AGE, SEX, AND LENGTH COMPOSITION OF CHINOOK SALMON FROM THE 2003 KUSKOKWIM RIVER SUBSISTENCE FISHERY

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ABSTRACT

Age, sex, and length (ASL) data were collected from chinook salmon harvested during the 2003 Kuskokwim River subsistence fishery to characterize the composition of harvest from the lower, middle, and upper river reporting areas. Data collections were coordinated by the Alaska Department of Fish and Game (ADF&G), Orutsararmiut Native Council (ONC), Kuskokwim Native Association (KNA), and McGrath Native Village Council (MNVC). Thirty-six subsistence fishers, from seven communities, collected most of the samples. The information for each chinook salmon included scales used for age determination, length, sex, date and location of capture, and gear type used for capture.

A total of 2,360 chinook salmon were sampled in 2003 (1,974 lower Kuskokwim River, 269 middle Kuskokwim River, and 117 upper Kuskokwim River samples), which is an increase over the 1,170 fish sampled in 2001 and similar to the 2,228 fish sampled in 2002. Ages were determined for 2,035 of the fish (86%) in 2003. Samples were collected from a variety of gear types and gillnet mesh sizes, but most fish were caught in gillnets with a mesh size 8 inches or larger (i.e., large mesh gear). Age-1.2 male chinook salmon accounted for 6.4% of the 2003 subsistence harvest, which was less than the 22.7% average from escapement projects. Conversely, older aged chinook salmon (age 1.4 and 1.5) accounted for 48.8% of the subsistence harvest, compared to an average of 35.5% at escapement projects. Female chinook salmon comprised 37.6% of the harvest, which was slightly higher than the 31.5% average from escapement projects. This was the first year of the project that age 1.3-chinook salmon was the most abundant in the subsistence harvest (44.2%).

Findings from 2003 provide the second complete year of baseline data available to assess changes in the ASL composition in response to the subsistence fishing schedule, which was instituted as a management tool in 2001 after Kuskokwim River chinook salmon were identified as a stock of concern by the Alaska Board of Fisheries. As in 2002, preliminary comparison between samples collected in the lower and middle river shows comparable percentages of older age fish (49.1% and 50.6%) and females (38.2% and 35.1%). The relative age and sex composition of the subsistence harvest with large mesh gear was uniform over time in the lower river; however, in the middle river, the percentage of older age fish and females decrease as the season progressed. The subsistence sampling program should be continued in the current design in order to allow for replicate sampling with increased sample sizes to verify the preliminary patterns described above. Furthermore, assessment of the influence of the subsistence fishing schedule requires collecting comparable data sets when the subsistence fishing schedule is not invoked. Finally, the numbers of samples collected from the middle and upper river, and the number of participants from those areas, should both be increased in order to better represent the subsistence harvest from those reporting areas.

KEY WORDS: age-sex-length, ASL, chinook salmon, king salmon, *Oncorhynchus tshawytscha,* Kuskokwim River, subsistence fishery, age class composition, sex composition, length composition, gillnet, mesh size selectivity, subsistence fishing schedule.

INTRODUCTION

The Kuskokwim River subsistence salmon fishery is one of the largest subsistence fisheries in Alaska, with harvests in 2003 of 67,788 chinook salmon *Oncorhynchus tshawytscha*, 69,019 chum salmon *O. keta*, 25,499 sockeye salmon *O. nerka*, and 32,780 coho salmon *O. kisutch* (ADF&G 2003). These harvest numbers are inclusive of Kipnuk, Kwigillingok and Kongiganak of north Kuskokwim Bay. The annual subsistence harvest of chinook salmon typically exceeds that of the annual incidental commercial catch, which averaged 31,000 fish from 1980 through 1999 (Ward et al. 2003). Subsistence caught chinook salmon are of particular interest to fishery managers because of the number of fish harvested, the importance of the species as a subsistence food, and because of the implications of subsistence fishers tendency to prefer harvesting chinook salmon with gillnets of 8-inch or larger mesh sizes (DuBois and Molyneaux 2000). This preferred mesh size range is selective toward catching larger, older age fish, and includes a higher percentage of females than occurs in catches made with smaller mesh nets (DuBois and Molyneaux 2000, ADF&G 1981). The result is a decrease in the percentage of older aged fish and females as each segment of the chinook salmon run progresses upstream through the gauntlet of nets, towards the spawning grounds. Chinook salmon spawning escapement is, by default, left to those fish that escape the gauntlet of subsistence and commercial gillnets. Hypothetically, the escapement ASL composition should favor that fraction of the adult chinook salmon population not selected for by gillnets.

For the purpose of this report, all discussion of harvest is limited to that harvest which occurs within the Kuskokwim River. An unknown number of Kuskokwim River chinook salmon are likely harvested in fisheries that occur in marine waters (Crane et al. 1996), however the abundance and stock composition of these intercepted salmon are largely unknown, as is the ultimate age-of-return of the salmon caught.

Most chinook salmon subsistence harvest occurs with gillnets (Ward et al. 2003). Drift gillnets are overwhelmingly the most common contemporary gear type used (Coffing 1997, Ward et al. 2003). Regulations do not restrict the mesh size used by subsistence fishers, and many choose to use large mesh sizes when targeting chinook salmon. Large mesh size, as used in this report, refers to any stretched mesh size of eight inches or larger. The 1994 annual subsistence survey included information about the gillnet mesh sizes fishers used to harvest chinook salmon, and of 497[2] respondents, 51% reported using eight-inch or larger mesh, 44% used six-inch or smaller mesh, and 5% used mesh sized between six and eight inches (Francisco et al. 1995). In 1967, of 588 fishing families surveyed, 517 (88%) reported using "king nets" and 513 reported using "chum nets" for subsistence fishing (ADF&G 1968). The use of large mesh sizes is as much to target larger chinook salmon as to avoid smaller species, whose numbers at times vastly exceed chinook salmon; however, most fishers do use both mesh types over the course of their annual salmon harvest activities. Gear usage in 2003 is thought to be closer to that reported in 1967 than 1994 based on comments from the Kuskowkim River Salmon Management Working Group (KRSMWG) and general conversations with subsistence fishers along the river.

[2] Francisco et al. (1995) lists total respondents as 490 (p. 29 and table 26); however, as per discussion with Michael Coffing (ADF&G, Subsistence Division, Bethel), the actual number of respondents is 497. The percentages presented in this report have been corrected accordingly.

Unlike subsistence fishers, commercial fishers have been required to use gillnet mesh sizes of six inches or smaller since 1985. The directed commercial fishery for chinook salmon was discontinued in 1987 due to depleted runs and the importance of this species as a subsistence food. Incidental commercial harvest of chinook salmon continues to occur during the June and July fishery that targets chum salmon (AAC 07.365, ADF&G 2002), though no such commercial fishery occurred in 2003.

Chinook salmon age, sex, and length (ASL) information is typically collected from fish sampled from commercial harvest and escapements. These samples form the basis for a variety of investigations including pre-season run outlooks, assessment of the number of females and older aged fish in the escapement, and the development of spawner-recruit models used to estimate run productivity and as the basis of biological escapement goals.

Collecting ASL data from the commercial harvests and escapement-monitoring projects has been a standard part of the Kuskokwim Area salmon management program, but sampling subsistence caught fish is a more recent addition. Historically, the ASL composition of the subsistence harvest was estimated from commercial catch samples (e.g. Huttunen 1986). Until 1985, this practice was reasonable, because the gear used for subsistence harvest was likely the same as the gear used during “unrestricted gear” commercial fishing periods, which is when most of the commercial chinook salmon harvest occurred. After 1985, when the commercial fishery was restricted to mesh sizes of six-inch or less, ADF&G staff sometimes sampled subsistence caught chinook salmon (e.g., Anderson 1991), but sex and length of the fish was typically unknown because collections were often limited to removing scales from fish that were already partially processed. In these instances, the sex composition of the subsistence harvest was based on samples collected from the restricted gear commercial fishery, which was likely not reflective of the actual sex composition of the subsistence harvest (Molyneaux and Samuelson 1992, DuBois and Molyneaux 2000). In some post-1985 years, the ASL composition of the subsistence harvest was estimated entirely from fish caught commercially with gillnets of six-inch or less mesh size (e.g., Anderson 1995), which was also likely not reflective of the actual ASL composition (Molyneaux and Samuelson 1992).

Modest efforts to collect complete ASL data from subsistence caught chinook salmon occurred in 1993, 1994, and 1995 as a pilot project that included enlistment of subsistence fishers and their families to collect the information (DuBois and Molyneaux 2000). The initiative was discontinued due to a lack of resources to execute the program. The program was re-established, and expanded, in 2001 through resources provided by the USFWS Office of Subsistence Management (OSM) in coordination with Commercial Fisheries Division of ADF&G and various Tribal organizations (DuBois et al. 2002). This report presents findings from the third year of this OSM sponsored program. The objective is to estimate the ASL composition of the annual Kuskokwim River chinook salmon subsistence harvest.

Background

Subsistence fishing for chinook salmon, as well as other species, occurs throughout the 700-mile length of the Kuskokwim River, and in many of the tributary streams. Fishing begins in the lower river in late May and extends through mid-July in the upper river. Salmon may be harvested by gillnet, beach seine, rod and reel, fish wheel, or spear (AAC 01.270, ADF&G 2002). The aggregate length of set or drift gillnets cannot exceed 50 fathoms. Any mesh size may be used but, gillnets with less than six-inch mesh must be less than 45 meshes deep and nets with greater than six-inch mesh may not exceed 35 meshes in depth. Rod and reel gear was recognized as a legal subsistence gear in the lower Kuskokwim River in 2000 (Ward et al. 2003), and then was adopted for the entire Kuskokwim River in 2001.

Annual subsistence harvest of salmon is estimated from harvest information collected during post-season surveys (Ward et al 2003). ADF&G Commercial Fisheries Division began the post-season surveys in 1960, and then the duty was transferred to Subsistence Division in 1988. Generally, subsistence harvest is estimated from house-to-house surveys, returned postcards and calendars, as is described in the annual management report. Village totals are estimated when survey data are expanded to include those not surveyed. Village totals are summed for area and drainage-wide totals. Gear types used for subsistence salmon harvest have been reported since 1996, but details about mesh size are only available for 1967 (ADF&G 1968) and 1994 (Francisco et al. 1995).

Most subsistence chinook salmon harvest occurs in the lower Kuskokwim River, especially the Bethel Area (Ward et al 2003). In 2003, fishers in the lower Kuskokwim River accounted for 89%[3] of the total Kuskokwim River chinook salmon subsistence harvest; with Bethel households accounting for 32% of the total river harvest. In contrast, fishers in the middle and upper Kuskokwim River accounted for about 8% and 3% of the harvest.

Commercial fishing is mostly limited to a 140-mile span of the lower Kuskokwim River, District 1 (Figure 1). The geographic range of the commercial fishery is constricted to this area because of market preferences. Directed commercial fisheries on Kuskokwim River chinook salmon have not been allowed since 1987 (Ward et al. 2003).

The Alaska Board of Fisheries recognized Kuskokwim River chinook salmon as a "yield concern" in October of 2000 (Burkey et al. 2000). Escapement goals were generally not achieved in 1998, 1999 and 2000 despite little commercial fishing effort and an annual fishing schedule imposed on subsistence fishers beginning in 2000. Escapements improved in 2001 and 2002 (Ward et al. 2003) and were even greater at most locations in 2003. Currently the Kuskokwim River is being managed under a rebuilding plan for chinook, as well as chum salmon as described in 5AAC 07.365 (ADF&G 2002).

Part of the rebuilding plan establishes a subsistence fishing schedule in June and July, in which subsistence fishing with gillnets and fish wheels is limited to a window of four consecutive days each week (AAC 07.365, ADF&G 2002). The schedule can be modified or discontinued

[3] Includes communities along the north end of Kuskokwim Bay.

depending on the fishery manager's assessment of the adequacy of salmon abundance to achieve escapement and subsistence needs. The intent of the fishing schedule, as presented to the Alaska Board of Fisheries in 2001, was to reduce subsistence fishing time early in the run to help ensure that subsistence harvests do not impair meeting escapement needs or "reasonable opportunity for all subsistence users" (Burkey et al. 2000). The objective states: "Reduce subsistence harvest early in the season when there is a much higher level of uncertainty in projecting total run abundance and spread subsistence fishing opportunity among users". In addition, there was discussion, and general agreement, among staff and board members that another benefit of the subsistence-fishing schedule would be to increase the number of female chinook and larger chinook salmon passing upstream of the lower Kuskokwim, including the spawning grounds.

Study Area

The study area partitions villages and associated fish camps into three reporting areas corresponding to historically reported data: the lower Kuskokwim River; which ranges from near the mouth to Tuluksak (river mile (rm) 136); the middle Kuskokwim River which ranges from just below Lower Kalskag (rm 188), to Chuathbaluk (rm 233), and the upper Kuskokwim River which includes all villages upstream of Chuathbaluk (Figure 1). Subsistence survey data from the river when divided into these three segments shows differing proportions in gear type usage (Table 1). Drift gillnets are most prominent in the lower river, although many fishers do use set gillnets early in the season when the density of fish is lower. Drift gillnets and rod and reel gear are popular in the middle river were there is a paucity of adequate setnet sites. In the upper river, set gillnets, drift gillnets, and rod and reel gear are used in more even proportions. From discussions with members of the KRSMWG and subsistence fishers in general gillnet mesh size usage to capture chinook salmon also differs along the river in that more fishers use eight-inch or larger mesh gillnets in the lower river than the middle and upper areas.

The lower Kuskokwim River reporting area is further partitioned into two sub-areas for clarifying responsibilities between Orutsararmiut Native Council (ONC) and ADF&G. ONC coordinated sampling in the Bethel sub-area, which ranged from Napaskiak (rm 71) to the mouth of the Gweek River (rm 90). ADF&G coordinated sampling in the second sub-area, which consisted of all villages and fish camps of the lower Kuskokwim River that were outside of the Bethel sub-area (Figure 2). Kuskokwim Native Association (KNA) was responsible for sampling in the middle Kuskokwim River reporting area and McGrath Native Village Council (MNVC) focused on the upper Kuskokwim River reporting area.

Objectives

The United States Fish and Wildlife Service (USFWS) Office of Subsistence Management (OSM) approved three projects in 2003, each of which included funding for the collection of ASL data from chinook salmon in the Kuskokwim River subsistence fishery. Project FIS 01-023 *Upper Kuskokwim River Inseason Subsistence Salmon Harvest Data Collection* had as its third objective:

Estimate age, sex, and size composition of chinook salmon harvested in the upper Kuskokwim River subsistence fishery.

Project FIS 01-132 *Bethel Area Inseason Subsistence Salmon Harvest Data Collection* had as its third objective:

Estimate age, sex, and size composition of chinook salmon harvested in the lower Kuskokwim River subsistence fishery.

Project FIS 01-225 *Middle Kuskokwim River Inseason Subsistence Salmon Harvest Data Collection* had as its third objective:

Estimate age, sex, and size composition of chinook salmon harvested in the middle Kuskokwim River subsistence fishery.

