King salmon*, *blueback*, *blacknose*, *blackhead*, *whitenose*, *grayback*, and *red king*.
- *Whitenose* was the name used by all villages to describe Chinook salmon with light-colored noses and greenish sides. *Blueback*, *blackhead*, and *blacknose* were names used to describe darker-colored Chinook salmon with blue or black backs.
- Descriptions of run order of the different types were similar among villages with the exception of Holy Cross.
- Chinook salmon from all parts of the drainage contributed to the stock composition of *whitenose* and *blackhead* salmon sampled at Pilot Station sonar. This may be because phenotypic identification of the salmon was not verified by multiple observers, or because phenotypes are not strongly correlated with large-scale genetic stock groups.

RECOMENDATIONS

- Though characteristics used to describe phenotypes of Chinook salmon were similar among villages, further validation of phenotypic identification across villages and for individuals is recommended. For example, exchange of photographs of the different phenotypes for identification by multiple fishers among lower river villages would aid in determining if identification of the types is reliable.
- A study to determine the mechanisms that may be responsible for the phenotypic differences should be conducted. For example, a mark-recapture study could investigate whether sexual maturation is a factor in the phenotypic differences, as noted in the discussion, by documenting if the phenotype of fish changes between the time of marking and recapture.

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Appendix A. Phenotypic characteristics of Chinook salmon questionnaire

Community _____ Date of Survey _____
 Interviewer _____ Person Interviewed _____
 (fisher/cutter)

YRDFA is funded from the Office of Subsistence Management this year to ask people about white nose and blue back king salmon. Local people have reported catching these different kinds of king salmon. If you agree that there are different kinds of king salmon, we'd like to know the distinguishing characteristics about these fish.

Can you identify a blue back or white nose king salmon?

Are there other kinds of king salmon you know about? What do you call them? (Local name?)

(if they answer "no" to first two questions- "As far as you know, there is only one kind of king salmon?")

King Salmon Run Descriptions	<i>Whitenose</i>	<i>Blueback</i>	Other _____
When does each run arrive in your area?			
How long does each run last?			
Where do you catch them or see them?			
What kind of gear do you use to catch them?			
Do you know where they are headed (spawning)?			
Characteristics			
What are the distinguishing characteristics of each run of king salmon?			
What is the color of their back?			
-- their nose?			
-- other color differences			
Which is the largest? Which are the fattest and the thinnest? (mark order in size)			
What is the shape of their nose?			

-- belly / stomach			
Are any of the fins, including the adipose fin, shaped differently or are they further forward or back on the fish? Is there a particular meaning or significance to the placement or shape of the fin?			
Are there any special characteristics relating to the jaw or chin for each run such as spots, shape or color?			
What is the meat like? (firm, soft, oily, etc)			
What do you use them for (i.e. strips, etc)?			
Other comments or drawings...			

Appendix B. Photographs of Chinook salmon taken at the village of Emmonak (RM21)



Fish #1 top, fish #2 bottom - *whitenose* Chinook salmon



Detailed shots of Fish #1- *whitenose* Chinook salmon



Details of Fish #1 continued



Fish #3- *whitenose* Chinook salmon

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