Other objectives for these three FIS projects involve inseason collection and reporting of subsistence harvest data and local participation at the Takotna River weir. Data collected in fulfillment of these objectives will be reported separately by McNeil et al. (*In Press*) and Gilk and Molyneaux (2004).

METHODS

Sample Collection

Most chinook salmon ASL information collected through this program was gathered by non-agency participants that included subsistence fishers, subsistence household members, or other community members who sampled fish caught near their local communities or fish camps. Participants were trained in sampling technique by technicians and biologists from the coordinating agencies of AD&FG, ONC, KNA or MNVC. Participants collected samples from their own catch and or the catches of others. Sample limits (number of fish samples) were not placed on individual participants though participants were selected as being willing to sample all season, sample all fish during each event, and were encouraged to sample other fish camps.

Prior to working with participants, technicians from ONC, KNA and MNVC attended training conducted by ADF&G staff in Bethel to review or learn standard ASL sampling procedures. In the days following the training, coordinating agency representatives identified and contacted prospective participants through referrals from village organizations or selected contacts. Persons interested in participating in the sampling program were trained to collect ASL data following ADF&G protocols, modified slightly from those used by ADF&G. Each sampler (participant) was provided with a sampling kit that included a meter stick, gum cards, wax paper inserts, forceps, data forms, pencils, and a clipboard with attached sampling instructions. The sampling form was a simplified modification of the mark-sense form typically used by ADF&G (Appendix A). Information collected from each fish included three scales for age determination, sex, length, gear type, mesh size, date and location of capture, and sampling participant's name. Staff from one of the coordinating agencies conducted follow-up visits to the participants to gather completed samples and to review the information for accuracy. The information was then delivered to the ADF&G for processing. Participants were paid for the information they collected, with payment arranged through the respective coordinating agency for the location where the samples were collected, or the community the person was resident.

Sample Design

The objective of this study was to characterize the age, sex, and length of the Kuskokwim River chinook salmon subsistence harvest. Though subsistence harvest estimates represent the season total, fishing for chinook salmon begins in the lower river in late May and extends through mid July in the upper river. Effort and harvest success may vary by week and is unknown. Harvest by gear type is also unknown. We collected as many ASL samples as possible throughout the months of May, June, and July to most accurately reflect what is occurring in the fishery. We are conducting what Geiger et al. (1990) termed a "grab sample" in that we lacked the guarantee that each chinook salmon in the harvest had an equal chance of selection (random sample) or that every i^{th} fish would be sampled (systematic sample). Gathering of an ASL sample would be very opportunistic and would be tied to availability in time and area of fish and samplers. We assumed that large sample sizes collected in the "grab" sample nature (opportunistic) would represent the harvest by gear and through time. If sampling participants expend effort (sampling their own and or looking for the catches of others) in an attempt to collect many samples then the assumption would be that when many fish are available (harvested) many samples would be collected and therefore be self-weighting by gear and area over the time period and in the area samplers are working. In summary it was hoped that if samplers look for chinook salmon to sample every day during a weekly subsistence period (i.e. consistent searching effort) more samples will be collected on days that more fish are harvested. This would more likely be true of community and household participants that sample fishers outside or in addition to their own household. This assumption is necessary if samples pooled through time are thought to be representative of the post-season harvest estimate.

The grab sample design (Geiger et al. 1990) was used to sample the Kuskokwim River subsistence chinook fishery during 2003. We collected as many samples as possible from each reporting area, with no intentional focus on gear type when recruiting participants. All samplers that were interested were encouraged to participate. The tentative sample goals (needed to purchase equipment and develop budgets) were 3,000 from the lower Kuskokwim River (2,000 by ONC and 1,000 by ADF&G), 750 from the middle Kuskokwim River and 300 from the upper Kuskokwim River. Postseason, samples from each reporting area were to be used to apportion the harvest estimate from that area by age and sex. Large samples for any reporting area would also allow us to post-stratify by time and gear.

For future consideration is the possibility that most variation in these ASL samples is among fishers and not individual chinook salmon. If that is the case we would consider optimizing the number of fishers to sample. That analysis is outside the scope of the project for 2003 but should be considered in the future. A look at components of variation may give some insight into sampling. Analysis like this may allow us to focus our sampling more efficiently.

Sampling Procedures

Sampling methods followed routine procedures outlined by ADF&G protocols (DuBois and Molyneaux 2000). Three scales were removed from the preferred area of each chinook salmon and mounted on gum cards (INPFC 1963). The clipboard provided to each participant included a laminated instruction sheet that illustrated the sampling procedure (Appendix B). Participants were instructed to determine the sex of each fish by cutting the fish and inspecting internally for gonads. Length was measured to the nearest millimeter from mid-eye to the fork-of-the-tail using a meter stick to provide a straight-line measurement. The participants recorded their name, scale card number, date of harvest, location of harvest, gear type, and mesh size if applicable, on a write-in-rain data form along with the sex and length information of each fish (Appendix A).

Age Determination

Age is determined from the annuli of scales taken from the preferred area of the fish (INPFC 1963). The scales, which are mounted on gum cards, are impressed in cellulose acetate using methods described by Clutter and Whitesel (1956). The scale impressions are magnified with a microfiche reader and age is determined through visual identification of annuli. Ages are directly entered into the computer ASCII files using European notation[4].

Data Processing, Analysis, and Reporting

ASL data collected from the Kuskokwim River subsistence chinook harvest were entered into a Juniper[5] field data recorder or directly into a computer ASCII file. The ASCII files were processed through a number of programs and compiled to produce age-sex and length summary tables. The age-sex table describes the age and sex composition for each stratum as a percentage based on the stratum sample. The length table for each stratum includes statistics on mean length and the range of lengths in each age-sex category.

Chinook salmon ASL data were stratified into three reporting areas: lower, middle and upper river as defined in our study area description. Samples from drift and set gillnets were pooled within each reporting area. In order to investigate differences in ASL composition among mesh sizes, lower and middle river data were further stratified by three gillnet mesh size ranges: (1) 6-

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[4] In European notation two digits are separated by a decimal and refer to the number of freshwater and marine annuli respectively. The first digit represents the freshwater age minus one. The second digit represents the number of annuli formed during the marine residency. Total age from brood year is the sum of the two ages plus one.

[5] The use of trade names intends only to document the methods used and does not constitute an endorsement by ADF&G.

inch or less, (2) greater than 6 inches but less than 8 inches, and (3) 8-inch or greater. Sufficient samples were collected from 8-inch and greater gillnets for the lower and middle Kuskokwim reporting areas to divide ASL data into temporal strata based on the weekly subsistence-fishing schedule in order to investigate differences in ASL composition through time.

Data corresponding to each area, gear, or time stratum were summarized for age, sex, and length composition. The percent by age and sex was calculated for each stratum sample, as was a mean length by age and sex. Data were then pooled across time strata for mesh sizes larger than 8 inches and summarized for ASL composition. Next data were pooled across gear types and summarized for ASL composition representative of each reporting area. ASL data were pooled to represent each reporting area to correspond with the way subsistence harvest data are collected. The post-season subsistence harvest survey estimates catch by area and lacks catch by time period or by gear type or gillnet mesh size.

The percent by age and sex calculated from all data pooled for a reporting area (lower, middle, and upper Kuskokwim River) was multiplied by the estimated subsistence harvest from the respective reporting area (Appendix C) to obtain the number of chinook salmon estimated to be that age and sex (for example age 1.2 males for the lower Kuskokwim River). Numbers of chinook salmon by age and sex were then summed across reporting areas to represent the total number of chinook salmon harvested in the Kuskokwim River of that age and sex. The total harvest of each age and sex combination was then use to estimate the proportion of the total by sex and age (in example for an estimate of percent females in the total subsistence harvest).

RESULTS

Sample Size and Gear Types

Thirty-seven participants collected 2,360 ASL samples in 2003 from chinook salmon harvested near nine Kuskokwim River communities (Table 2). The number of participants represents a minimum number of harvests sampled as most participants sampled catches in addition to their own. The lower river reporting area accounted for 84% of the samples followed by the middle (11%) river and few samples from the upper river area (5%). Age was determined for 2,035 of the fish sampled, which was 3% of the estimated 67,788 chinook salmon harvested in the 2003 Kuskokwim subsistence fishery (Appendix C). Samples from drift and set gillnets were pooled by mesh size category for estimates of age and length composition. All samples collected throughout the reporting areas were from gillnet caught chinook salmon except four samples from rod and reel catches of which only one was aged.

Thirty-two participants collected 1,974 ASL samples in 2003 from the chinook salmon harvest near the lower Kuskokwim River communities of Eek, Tuntutuliak, Napakiak, Bethel, and Akiachak (Table 2). Chinook salmon caught near Bethel accounted for 68% of the samples. All but 4 samples were from gillnet caught chinook salmon and 84% were caught by gillnets with mesh size 8 inches or greater. The gillnets included 12 mesh sizes (5-, 5¼-, 5⅜-, 5½-, 6-, 7-, 7½-, 7⅞-, 8-, 8⅛-, 8¼-, and 8½-inch mesh).

Two participants collected 269 ASL samples in 2003 from the chinook salmon harvest near the middle Kuskokwim River communities of Aniak and Chuathbaluk (Table 2). All chinook salmon sampled in the middle Kuskokwim River were caught in either drift of set gillnets (Table 2). The gillnets included two mesh sizes (6- and 8-inch mesh). Nets with 8-inch mesh accounted for 80% of the samples.

Three participants collected 117 ASL samples in 2003 from chinook salmon harvest near the upper Kuskokwim River communities of Nikolai and McGrath (Table 2). The chinook salmon were caught with gillnets hung with 8¼-inch mesh and 4-inch mesh. Nets with 4-inch mesh accounted for 85% of the samples.

ASL Composition

The ASL composition of chinook salmon varied by reporting area (lower, middle, and upper river) and by the harvest method. Participants reported that sex determination for all chinook salmon samples was verified by cutting the fish and looking for eggs.

Lower Kuskokwim River

Age composition, pooled across all gear types sampled from the lower Kuskokwim River, was 43.7 age-1.3 fish, 42.8% age-1.4 fish, 7.0% age-1.2 fish, and 6.3% age-1.5 fish (Table 3). The prevalence of age-1.4 chinook salmon increased with increasing mesh size: 22.8% SE=3.8 (6-inch or less), 37.9% SE=4.5 (6½- to 7⅞-inch) and 44.8% SE=1.3 (8-inch and greater). Age-1.3 chinook salmon comprised varying percentages between mesh sizes but the percentages did not increase with increasing mesh size (32% SE=4.2 in 6-inch or less, 52.6% SE=4.7 in 6½- to 7⅞-inch, and 43.5% SE=1.3 in 8-inch and greater). Age-1.2 fish occurred most frequently in the 6-inch or smaller mesh size, where they accounted for 33.3% (SE=5.8) of the samples.

Sex composition of aged samples pooled across all gear types was 38.2% female. The composition by gillnet mesh size category was: 30.1% female for mesh of 6-inch or less, 34.5% for 6½- to 7⅞-inch mesh, and 39.2% for mesh of 8-inch or larger (Table 3). The percent female by age ranged from 5.9% of age 1.2 and 21.5% of age 1.3 to 57.7% of age 1.4 and 57.9% of age 1.5 chinook salmon, as viewed across all gear types.

Length composition of aged samples from the lower Kuskokwim River varied by sex and gear type (Table 4). Overall, females tended to be larger at age than males except for the youngest age 1.2 chinook salmon, which were nearly all male. Generally, mean length at age also increased with an increase in mesh size of the capture gear but was a more consistent pattern for males than females.

Middle Kuskokwim River

The age composition of chinook salmon from samples pooled across all gear types sampled from the middle Kuskokwim River, was 42.4% age-1.3 fish, 39.6% age-1.4 fish, 11% age-1.5 fish, and 6.9% age-1.2 fish (Table 5). Age 1.4-fish and age 1.3-fish were most prevalent in gillnets with 8-inch mesh, where they accounted for 41.6% (SE=3.6) and 41.1% (SE=3.5) of the samples. Age-1.3 fish occurred most frequently in gillnets of 6-inch mesh size, where they accounted for 47.9% (SE=7.2) of the samples.

Sex composition of aged samples pooled across all gear types was 35.1% female. The sex composition by gillnet mesh size was: 29.2% female for gillnets with 6-inch mesh and 36.5% for 8-inch mesh (Table 5). The percent female also increased with age from 0% at age 1.2, 16.3% (SE=3.6) at age 1.3 to 50.5% (SE=5.1) at age 1.4 and 74.1% (SE=8.4) at age 1.5, as viewed across all gear types.

Length composition of aged samples from the middle Kuskokwim River also varied by sex and gear type (Table 6). Overall, female chinook salmon tended to be larger at age than males. The mean length of chinook salmon was also larger from samples taken from the 8-inch mesh gillnets compared to the 6-inch mesh.

Upper Kuskokwim River

Age composition of chinook salmon, pooled across all gear types sampled from the upper Kuskokwim River, was 58.9% age-1.3 fish, 36.7% age-1.4 fish, 3.3% age-1.5 fish, and 1.1% age-1.2 fish (Table 7). Sex composition of aged samples pooled across all gear types was 26.7% female, though most samples were from 4-inch mesh, which was 24.7% female chinook salmon. Length composition of aged samples from the upper Kuskokwim River showed a similar pattern as did samples from the middle and lower river, with females tending to be larger at age than males (Table 8). Few fish, however, were sampled from large mesh gillnets and comparisons with samples from 4-inch mesh cannot be made.

Temporal Stratification

Sufficient samples were collected from subsistence harvests with gillnets of 8-inch and larger mesh size in the lower and middle Kuskokwim River to investigate temporal patterns in the ASL composition. Data were stratified around weekly subsistence periods beginning on June 4th, though sampling occurred prior to that for the lower Kuskokwim reporting area. Each area was divided into four temporal strata: 25 through 31 May, 4 through 7 June, 11 through 14 June, 18 through 21 June, 25 through 28 June, and 3 through 7 July in the lower Kuskokwim and 4 through 7 June, 11 through 14 June, and 18 through 21 June for the middle area. Days between these weekly strata were closed to subsistence fishing by gillnets.

The age composition varied some among weekly strata for the lower Kuskokwim (Table 3) especially noted in the first and last time strata. The youngest age-1.2 fish were most prevalent in July, while the oldest age 1.5 chinook salmon represented the largest proportion of the sample (17.1%) in May. Any pattern of changing composition over time by age-sex category (Table 3) or mean length by age-sex category (Table 4) was less apparent in June. Unfortunately for these comparisons few samples were collected to represent the week of May 25 (41) or July 3 (28).

For the middle Kuskokwim area the percentage of age-1.4 fish tended to decrease over time from 55.6% (SE=8.3) to 35.4%, (SE=4.2) while the percentage of age-1.2 fish increased over time from 0.0% to 9.4% (SE=2.6) (Table 5). The percentage of female chinook salmon also decreased over time from 52.8% (SE=8.3) to 29.9% (SE=4.1). Average length of sampled chinook salmon did not trend over time (Table 6). Sample sizes for the first two strata were small (36 and 34 aged chinook salmon).

Subsistence Harvest ASL Composition

The total estimated subsistence harvest of Kuskokwim River chinook salmon in 2003 was 67,788 (T. Krauthoefer, ADF&G, personal communication; Appendix C). Harvests from the lower, middle and upper river were apportioned to age and sex using the ASL composition of samples pooled by gear for that reporting area (bottom row of Tables 3, 5, 7). Numbers of fish by age and sex were then summed across areas to represent the total by age and sex (Table 9). The 2003 chinook harvest included 29,962 age-1.3 fish (44.2%), 28,539 age-1.4 fish (42.1%), and 4,542 age-1.2 and age-1.5 fish (6.7%). Estimated sex composition was 42,330 males (62.4%) and 25,458 females (37.6%). Eighty-eight percent of the harvest was taken in the lower river, including 22,875 female chinook salmon. In contrast only 2,285 chinook salmon were estimated to be harvested in the upper river, of which only 610 were female.

A summary of findings from the 2003 sampling program was distributed to participants and interested groups in March 2003 (Appendix D). Generalizations on mesh sizes used and ASL composition were presented in graphical and text format. Information also included acknowledgment of funding groups and the participating agencies.

DISCUSSION

Total Kuskokwim River Subsistence Harvest

Several assumptions underlie our estimate of the ASL composition of the chinook salmon harvest from the Kuskokwim River. Their fulfillment, or lack thereof, affects the accuracy of our estimates and conclusions we draw from ASL patterns observed across time, area, and gear. The actual harvest by gear type of chinook salmon is unknown. Also unknown is the harvest by weekly fishing period. We assume that our samples are representative of the harvest by gear type and are in proportion to abundance through time such that pooled samples by reporting area across time represent the true ASL composition of the season total harvest for that reporting area (lower, middle, upper). To varying degrees, like assumptions apply to escapement and commercial catch sampling programs.

During the postseason subsistence harvest surveys, fishers are asked the type of gear they use to harvest salmon (Table 1). These estimates of gear usage are not specific for chinook salmon nor is the mesh size for gillnets reported. Most likely chinook salmon are targeted by all the major gear groupings. For example, fish wheels are not an efficient gear for chinook salmon, but very few fish wheels are used, and none were reported used in 2003. It is also unknown what percent of the harvest is taken by each gear type. For example, 20% of the households report using rod and reel gear to harvest subsistence salmon, but it is likely that much less than 20% of the chinook salmon are harvested with that gear given its efficiency compared to gillnets. Eighty percent of the households use gillnets, and it is likely that even a greater percent of the harvest is taken with that gear.

The sample collection in 2003 was entirely composed of gillnet caught chinook salmon (only one aged sample from rod and reel). This is higher than the postseason gear estimates. Obvious omissions include the 16% of fishers reported to have used rod and reels in the lower river (Table 1) and the 28% in the middle river. It is likely that far less than 16% or 28% of the chinook harvest was caught with rod and reel in the lower and middle river. Rather it is likely and most confidently for the lower river that our mixture of gear and mesh sizes sampled is representative of those used this season. In question is the small sample of upper Kuskokwim River chinook salmon of which 90% of the aged scales (Table 7) were from 4-inch mesh gillnets.

We also think an adequate job was done characterizing the harvest through time. If there are changes in ASL composition through time, then samples need to be representative of abundance in order to be pooled and accurately represent a season total. Sampling occurred throughout the chinook salmon run in 2003, especially in the lower river, though most samples came from the second week in June rather than early June when historic catch calendar analysis indicates that most of the harvest occurs. This could be an artifact of the timeliness of when sampling kits are distributed to subsistence fishers. This potential bias should be addressed by the coordinating agencies through distributing sampling kits to participants prior to the fishing season. This aspect is being addressed at least in part through the development of a pool of samplers that return each year to participate in the program.

Overall the chinook harvest in 2003 (67,788) was similar to 2002 (66,807) and was less than the harvest in 2001 (73,610). The age compositions of the 2003 harvest differed from other years in that more age-1.3 fish were harvested (44.2% versus 33.3% and 29.9% in 2002 and 2001) and fewer age-1.4 fish (42.1% versus 53.7% in 2002 and 60.6% in 2001). We feel this was due to the strength of the age-1.3 year class component of the run in 2003 rather than selective properties of the gear. The sex composition estimate (37.6% female) was within the range seen in 2002 (40.7%) and 2001 (35.4%).

In 2003, 96% of the sampled age-1.2 chinook salmon were reported to be male, which was unlike 2002 when the proportion of females was thought to be biased high (Molyneaux et al.

2004) due to erroneous sex determination,. This is still somewhat higher than was found in sex confirmed fish sampled by ADF&G where less than 1% of the aged-1.2 chinook salmon were female (DuBois and Molyneaux 2000). The ADF&G samples consisted of 789 chinook salmon from the Kuskokwim River commercial fishery in 1997, 1998, and 1999. The 2001 subsistence samples (DuBois et. al 2002) had an incidence of female age-1.2 chinook salmon more comparable to that found in the ADF&G sex-confirmed fish.

Correct sex determination has been a challenge in other salmon ASL data sets (e.g., Linderman et al. 2003, DuBois and Molyneaux 2000). The subsistence ASL sampling program sought to address this challenge by directing participants to confirm the sex by cutting the belly of the fish, then inspecting internally for the presence of eggs. In 2002 it was suspected that all participants may not have diligently followed the directive, but compliance is thought to have improved markedly in 2003 due to field staff from the coordinating organizations stressing the need for sex confirmation to participants. This education effort should be continued in order to insure sustained compliance and data accuracy.

Part of the intent in estimating the ASL composition of the subsistence harvest is to allow development of a reconstruction of the total chinook salmon run to the Kuskokwim River, which in time could be used to develop brood tables for determining overall chinook salmon productivity. Apportioning the subsistence harvest by the ASL composition is one of three components in achieving this goal. The second component is apportioning the commercial harvest by the ASL composition, which has not been an issue for the past few years due to the stock of concern finding. The third component is estimating the total escapement ASL composition. The third goal has not yet been achieved, however, progress has been made through the operation of the mainstem radio telemetry project in combination with marked to unmarked ratios recorded at the array of weir projects where chinook escapement and ASL information are collected (e.g., Stuby 2003).

Comparison of Subsistence and Escapement ASL Compositions

Age composition of chinook salmon in the subsistence harvest differed from that observed in the escapement (Table 10 and Figure 3) in 2003. As in 2002 the most notable difference is that male age-1.2 chinook salmon comprised 6.4% of the subsistence harvest, but 22.7% of the escapement as averaged across four of the six monitored tributary escapement projects[6]. Estimates at escapement projects ranged from 8.2% to 33.4%, and are all above the 6.4% observed in the subsistence fishery. Furthermore age-1.4 and -1.5 chinook salmon, combined, were 48.8% of the subsistence harvest, but averaged 35.5% of the escapement (Table 10, Figure 3). The proportion of age-1.3 fish in the subsistence harvest, however, was similar to the escapement average (44.2% versus 41.7%).

The subsistence harvest included a percentage of female chinook salmon (37.6%) that was also similar to the escapement average of 31.5%; Table 10. Furthermore, the 37.6% female observed

[6] Samples from the George River and Tatlawiksuk River weirs were omitted. Samples were not collected throughout the duration of the run and were too few to characterize the 2003 escapement.

in the subsistence fishery was within the range of percentages observed at the six escapement projects (18.3% to 45.9%).

Average length, by age-sex category, of chinook salmon sampled from the subsistence harvest was well within the range of average lengths observed in the six escapement projects (Table 10 and Figure 3). Mean length at age was nearly identical for most ages.

The difference in the age composition of chinook salmon in the subsistence harvest and in the escapement is attributed to the selectivity of gillnets hung with 8-inch and greater mesh sizes, which are the most prominent gear type used in the subsistence harvest of Kuskokwim River chinook salmon and represented 80% of the samples. The selectivity of these nets, by default, reduces the number of older aged fish and females in the escapement, and increases the percentage of predominantly male age-1.2 fish on the spawning grounds (ADF&G 1981). This becomes a significant factor as exploitation increases.

Two implications come to mind as to the significance of this imbalance. First is that the resulting escapements have reduced egg laying potential due to the reduction of females, and especially the reduction of the larger more fecund females (ADF&G 1981, Ricker 1980). This also brings into question the utility of escapement goals that do not take into account sex composition and the egg laying potential of annual escapements. In the Tuluksak River, for example, the proportion of female chinook salmon has been reported as low as 14% (Harper 1995).

The second implication harkens to a question posed by Nickie Mellick, a recently deceased Kuskokwim River elder, who asked, “Why don’t we see the abundance of large chinook salmon like we once did?”. The answer may be that we are fishing them out. Age at maturity in chinook salmon is known to have a heritable component (Hankin et al. 1993). Large mesh gillnets act as a directional evolutionary force on a chinook salmon population, whereby the introduction of a relatively new environmental influence results in a discrete segment of the populations having a lower breeding success than the rest of the population. Experimental selective harvest of large individuals from fish populations has been found to reduce the average body size at age over successive generations (Conover and Munch 2002); moreover, there are numerous examples where size selective harvest is believed to have resulted in reduced average body size at age and average age of maturity in various salmon populations over timescales of 20 years or more (e.g., Ricker 1980, ADF&G 1981, Thorpe 1993, Bigler et al. 1996).

Modeling experiments using available genetic data show that modest shifts in chinook salmon average size at age can occur in responses to directional selection (Hard 2004). The degree of reduction depends on harvest rate, the harvest size threshold, and the strength of stabilizing natural selection on size. Detectable change, however, could occur in as few as three generations if the selectivity is intense, or may require many dozens of generations if the selectivity is less intense or somehow mitigated.

Thorpe (1993), also, cautions that the social and economic pressures of fishery management must balance with the realization that the stock structure of salmonid populations is adaptive. There is evidence that discontinuing the use of large mesh gillnets may result in a return of the larger and older chinook salmon (John H. Clark, ADF&G personal communication), but suggesting the discontinuation of large mesh gillnets in the Kuskokwim River subsistence fishery would be met with strong public disfavor. Even discontinuing harvest, however, does not guarantee selection back to the original state (Conover and Munch 2002).

According to Conover and Munch (2002), long-term sustainable yield requires management practices to incorporate tools that preserve natural genetic variation, such as the use of harvest methods that mirror genetic variation. This strategy was also discussed by ADF&G (1981) in considering the required use of smaller mesh gillnets, but such an action would again meet with considerable social resistance in the Kuskokwim Area, create a concern for "dropouts," and result in an increased harvest of non-target species such as chum salmon.

Another alternative is that management programs incorporate "disruptive selection" practices as described by Hard (2004). Such practices can substantially reduce the strength of selection on size if a sufficient proportion of large fish escape the fishing related mortality. A form of disruptive selection is currently practiced in the Kuskokwim River through the subsistence fishing schedule instituted in 2001 (Burkey et al. 2000). The evolutionary significance of the schedule was not part of the original argument for its implementation, but continued use of the schedule may be a prudent long-term management strategy considering the findings described by Hard (2004).

Influence of the Subsistence Fishing Schedule

Part of the intent of the subsistence fishing schedule, as discussed during deliberations at the January 2001 BOF meeting, was to increase the number of larger (i.e., older aged) chinook salmon in the escapement and to increase the number of female chinook salmon in the escapement. This was thought to occur as chinook salmon passed upriver during closed periods immune from the selective removal of large mesh gillnets. Assessment of the effectiveness of the schedule to achieve these goals requires a comparison of two different sets of subsistence and escapement ASL data: one set collected when the subsistence fishing schedule is in effect, and another when the schedule is not in effect. The relative difference between the subsistence and escapement ASL compositions, with and without the fishing schedule, should provide insight into the effectiveness of the schedule at achieving the intended goals. Furthermore, this will need to occur over a number of years as differences between the harvests under the two management regimes will be confounded with the underlying differences in brood year strength in chinook salmon for those years.

The schedule was in effect since 2001, so the chinook salmon ASL data collected these years, does not yet resolve the issue of whether the goals of the schedule are being achieved. Furthermore, the 2001 data are incomplete because of the lack of middle and upper river subsistence samples (DuBois et al. 2002). These three years of data do, however, begin to provide the first set of data needed to address the issue.

Collecting the second set of ASL data (i.e., samples without the influence of the subsistence fishing schedule), could be obtained either by instituting an adaptive management approach, in which the fishing schedule would be discontinued for a number of years while a comparable set of ASL data is collected, or by waiting until circumstance change such that the subsistence fishing schedule is not invoked.

Selective Removal of Large Chinook Salmon by Area of Harvest

Approximately eighty percent of the annual subsistence harvest of chinook salmon occurs in the lower Kuskokwim River (Ward et al. 2003). Most of this harvest likely occurs with gillnets hung with 8-inch or larger mesh sizes (ADF&G 1968 and Francisco et al. 1995; Table 2) which are selective for larger chinook salmon, and particularly female chinook salmon because they tend to return larger at age than males (ADF&G 1981 and DuBois and Molyneaux 2000). A likely consequence of this selective harvest practice is that larger chinook salmon, particularly females, would be progressively removed from the run as the fish migrate upstream. This would be discernable only if exploitation was fairly high.

Small sample sizes from the upper and middle Kuskokwim River areas and differences in the mesh sizes sampled among all reporting areas makes detection of any selective removal of large chinook salmon by area of harvest impossible. Age-1.3 fish dominate the 6-inch and less category of the upper Kuskokwim River reporting area (Figure 4), and declined in incidence in the middle and lower river areas. Yet upper river samples were collected by 4-inch mesh gillnets while all middle river samples were from 6-inch mesh samples and lower river samples were all from larger than 5-inch mesh gillnets and 49% of the lower river sample was from 6-in mesh. Differences among reporting areas could be due solely to the mesh sizes sampled as smaller mesh sizes select for smaller and younger chinook salmon. Alternatively, the age composition differences could be due in part to more large fish being available for capture in the lower river. The upper river sample from 8-inch mesh (9 fish, Table 7) is too small to compare across areas of 8-inch and larger category, or to all gear types pooled. The age composition is similar among 8-inch samples from the lower and upper river areas as is the percent female (Figure 5). Furthermore, the average length by age and sex showed the same pattern among reporting areas with females being slightly larger at age (Figure 6).

This lack of findings may be confounded for at least two additional reasons. First, the mixture of gear types used to harvest fish may be different between the upper, middle and lower Kuskokwim River reporting areas, as suggested by the distribution of gear types from which samples were collected in 2003 (Table 2). The small samples sizes and more limited number of participants, from the middle and upper Kuskokwim River may also skew the findings. It also may be the case that exploitation is not great enough to produce discernable selective results. Removals in the lower river should also have caused differences in middle river samples; yet large mesh gear caught nearly identical percents by age and sex in the middle and upper river. The lack of discernable differences between the lower and middle river samples may be more an artifact of limitations in the study design, than to any basis in reality. Very few fish are removed in the middle river to add to the differences seen in the upper river.

Specific information on the gear type with which fish are harvested is not typically reported in the Kuskokwim River subsistence fishery. Only results from specific gear surveys in 1994 (Francisco et al. 1995) and 1967 (ADF&G 1968) are available for comparison to the percent composition of gears from which our samples came. Similar to the percent using large mesh gear in 1976, 80% of our samples came from large mesh gillnets (Table 2). Members of the Kuskokwim River Salmon Management Working Group have also noted that most fishers in the lower Kuskokwim River currently use large mesh gear to catch chinook salmon, in comparison to the far fewer subsistence fishers using large mesh gear in the middle and upper river. The agrees with conservations we have had with subsistence users along the river.

Temporal Stratification

When viewed from a given point along the migratory route, the ASL composition of salmon populations sometimes change as the run progresses through time (DuBois and Molyneaux 2000). The chinook salmon harvest from the Kuskokwim River was investigated for such patterns by stratifying samples by specific harvest dates. Only the lower and middle Kuskokwim River catch with gillnets of 8-inch or greater mesh size had sufficient numbers of fish samples to stratify (Figures 7 and 8). The ASL composition for chinook salmon harvested in the lower Kuskokwim River (Figure 7) varied by time period, but lacked a consistent trend. In the middle Kuskokwim River, however, the percentage of age-1.4 fish decreased over time from 55.6% to 35.4% (Figure 8). There was a concurrent increase in age-1.2 fish from 0% to 9.4%. The percentage of female chinook salmon also decreased over time in the middle Kuskokwim River, from 52.8% to 29.9%. The changes observed in the middle Kuskokwim River, relative to the uniform pattern seen in the lower Kuskokwim River, might be the result of selective downstream harvest patterns. Any conclusion should be considered with caution due to the small sample sizes, particularly when dividing temporal strata into age-sex categories. We also note that some chinook stocks (notably; Eek, Kwethluk, Kisaralik, and Tuluksak Rivers) are present only in the lower river fishery, which may further confound our ability to discern patterns.

Adequacy of Sample Sizes and Participation

Determining an adequate sample design for this project is a daunting challenge. Ideally sampling would be in proportion to the harvest by gear, through time, and by location as we pool samples by area to apply to harvest by area. We do not know, however, the harvest by gear type nor through time. The current strategy is simply the more, the better, hoping that intensive sampling will weight towards the gear most commonly used and catching the most chinook salmon. We are hoping to closely approximate proportional sampling. Design variables to be accounted for include harvest derived from many different gillnet mesh sizes, rod and reel gear, and fish wheels. Furthermore, gillnets can be fished either as set or drift nets, which may also influence the ASL composition of the catch. The ASL composition is also influenced by the hanging ratio, which fishers may vary depending on the continuum of preference between catching fish by gilling or tangling. These variables are compounded by changes in the ASL composition over time, distance upstream, and by changes in preferred fishing methods over time or location.

Adequately adjusting for all these variables is a challenge. The current sampling strategy has three parts:

1. Begin sampling at the start of the season and encourage participants to continue sampling through the end of their harvest season. This help account for changes in ASL through time, or changes in harvest effort or success through time.
2. Sample as many fish as you can from each reporting area. Again we are hoping that intensive sampling self weights towards the most successful gear in terms of harvest taken.
3. Sample from as many fishers as you can from each reporting area. This helps account for use of various mesh sizes.

Additional challenges are enticing subsistence fishers to participate in the program, and ensuring the quality of the information being collected. The primary enticement for subsistence fishers is the monetary payment associated with the fish they sample. Critics site that the payment method create an incentive for dishonest sampling practices, but to date we do not have any known incidences of such practices. This continues to be a concern, however, that program managers need to monitor as part of the standard information quality assessment, and the same concern applies to all ASL sampling programs.

Efforts to monitor the quality of the information being collected mostly occur by careful training of prospective participants, followed with repeat site visits, and careful review of the information participants submit. Participants are encouraged to submit samples early and often in order to allow program managers early and repeated opportunity to inspect for problems. The primary challenges are simply helping participants keep information organized so that fish scales can be matched with the correct sex and length data, plus ensuring that participants are diligent about confirming the sex of fish. This challenge can be addressed in large part by developing a pool of quality samplers that repeatedly participate in the program each year, but this advantage is undermine if annual program operations are discontinuous due to inconsistent funding.

Even with the monetary payment, over half the individuals trained and outfitted with sampling kits decided not to participate. Some cite the tedium of the task as the reason they opt out, others cite the inadequacy of the monetary compensation or they have difficulty modifying their routine to accommodate the sampling needs. The task of recording and organizing the information is daunting enough to dissuade some prospective participants, although the simplified data form helps (Appendix A).

Not withstanding these hurdles, enlisting user participation has resulted in much improved information gathering. Formerly, ADF&G staff attempted to characterize the ASL composition of the subsistence harvest by using commercial catch samples as a surrogate (e.g. Huttunen 1986, Molyneaux and Samuelson 1992, and Anderson 1995), or by traveling to fish camps to opportunistically sample freshly caught chinook salmon (e.g., Anderson 1991, DuBois and Molyneaux 2000). Coordinating sampling trips with fish availability, however, was unproductive. Furthermore, most often, the gear type in which the fish were caught was unknown, and the length and sex of the fish could not be determined because of fish being partially processed at the time the ADF&G staff arrived. In some incidences, ADF&G staff may have sampled an individual fish multiple times, as they sometimes resorted to ripping scales from strips hanging on the drying racks. Another hindrance of past practices was the intrusion, as some viewed it, of ADF&G staff entering fish camps and handling the fish that was being prepared for family consumption. In all, these past practices were simply inadequate for gathering samples in a manner sufficient to characterize the subsistence harvest. Despite a few shortfalls, the current user involvement method is vastly superior to past practices. Furthermore, the current method, arguably, is the most cost effective means of gathering such information.

CONCLUSIONS

Total Kuskokwim River Subsistence Harvest

- Age composition of the 2003 Kuskokwim River chinook salmon subsistence harvest (Table 9) included 29,962 age-1.3 fish (44.2%), 28,539 age-1.4 fish (42.1%), 4,542 age-1.2 (6.7%), and age-1.5 fish (6.7% as well).
- Sex composition of the harvest (Table 9) included 42,330 males (62.4%) and 25,458 females (37.6%).

Comparison of the Subsistence and Escapement ASL Compositions

- Age composition of the subsistence harvest differed from escapements (Figure 3):
  1. Age-1.2 male chinook salmon comprised 6.4% of the subsistence harvest, but escapement averaged 22.7%.
  2. Age-1.4 and -1.5 fish comprised 48.8% of the subsistence harvest, but escapement averaged 35.5%.
  3. Age-1.3 chinook salmon were near even in the two populations (44.2% and 41.7%)
- Female chinook salmon composed 37.6% of the subsistence harvest, but escapements averaged 31.5% (Table 10).
- Average lengths by age-sex category were comparable (Figure 3).

Influence of the Subsistence Fishing Schedule

- Available information is yet insufficient to determine whether the subsistence fishing schedule is an effective management tool for increasing proportion of older aged fish and female chinook salmon up stream of the lower Kuskokwim River. Missing is a comparable dataset collected without the influence of the fishing schedule and the number of years needed to account for variable year class strength.

Selective Removal of Large Chinook Salmon by Area of Harvest

- Differences in harvest gear between reporting areas, small sample sizes and or insufficient exploitation to create selective removal detectable upriver negate drawing conclusions from this dataset.

Temporal Stratification

- The ASL composition was relatively uniform over time for chinook salmon harvested in the lower Kuskokwim River (Figure 7).
- In the middle Kuskokwim River, however, the percentage of age-1.4 fish decreased over time from 55.6% to 35.4%, age-1.2 fish increased from 0.0% to 9.4%, and the percentage of female chinook salmon decreased over time from 52.8% to 29.9% (Figure 8).

Adequacy of Sample Sizes and Participation

- It is unknown how representative samples are of total harvest. We assume ASL composition of pooled samples are adequate to represent total harvest from the post-season survey.
- Current sampling strategy:
  1. Begin sampling at the start of the season and encourage participants to continue, sampling through the end of their harvest season,
  2. Sample as many fish as you can from each reporting area,
  3. Sample from as many fishers as you can from each reporting area.

RECOMMENDATIONS

- Record and report the number of different fishers being sampled by participants collecting ASL data from chinook salmon in the Kuskokwim River subsistence harvest. This is in contrast to knowing only the number of participants collecting ASL data in 2003.

- Increase the number of participants, and the number of samples, collected from the middle and upper Kuskokwim River reporting areas. For the upper river reporting area, recruit participants from Crooked Creek, Red Devil, Sleetmute, and Stony River by utilizing coordinating organization platforms on the George and Tatlawiksuk Rivers. Also need to ensure that samples from rod and reel, and fish wheel subsistence harvest are not being inadvertently excluded in each reporting area.

- Distribute sampling kits earlier and prior to the start of fishing in order to assure representative sampling of harvest in early June.

- Prepare a sampling design for ASL collection to include gear type categories, time strata and minimum sample size per stratum for analysis.

- Address discrepancies in sex determination through increased participant training, increased in-season participant monitoring, and follow-up with individuals associated with suspect data quality.

- Assess the effectiveness of the subsistence fishing schedule by continuing the multi-year subsistence sampling program to allow for comparison of ASL data collections between reporting areas and escapement projects for years when the subsistence fishing schedule is used and years when the schedule is not used.

- Analyze data from the post-season subsistence survey that documents the degree to which large mesh gillnets are used. Survey results currently identifies “drift gillnet” and “set gillnet” categories. These categories could each be divided into “…gillnets with large mesh (8-inch or greater)”; “… gillnets with small mesh (6-inch or smaller), and …gillnets with intermediate mesh size.” used for chinook salmon.

- Increase return of catch calendars and from them estimate harvest through time in order to combine with ASL samples collected from weekly subsistence fishing periods.

- Investigate possible gear size confounding effect between reporting areas by comparing samples from a specific gear type, such as 8-inch drift gillnets. One approach would be to provide individuals with a free net, hung in a standardized configuration, with the requirement that the recipient record ASL information from their chinook harvest.

- Finally, some of the points discussed in this report are derived from small sample sizes. Speculations about some of the patterns, or lack there of, may not be statistically significant. The intent of this conjecture is to identify possible patterns that warrant additional monitoring. Managers and researchers, therefore, should consider the points made in this report as preliminary.

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Table 1. Gear types reported used for subsistence fishing in the Kuskokwim Area in 2003 (T. Krauthoefer, ADF&G Personal Communication).

	Number of Households Reporting Types Gear Used [a]						
Reporting Area	Set Gillnet	Drift Gillnet	Fish Wheel	Rod & Reel	Seine	Spear	Total
Lower Kuskokwim River	146	697	0	165	0	0	1,008
	14%	69%	0%	16%	0%	0%	
Middle Kuskokwim River	25	101	0	49	0	0	175
	14%	58%	0%	28%	0%	0%	
Upper Kuskokwim River	49	38	0	49	0	0	136
	36%	28%	0%	36%	0%	0%	
Drainage Total	220	836	0	263	0	0	1,319
	17%	63%	0%	20%	0%	0%	

[a] Used for all species of salmon caught.

Table 2. Sample distribution by gear type and location in the 2003 Kuskokwim River chinook salmon subsistence harvest ASL sampling program.

Gear type	Lower Kuskokwim						Middle Kuskokwim			Upper Kuskokwim			Total
	Eek	Tuntutuliak	Napakiak	Bethel	Akiachak	Lower Kuskokwim Subtotals	Aniak	Chuathbaluk	Middle Kuskokwim Subtotal	Nikolai	McGrath	Upper Kuskokwim Subtotal	
Rod & reel				4									4
Subtotal						4			0			0	4
Percent						0%			0%			0%	0%
Gillnets													
8-1/2 inch mesh				20									20
8-1/4 inch mesh	60			248							17		325
8-1/8 inch mesh				28									28
8.0 inch mesh	40	34	68	1,102	51		216						1,511
Subtotal						1,651			216			17	1,884
Percent						70%			9%			1%	80%
7-7/8 inch mesh				18									18
7-3/4 inch mesh													0
7-1/2 inch mesh		20		50									70
7.0 inch mesh				40									40
Subtotal						128			0			0	128
Percent						5%			0%			0%	5%
6.0 inch mesh		7	52		34			53					146
5-1/2 inch mesh				47									47
5-3/8 inch mesh				10									10
5-1/4 inch mesh				31									31
5.0 inch mesh				10									10
4.0 inch mesh										90	10		100
Subtotal						191			53			100	344
Percent						8%			2%			4%	15%
Subtotal [a]	100	61	120	1,608	85	1,974	216	53	269	90	27	117	2,360
Percent	4%	3%	5%	68%	4%	84%	9%	2%	11%	4%	1%	5%	100%
Number of Participant Samplers	3	3	2	22	2	32	1	1	2	1	2	3	37

[a] Sample size includes unaged chinook salmon samples.

Table 3. Age and sex composition of chinook salmon samples from the lower Kuskokwim River subsistence fishery, 2003.

Sample Dates	Sample	Sex	Age Class													
Gear	Size		1.2		1.3		2.2		1.4		1.5		1.6		Total	
	(n)		n	%	n	%	n	%	n	%	n	%	n	%	n	%
7/2 - 5	1	M	0	0.0	0	0.0	0	0.0	1	100.0	0	0.0	0	0.0	1	100.0
Rod & Reel		F	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
		Total	0	0.0	0	0.0	0	0.0	1	100.0	0	0.0	0	0.0	1	100.0
5/26 - 7/8	123	M	39	31.7	33	26.8	0	0.0	11	9.0	3	2.4	0	0.0	86	69.9
6 inch or less mesh		F	2	1.6	14	11.4	0	0.0	17	13.8	4	3.3	0	0.0	37	30.1
		Total	41	33.3	47	32.0	0	0.0	28	22.8	7	5.7	0	0.0	123	100.0
6/12 - 24	115	M	6	5.2	49	42.2	0	0.0	17	14.6	3	2.6	0	0.0	75	65.5
6 1/2 - 7 7/8 inch mesh		F	0	0.0	12	10.4	0	0.0	27	23.3	1	0.8	0	0.0	40	34.5
		Total	6	5.2	61	52.6	0	0.0	44	37.9	4	3.4	0	0.0	115	100.0
5/25 - 31	41	M	0	0.0	13	31.7	0	0.0	8	19.5	6	14.6	0	0.0	27	65.9
8 inch and greater mesh		F	0	0.0	0	0.0	0	0.0	13	31.7	1	2.5	0	0.0	14	34.1
		Subtotal	0	0.0	13	31.7	0	0.0	21	51.2	7	17.1	0	0.0	41	100.0
6/4 -7	138	M	8	5.8	44	31.9	0	0.0	29	21.0	8	5.8	0	0.0	89	64.5
8 inch and greater mesh		F	0	0.0	7	5.1	0	0.0	33	23.9	9	6.5	0	0.0	49	35.5
		Subtotal	8	5.8	51	37.0	0	0.0	62	44.9	17	12.3	0	0.0	138	100.0
6/11 - 14	611	M	36	5.9	227	37.2	0	0.0	124	20.3	19	3.1	0	0.0	407	66.6
8 inch and greater mesh		F	0	0.0	66	10.8	0	0.0	116	19.0	22	3.6	0	0.0	204	33.4
		Subtotal	36	5.9	293	48.0	0	0.0	240	39.3	41	6.7	0	0.0	611	100.0
6/18 - 21	451	M	15	3.3	158	35.1	0	0.0	80	17.8	3	0.7	0	0.0	258	57.2
8 inch and greater mesh		F	1	0.2	38	8.4	0	0.0	139	30.8	15	3.3	0	0.0	193	42.8
		Subtotal	16	3.5	196	43.5	0	0.0	219	48.6	18	4.0	0	0.0	451	100.0
6/25 - 28	192	M	7	3.7	54	28.1	0	0.0	32	16.7	3	1.6	0	0.0	96	50.0
8 inch and greater mesh		F	1	0.5	21	11.0	0	0.0	64	33.3	10	5.2	0	0.0	96	50.0
		Total	8	4.2	75	39.1	0	0.0	96	50.0	13	6.8	0	0.0	192	100.0
7/3 - 7	28	M	1	3.6	5	17.9	0	0.0	6	21.4	0	0.0	0	0.0	12	42.9
8 inch and greater mesh		F	3	10.7	2	7.1	0	0.0	11	39.3	0	0.0	0	0.0	16	57.1
		Total	4	14.3	7	25.0	0	0.0	17	60.7	0	0.0	0	0.0	28	100.0
5/25 - 7/7	1,461	M	67	4.6	501	34.3	0	0.0	279	19.1	39	2.7	0	0.0	889	60.8
8 inch and greater mesh		F	5	0.3	134	9.2	0	0.0	376	25.7	57	3.9	0	0.0	572	39.2
All Dates Combined		Total	72	4.9	635	43.5	0	0.0	655	44.8	96	6.6	0	0.0	1,461	100.0
5/25 - 7/8	1,700	M	112	6.6	583	34.3	0	0.0	308	18.1	45	2.6	0	0.0	1,051	61.8
All Gear Types		F	7	0.4	160	9.4	0	0.0	420	24.7	62	3.6	0	0.0	649	38.2
		Total	119	7.0	743	43.7	0	0.0	728	42.8	107	6.3	0	0.0	1,700	100.0

Table 4. Mean length (mm) of chinook salmon samples from the lower Kuskokwim River subsistence fishery, 2003.

Sample Dates / Gear	Sex		Age Class 1.2	2.2	1.3	1.4	1.5	1.6
7/2 - 5	M	Mean Length				1040		
Rod & Reel		Range				1040-1040		
		Sample Size	0	0	0	1	0	0
	F	Mean Length						
		Range						
		Sample Size	0	0	0	0	0	0
5/26 - 7/8	M	Mean Length	529		689	801	807	
6 inch or less mesh		Range	440-605		525-805	704-903	760-900	
		Sample Size	39	0	33	11	3	0
	F	Mean Length	497		693	820	807	
		Range	490-503		607-802	702-920	709-915	
		Sample Size	2	0	14	17	4	0
6/12 - 24	M	Mean Length	528		736	807	956	
6 1/2 - 7 7/8 inch mesh		Range	430-600		590-890	710-910	752-1200	
		Sample Size	6	0	49	17	3	0
	F	Mean Length			793	860	835	
		Range			680-865	720-950	835-835	
		Sample Size	0	0	12	27	1	0
5/25 -31	M	Mean Length			745	814	788	
8 inch and greater mesh		Range			620-855	730-985	745-930	
		Sample Size	0	0	13	8	6	0
	F	Mean Length				874	945	
		Range				730-980	945-945	
		Sample Size	0	0	0	13	1	0
6/4 -7	M	Mean Length	592		719	795	801	
8 inch and greater mesh		Range	479-730		500-811	506-947	700-910	
		Sample Size	8	0	44	29	8	0
	F	Mean Length			752	825	898	
		Range			646-840	703-941	749-994	
		Sample Size	0	0	7	33	9	0
6/11 - 14	M	Mean Length	545		729	802	843	
8 inch and greater mesh		Range	386-713		403-880	607-1000	630-935	
		Sample Size	36	0	227	124	19	0
	F	Mean Length			769	851	889	
		Range			656-1002	700-1000	790-990	
		Sample Size	0	0	66	116	22	0
6/18 - 21	M	Mean Length	552		742	834	901	
8 inch and greater mesh		Range	480-610		540-860	676-1000	792-1050	
		Sample Size	15	0	158	80	3	0
	F	Mean Length	566		790	854	893	
		Range	566-566		634-919	720-970	820-998	
		Sample Size	1	0	38	137	15	0

Table 4. Continued (page 2 of 2).

Sample Dates Gear	Sex		Age Class 1.2	2.2	1.3	1.4	1.5	1.6
7/3 - 7 8 inch and greater mesh	M	Mean Length	590		752	812		
		Range	590-590		660-820	730-876		
		Sample Size	1	0	5	6	0	0
	F	Mean Length	475		841	854		
		Range	465-490		822-860	750-914		
		Sample Size	3	0	2	11	0	0
5/25 - 7/7 8 inch and greater mesh All Dates Combined	M	Mean Length	552		735	813	835	
		Range	386-730		403-880	506-1040	630-1050	
		Sample Size	67	0	501	279	39	0
	F	Mean Length	502		774	848	889	
		Range	465-566		634-1002	650-1000	749-998	
		Sample Size	5	0	134	376	57	0
5/25 - 7/8 All Gear Types	M	Mean Length	543		733	812	841	
		Range	386-730		403-890	506-1040	630-1200	
		Sample Size	112	0	583	308	45	0
	F	Mean Length	501		768	848	882	
		Range	430-566		607-1002	650-1000	709-998	
		Sample Size	7	0	160	420	62	0

Table 5. Age and sex composition of chinook salmon samples from the middle Kuskokwim River subsistence fishery, 2003.

Sample Dates / Sample Area / Gear	Sample Size (n)	Sex	Age Class 1.2 n	1.2 %	1.3 n	1.3 %	2.2 n	2.2 %	1.4 n	1.4 %	1.5 n	1.5 %	1.6 n	1.6 %	Total n	Total %
6/14 - 25	48	M	3	6.3	20	41.7	0	0.0	9	18.8	2	4.2	0	0.0	34	70.8
6 inch mesh		F	0	0.0	3	6.2	0	0.0	6	12.5	5	10.4	0	0.0	14	29.2
		Total	3	6.3	23	47.9	0	0.0	15	31.3	7	14.6	0	0.0	48	100.0
6/4 - 7	36	M	0	0.0	9	25.0	0	0.0	8	22.2	0	0.0	0	0.0	17	47.2
8 inch mesh		F	0	0.0	2	5.6	0	0.0	12	33.4	5	13.9	0	0.0	19	52.8
		Subtotal	0	0.0	11	30.6	0	0.0	20	55.6	5	13.9	0	0.0	36	100.0
6/11 - 14	34	M	2	5.9	9	26.5	0	0.0	8	23.5	0	0.0	0	0.0	19	55.9
8 inch mesh		F	0	0.0	4	11.7	0	0.0	9	26.5	2	5.9	0	0.0	15	44.1
		Subtotal	2	5.9	13	38.2	0	0.0	17	50.0	2	5.9	0	0.0	34	100.0
6/18 - 21	127	M	12	9.4	49	38.6	0	0.0	23	18.1	5	3.9	0	0.0	89	70.1
8 inch mesh		F	0	0.0	8	6.3	0	0.0	22	17.3	8	6.3	0	0.0	38	29.9
		Subtotal	12	9.4	57	44.9	0	0.0	45	35.4	13	10.2	0	0.0	127	100.0
6/4 - 21	197	M	14	7.1	67	34.0	0	0.0	39	19.8	5	2.6	0	0.0	125	63.5
8 inch mesh		F	0	0.0	14	7.1	0	0.0	43	21.8	15	7.6	0	0.0	72	36.5
All Dates Combined		Total	14	7.1	81	41.1	0	0.0	82	41.6	20	10.2	0	0.0	197	100.0
6/4 - 25	245	M	17	6.9	87	35.5	0	0.0	48	19.6	7	2.8	0	0.0	159	64.9
All Gear Types		F	0	0.0	17	6.9	0	0.0	49	20.0	20	8.2	0	0.0	86	35.1
		Total	17	6.9	104	42.4	0	0.0	97	39.6	27	11.0	0	0.0	245	100.0

Table 6. Mean length (mm) of chinook salmon samples from the middle Kuskokwim River subsistence fishery, 2003.

Sample Dates Gear	Sex		Age Class 1.2	2.2	1.3	1.4	1.5	1.6
6/14 - 25	M	Mean Length	490		756	802	945	
6 inch mesh		Range	455-525		670-860	735-925	890-1000	
		Sample Size	3	0	20	9	2	0
	F	Mean Length			808	871	870	
		Range			745-860	800-920	820-945	
		Sample Size	0	0	3	6	5	0
6/4 - 7	M	Mean Length			790	896		
8 inch mesh		Range			720-860	760-1000		
		Sample Size	0	0	9	8	0	0
	F	Mean Length			900	903	914	
		Range			890-910	830-1010	870-950	
		Sample Size	0	0	2	12	5	0
6/11 - 14	M	Mean Length	630		843	951		
8 inch mesh		Range	610-650		760-920	900-1150		
		Sample Size	2	0	9	8	0	0
	F	Mean Length			795	936	1085	
		Range			720-850	860-1100	1050-1120	
		Sample Size	0	0	4	9	2	0
6/18 - 21	M	Mean Length	592		817	914	974	
8 inch mesh		Range	460-640		670-960	800-1180	870-1080	
		Sample Size	12	0	49	23	5	0
	F	Mean Length			874	938	1005	
		Range			750-930	800-1050	950-1100	
		Sample Size	0	0	8	22	8	0
6/4 - 21	M	Mean Length	597		817	918	974	
8 inch mesh		Range	460-650		670-960	760-1180	870-1080	
All Dates Combined		Sample Size	14	0	67	39	5	0
	F	Mean Length			855	928	985	
		Range			720-930	800-1100	870-1120	
		Sample Size	0	0	14	43	15	0
6/4 - 25	M	Mean Length	578		803	896	966	
All Gear Types		Range	455-650		670-960	735-1180	870-1080	
		Sample Size	17	0	87	48	7	0
	F	Mean Length			847	921	957	
		Range			720-930	800-1100	820-1120	
		Sample Size	0	0	17	49	20	0

Table 7. Age and sex composition of chinook salmon samples from the upper Kuskokwim River subsistence fishery, 2003.

Sample Dates Gear	Sample Size (n)	Sex	Age Class 1.2 n	1.2 %	1.3 n	1.3 %	2.2 n	2.2 %	1.4 n	1.4 %	1.5 n	1.5 %	1.6 n	1.6 %	Total n	Total %
6/20 - 7/16	81	M	1	1.2	42	51.9	0	0.0	18	22.2	0	0.0	0	0.0	61	75.3
4 inch mesh		F	0	0.0	10	12.3	0	0.0	7	8.7	3	3.7	0	0.0	20	24.7
		Total	1	1.2	52	64.2	0	0.0	25	30.9	3	3.7	0	0.0	81	100.0
6/29 - 7/4	9	M	0	0.0	1	11.1	0	0.0	4	44.5	0	0.0	0	0.0	5	55.6
8 1/4 inch mesh		F	0	0.0	0	0.0	0	0.0	4	44.4	0	0.0	0	0.0	4	44.4
		Total	0	0.0	1	11.1	0	0.0	8	88.9	0	0.0	0	0.0	9	100.0
6/20 - 7/16	90	M	1	1.1	43	47.8	0	0.0	22	24.5	0	0.0	0	0.0	66	73.3
All Gear Types		F	0	0.0	10	11.1	0	0.0	11	12.2	3	3.3	0	0.0	24	26.7
		Total	1	1.1	53	58.9	0	0.0	33	36.7	3	3.3	0	0.0	90	100.0

Table 8. Mean length (mm) of chinook salmon samples from the upper Kuskokwim River subsistence fishery, 2003.

Sample Dates Gear	Sex		Age Class 1.2	2.2	1.3	1.4	1.5	1.6
6/20 - 7/16 4 inch mesh	M	Mean Length	690		712	806		
		Range	690-690		570-838	580-975		
		Sample Size	1	0	42	18	0	0
	F	Mean Length			725	787	823	
		Range			630-770	730-830	770-850	
		Sample Size	0	0	10	7	3	0
6/29 - 7/4 8 1/4 inch mesh	M	Mean Length			680	835		
		Range			680-680	750-910		
		Sample Size	0	0	1	4	0	0
	F	Mean Length				858		
		Range				790-920		
		Sample Size	0	0	0	4	0	0
6/20 - 7/16 All Gear Types	M	Mean Length	690		711	811		
		Range	690-690		570-838	580-975		
		Sample Size	1	0	43	22	0	0
	F	Mean Length			725	813	823	
		Range			630-770	730-920	770-850	
		Sample Size	0	0	10	11	3	0

Table 9. Age and sex composition of chinook salmon from the Kuskokwim River subsistence fishery. [a]

Reporting Area	Sample Size	Sex	1.2 N	1.2 %	1.3 N	1.3 %	2.2 N	2.2 %	1.4 N	1.4 %	1.5 N	1.5 %	1.6 N	1.6 %	Total N	Total %
Total Kuskokwim River-2001[e]		M	3,269	4.4	18,658	25.3	0	0.0	24,105	32.7	1,430	1.9	0	0.0	47,530	64.6
		F	136	0.2	3,405	4.6	0	0.0	20,564	27.9	1,907	2.6	0	0.0	26,080	35.4
	1,081	Total	3,405	4.6	22,063	29.9	0	0.0	44,669	60.6	3,337	4.5	0	0.0	73,610	100.0
Total Kuskokwim River-2002[e]		M	4,304	6.0	18,127	25.4	13	0.0	18,194	25.5	1,682	2.4	0	0.0	42,321	59.3
		F	1,274	1.8	5,623	7.9	0	0.0	20,141	28.2	1,931	2.7	45	0.1	29,013	40.7
	2,014	Total	5,578	7.8	23,750	33.3	13	0.0	38,335	53.7	3,613	5.1	45	0.1	66,807	100.0
Lower Kuskokwim River[b]		M	3,952	6.6	20,540	34.3	0	0.0	10,839	18.1	1,557	2.6	0	0.0	37,008	61.8
		F	240	0.4	5,629	9.4	0	0.0	14,791	24.7	2,216	3.7	0	0.0	22,875	38.2
	1,700	Subtotal	4,192	7.0	26,169	43.7	0	0.0	25,630	42.8	3,773	6.3	0	0.0	59,883	100.0
Middle Kuskokwim River[c]		M	388	6.9	1,995	35.5	0	0.0	1,102	19.6	157	2.8	0	0.0	3,647	64.9
		F	0	0.0	388	6.9	0	0.0	1,124	20.0	461	8.2	0	0.0	1,973	35.1
	245	Subtotal	388	6.9	2,383	42.4	0	0.0	2,226	39.6	618	11.0	0	0.0	5,620	100.0
Upper Kuskokwim River[d]		M	25	1.1	1,092	47.8	0	0.0	558	24.4	0	0.0	0	0.0	1,675	73.3
		F	0	0.0	254	11.1	0	0.0	279	12.2	75	3.3	0	0.0	610	26.7
	90	Subtotal	25	1.1	1,346	58.9	0	0.0	839	36.7	75	3.3	0	0.0	2,285	100.0
Total Kuskokwim River-2003[e]		M	4,365	6.4	23,627	34.9	0	0.0	12,498	18.4	1,714	2.5	0	0.0	42,330	62.4
		F	240	0.4	6,270	9.3	0	0.0	16,194	23.9	2,752	4.1	0	0.0	25,458	37.6
	2,035	Total	4,542	6.7	29,962	44.2	0	0.0	28,539	42.1	4,542	6.7	0	0.0	67,788	100.0

a Applied percentages for each reporting area are from samples collected in each reporting area.

b Includes harvests from communities North Kuskokwim Bay to Tuluksak.

c Includes harvests from communities Lower Kalskag to Chuathbaluk.

d Includes harvests from communities Crooked Creek to Telida.

e The number of fish in the "Total Kuskokwim River" is the sum of the lower, middle and upper reporting area. Percentages are derived from the sums.

Table 10. ASL composition of the Kuskokwim River chinook salmon escapement, and subsistence harvest from 2003.

	Percent Age-Sex Category[b]						
Information Source[a]	Male 1.2	Male 1.3	Female 1.3	Male 1.4	Female 1.4	Male 1.5	Female 1.5
Takotna Weir	8.2	31.2	9.8	14.8	34.4	0.0	1.6
Kogrukluk Weir	18.7	40.1	2.5	10.0	26.0	0.0	2.8
Kwethluk Weir	30.6	40.2	3.1	10.0	13.2	0.5	2.0
Tuluksak Weir	33.4	32.2	7.6	3.7	18.7	0.0	4.2
Escapement Average	22.7	35.9	5.8	9.6	23.1	0.1	2.7
Subsistence Fishery	6.4	34.9	9.3	18.4	23.9	2.5	4.1
	Average Length by Age in mm						
Takotna Weir	514	723	817	764	867	0	975
Kogrukluk Weir	567	703	781	823	866	917	899
Kwethluk Weir	539	695	800	807	862	882	897
Tuluksak Weir	536	683	770	800	866	0	909
Escapement Average	539	701	792	799	865	900	920
Subsistence Fishery	549	740	773	823	855	858	898

	Season Percent Females	
	Females	Sample Size
Takotna Weir	45.9	61
Kogrukluk Weir	31.3	373
Kwethluk Weir	18.3	1,133
Tuluksak Weir	30.5	225
Weir Average	31.5	
Subsistence Fishery	37.6	

[a] Samples from the George and Tatlawiksuk weirs were omitted. Samples were not collected throughout the duration of the run and were too few to characterize the 2003 escapement.

[b] Rare sex and age class combinations were not included (female 1.2 and age 2.2.)

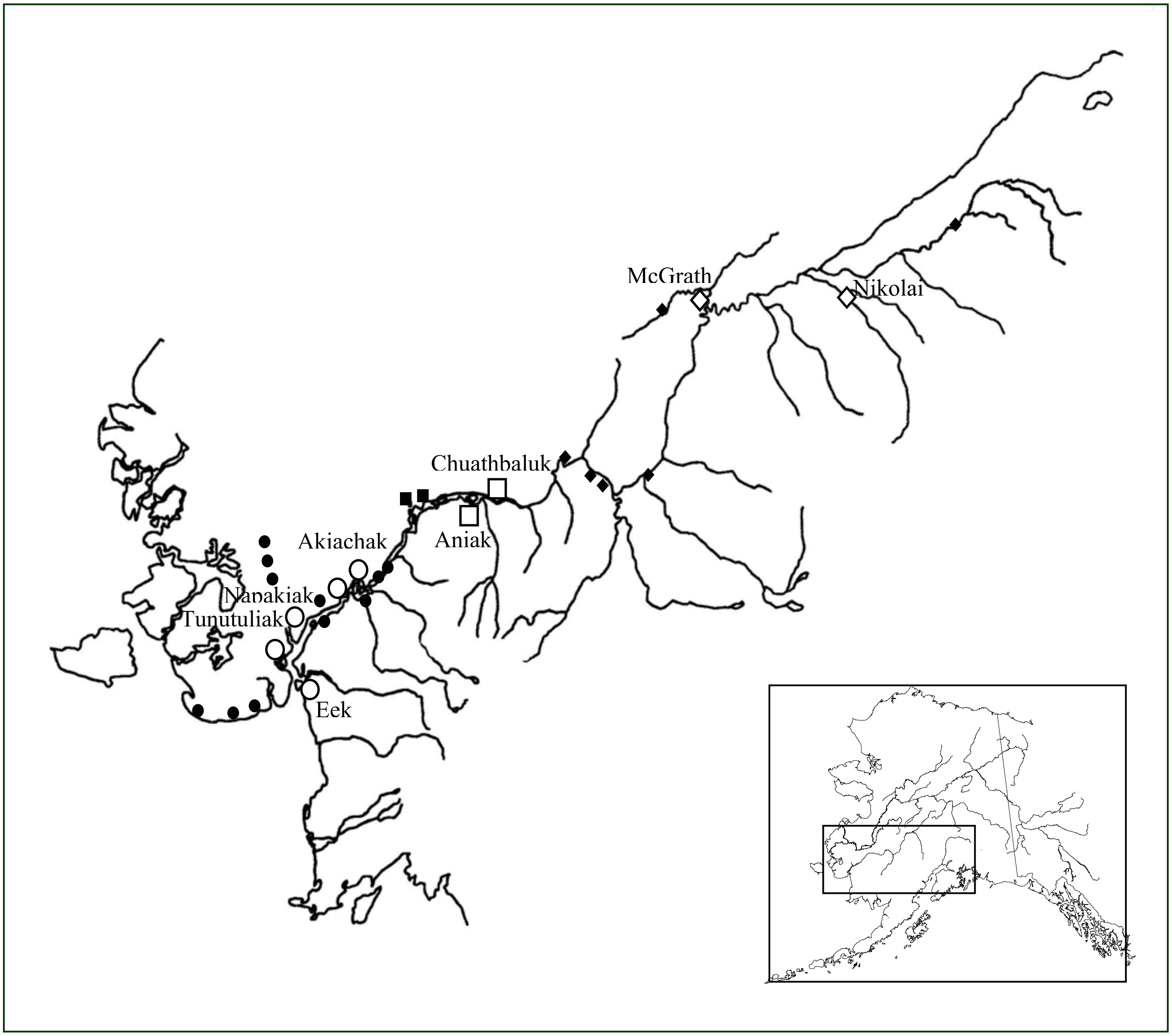


Figure 1. The Kuskokwim River drainage, with notation of village locations in the lower (circles), middle (squares) and upper river (diamonds) reporting areas.

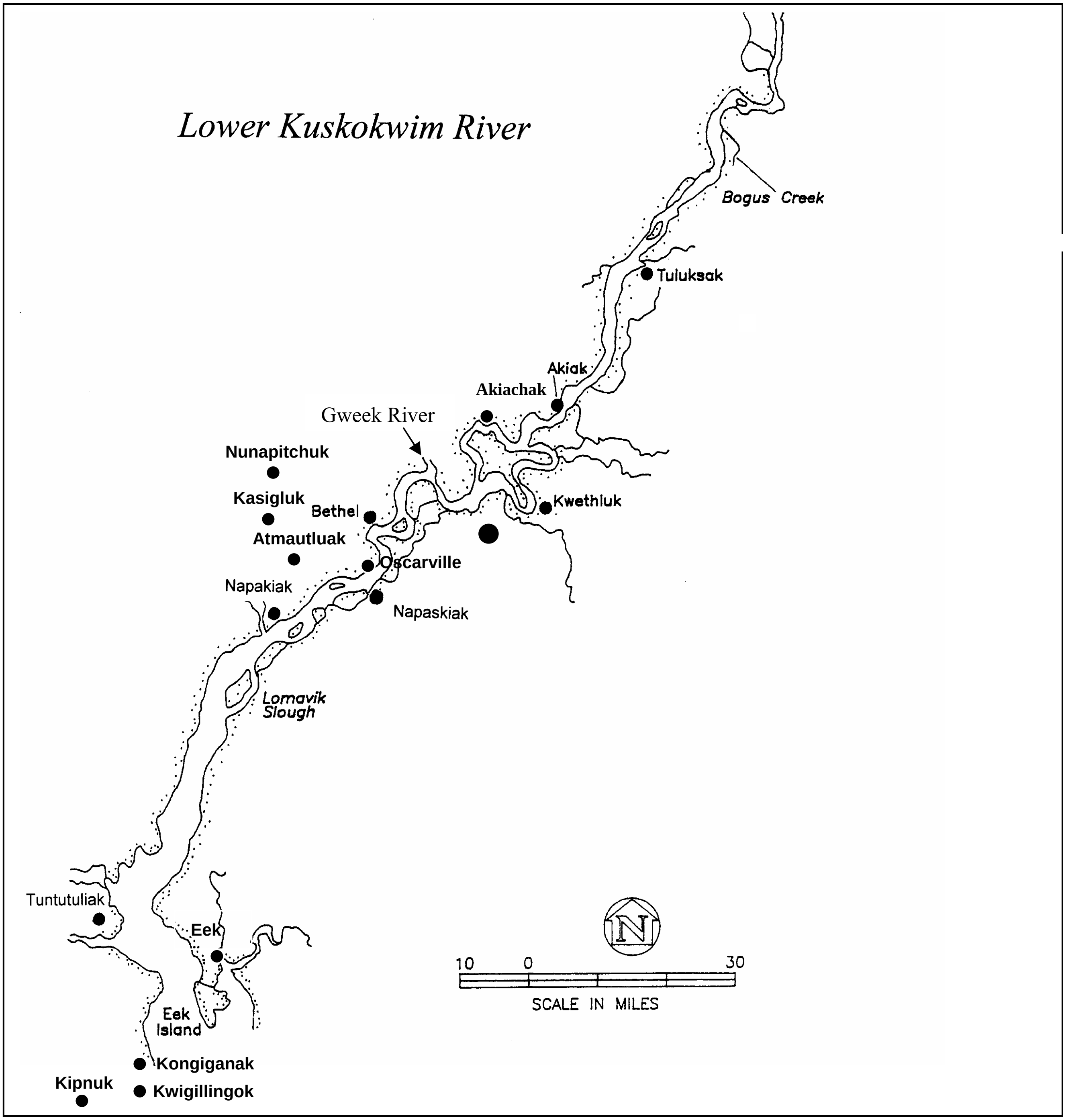


Figure 2. The lower Kuskokwim River reporting area, with notation of village locations.

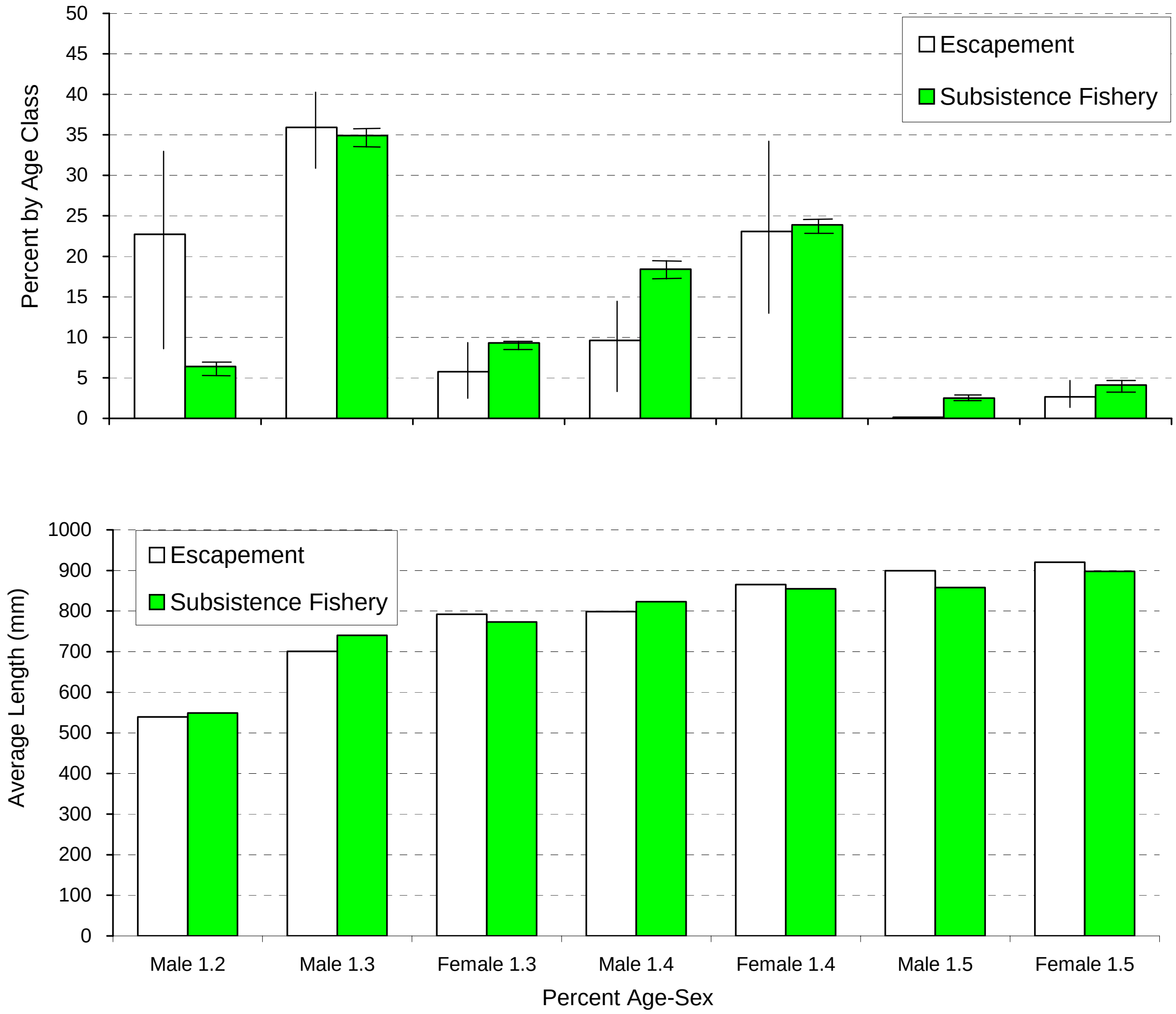


Figure 3. ASL composition of the Kuskokwim River chinook salmon subsistence harvest (with +/- SE) and escapement (with range) from 2003.

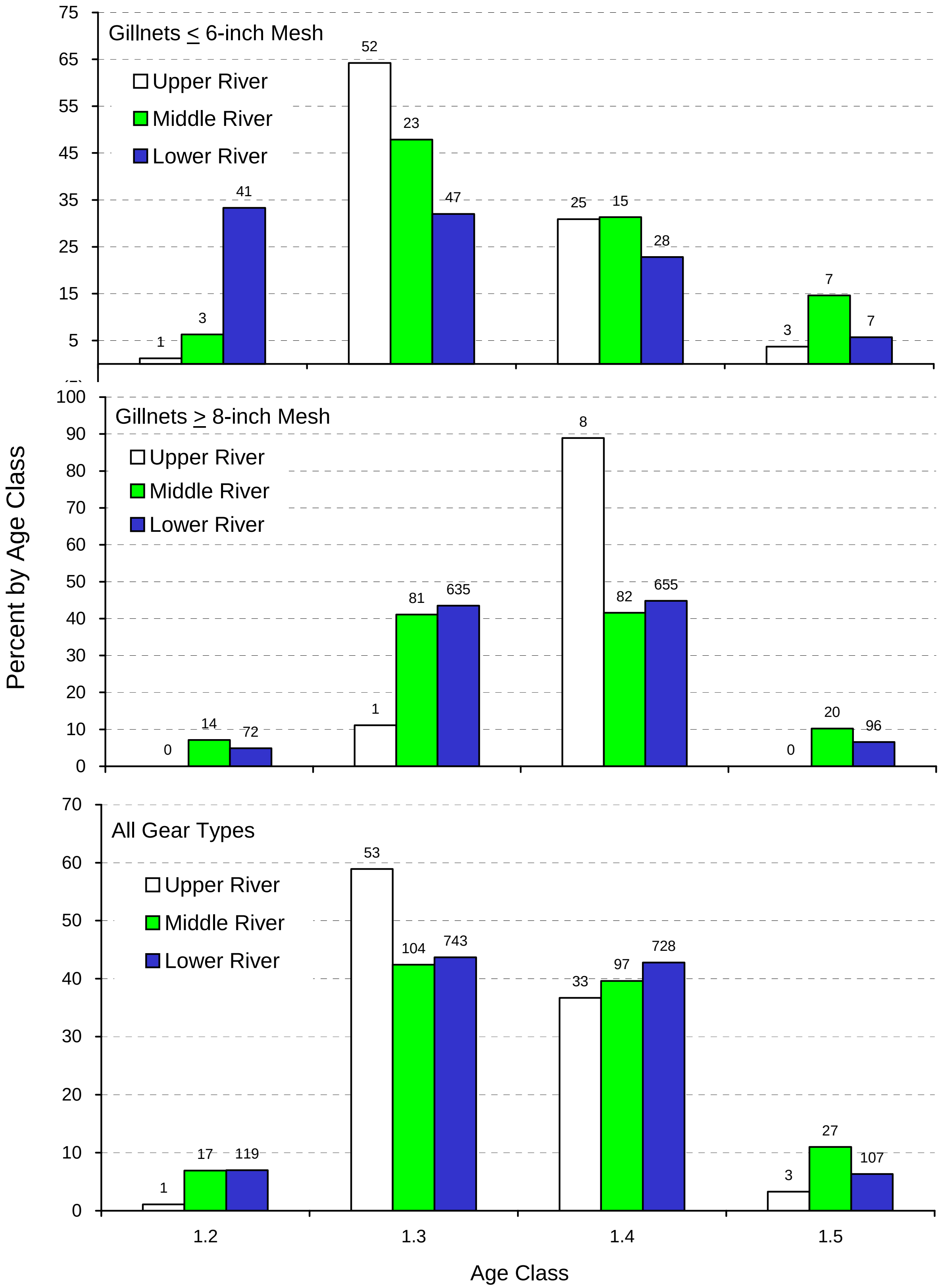


Figure 4. Age class composition of chinook salmon harvest by gear type in the upper, middle and lower Kuskokwim River subsistence fisheries, 2003. The number on the top of each bar is the sample size.

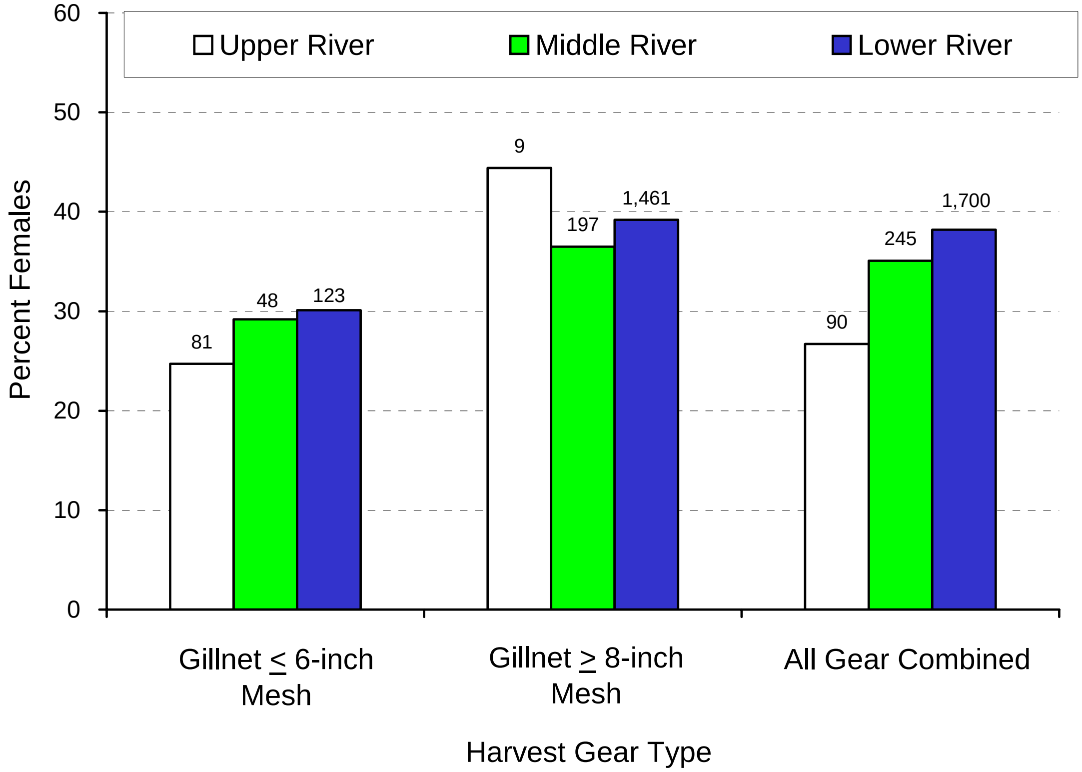


Figure 5. Percentage of female chinook salmon by gear type, harvested in the upper, middle, and lower Kuskokwim River subsistence fishery, 2003. The number on top of each bar is the sample size.

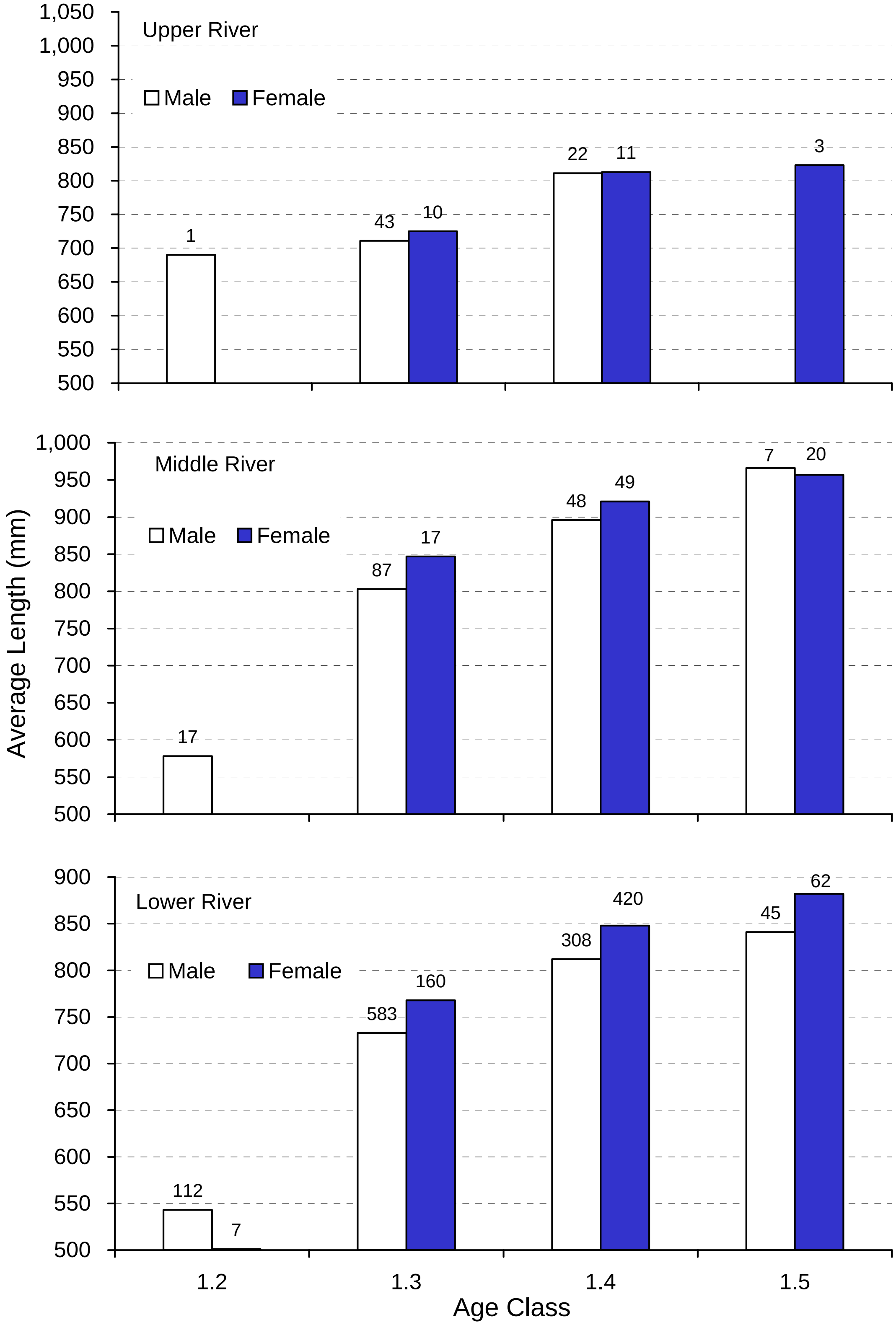


Figure 6. Average length by age and sex of chinook salmon harvested in the upper, middle and lower Kuskokwim River subsistence fisheries in 2003, for all gear types. The number on the top of each bar is the sample size.

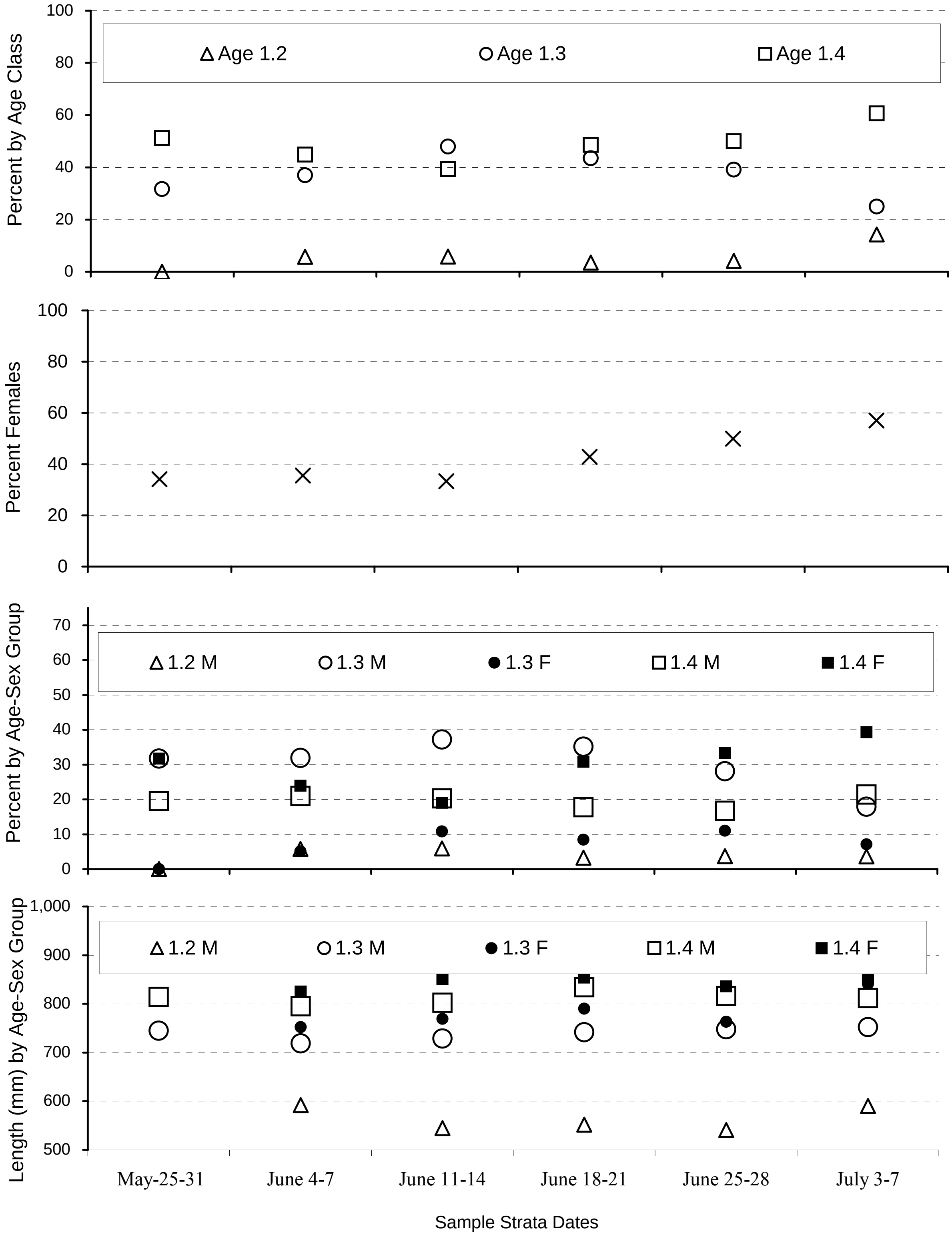


Figure 7. Temporally stratified ASL composition of chinook salmon harvested in the lower Kuskokwim River subsistence fishery with gillnets of 8-inch and larger mesh size, 2003.

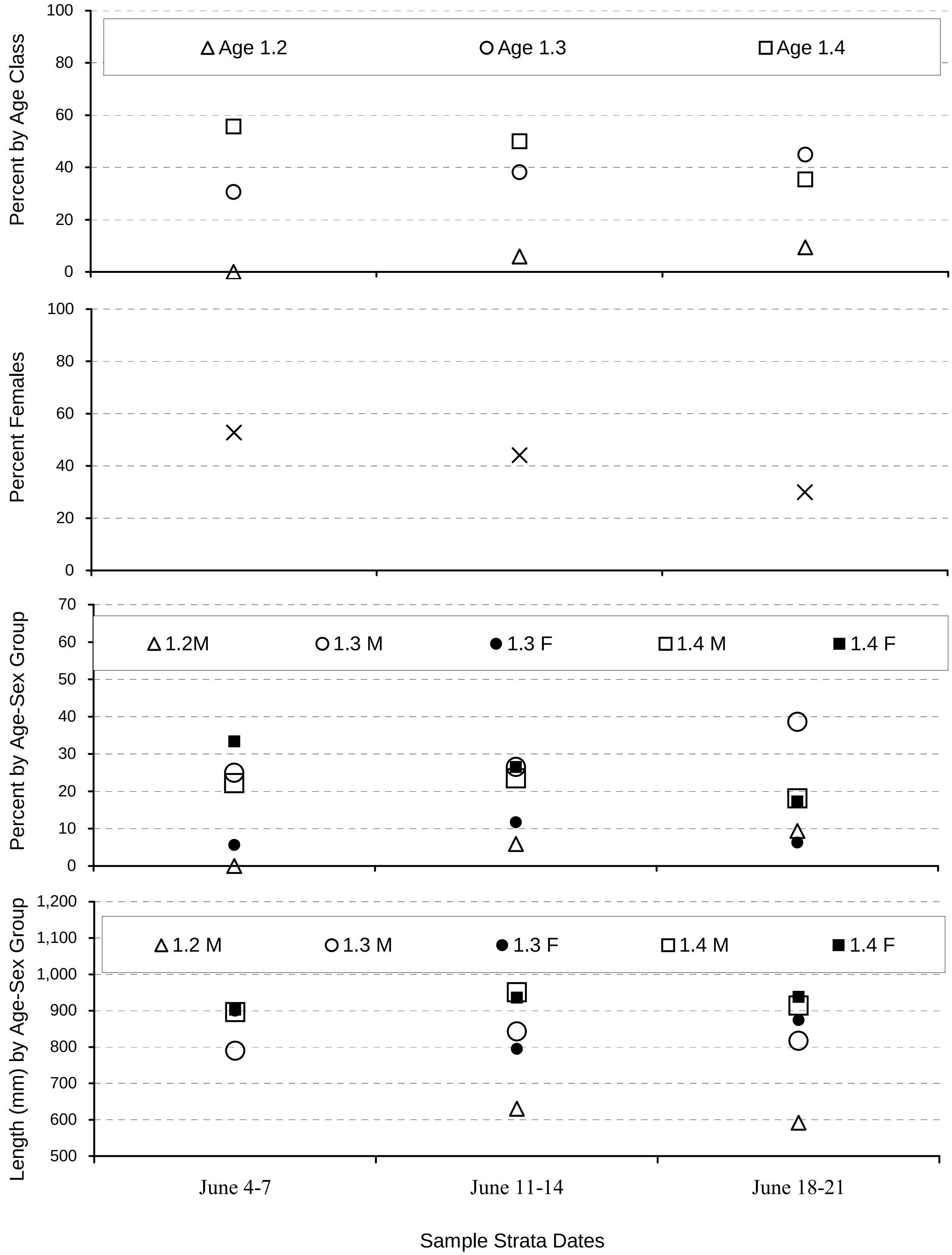


Figure 8. Temporally stratified ASL composition of chinook salmon harvested in the middle Kuskokwim River subsistence fishery with gillnets of 8-inch and larger mesh size, 2003.

Appendix A. Data form used for age-sex-length sampling of chinook salmon.

SUBSISTENCE KING SALMON DATA FORM

Name: ______________________________ Scale Card Number: __________

Address: ____

Sample Date: __________ (month/ day/ year SSN: ____________________

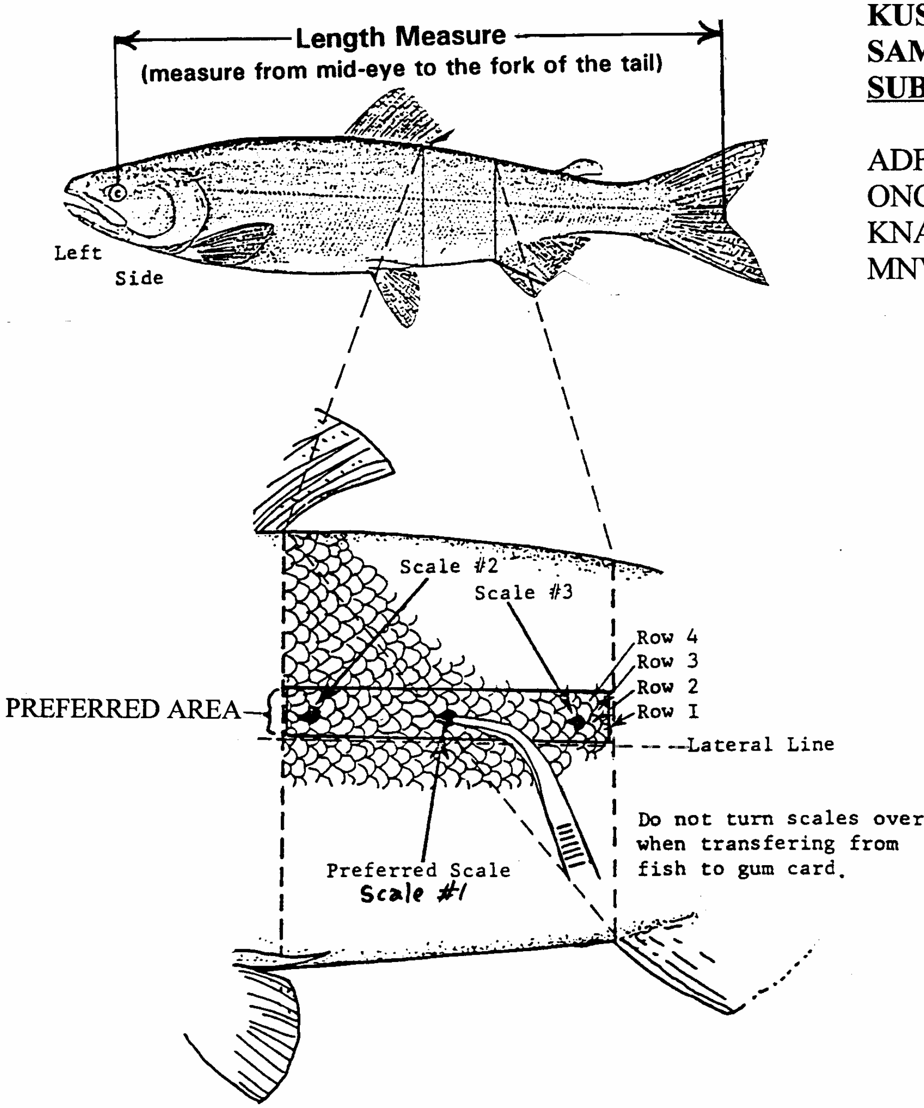
Location: ______________________________ (examples: Kuskokwim River near Bethel, Kuskokwim River near Akiak)

Gear Type: Drift Gillnet Set Gillnet Rod & Reel Fishwheel

Mesh Size: __________ Did you cut every fish to look for eggs? Yes or No

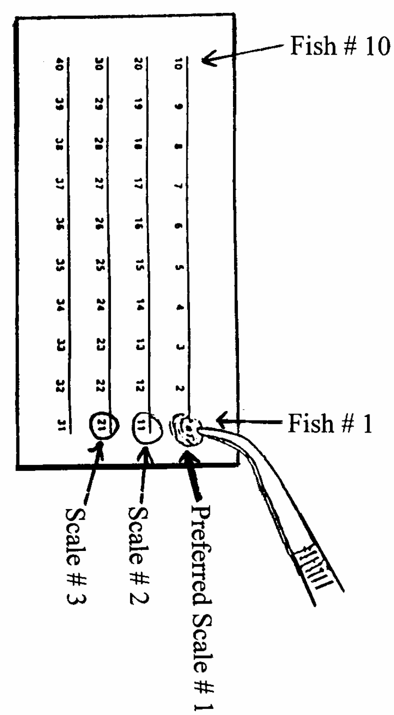
Fish Number	Sex (M or F)	Length (mm)	Comments
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

Appendix B. Instruction sheet for ASL sampling of chinook salmon.



KUSKOKWIM RIVER SAMPLING PROGRAM FOR <u>SUBSISTENCE KING SALMON</u>

ADF&G (Bethel) 543-2433
ONC (Bethel) 543-2608
KNA (Aniak) 675-4384
MNVC (McGrath) 524-3023



<u>Age-Sex-Length Sampling Instructions</u>

1) Position king salmon left side up.
2) Take preferred scale #1 located two rows above the lateral line and intersecting a diagonal line from the back of the dorsal fin to the front of the anal fin.
3) Clean scale by removing slime.
4) Place scale directly over number on gum card. Be careful to keep scale right side up and mount scale in same orientation.
5) Repeat above steps for scales # 2 and # 3 (see picture).
6) Measure length (mm) from mid-eye to fork of tail.
7) Cut fish belly and determine sex.

Payment requires the following information for each king salmon:

1) Three readable scales from each fish.
2) Sex of each fish.
3) Length of each fish.
4) Gear type and mesh size.
5) Date of capture.
6) Location of capture.
7) Your name on data form and scale card.

Appendix C. Kuskokwim River subsistence chinook salmon harvests, 2001, 2002 and 2003. (Krauthoefer, ADF&G, Personal Communication).

Community	Year [a]		
	2001	2002	2003
LOWER KUSKOKWIM RIVER REPORTING AREA			
Kipnuk	1	1	0
Kwigillingok	0	0	0
Kongiganak	1,454	808	1,386
North Kuskokwim Bay	1,455	809	1,386
Tuntutuliak	2,993	3,632	3,095
Eek	1,728	2,432	2,364
Kasigluk	588	381	356
Nunapitchuk	3,250	3,883	3,763
Atmautluak	740	1,282	1,396
Napakiak	2,290	1,931	2,105
Napaskiak	4,662	3,856	5,012
Oscarville	1,753	953	1,073
Bethel	27,209	19,305	21,475
Kwethluk	6,127	6,429	4,938
Akiachak	6,445	6,860	5,346
Akiak	3,369	3,340	3,896
Tuluksak	2,451	2,364	3,678
Subtotal	63,605	56,648	58,497
Lower Kuskokwim Subtotal	65,060	57,457	59,883
MIDDLE KUSKOKWIM RIVER REPORTING AREA			
Lower Kalskag	2,181	1,210	2,016
Upper Kalskag	1,014	1,420	1,128
Aniak	2,524	2,994	2,077
Chuathbaluk	627	663	399
Middle Kuskokwim Subtotal	6,346	6,287	5,620
UPPER KUSKOKWIM RIVER REPORTING AREA			
Crooked Creek	508	790	831
Red Devil	175	248	72
Sleetmute	473	516	685
Stony River	139	293	111
Lime Village	262	0	65
McGrath	360	700	506
Takotna	5	9	0
Nikolai	282	507	15
Telida	0	0	0
Upper Kuskokwim Subtotal	2,204	3,063	2,285
Kuskokwim River Total	73,610	66,807	67,788

[a] Kipnuk, Kwigillingok, Kasigluk, and Telida data are from calendar reporting only in 2002.

Appendix D. Summary results distributed to chinook salmon age-sex-length sampling participants.

Age-Sex-Length Sampling from Subsistence Harvested King Salmon in 2003

A number of subsistence fishers in the Kuskokwim River collected information on their king salmon catches to help biologists better understand the needs of subsistence users. The following information is a summary of those findings:

(1) Thirty six samplers from local communities participated in the age-sex-length sampling program in the Kuskokwim Area.

(2) A total of 2,360 king salmon were sampled from Kuskokwim River harvests near Eek,Tuntutuliak, Napakiak, Bethel, Akiachak, Aniak, McGrath.

(3) Samples were collected from a variety of gear types (Figure 1):

(a) 12 drift gillnet mesh sizes (5, 5-1/4, 5-1/2, 6, 7, 7-1/2, 7-3/4, 7-7/8, 8, 8-1/8, 8-1/2 and 8-1/4 inches),

(b) 4 set gillnet mesh sizes (4, 5-1/2, 6 and 8-1/2 inches),

(c) and rod and reel gear;

(d) 85% were from gillnets with mesh of 8 inches or larger.

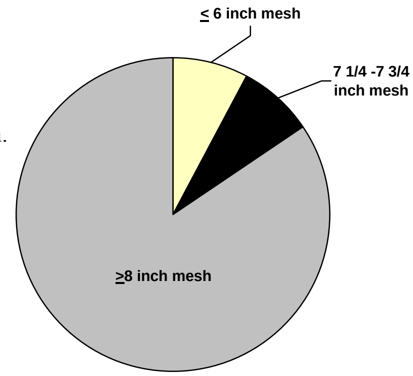


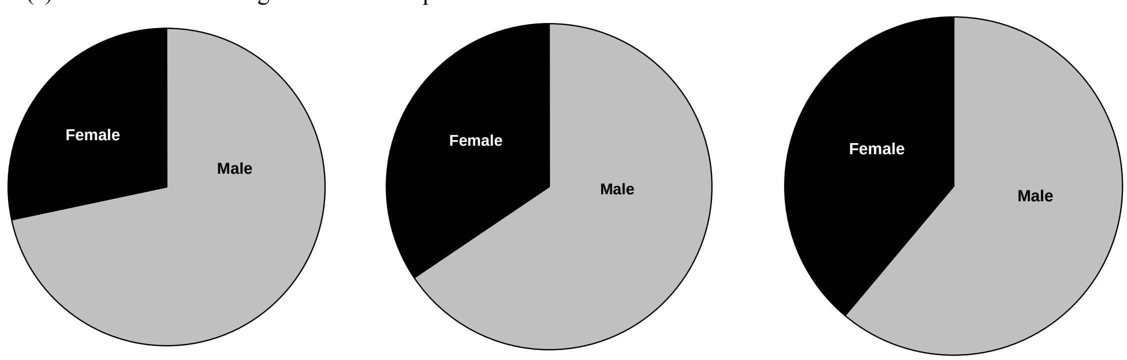
Figure 1. Mesh size composition of king salmon samples collected in the Lower Kuskokwim River subsistence fishery.

(4) Sex composition by mesh size was (Figure 2):

(a) 28 % female for less than or equal to 6 inch mesh,

(b) 34 % female for 7-1/4, 7-3/4 inch mesh,

(c) and 39% female for greater than or equal to 8 inch mesh.



Sex composition for less than or equal to 6 inch mesh

Sex composition 7 1/4 to 7 3/4 inch mesh

Sex composition for greater than or equal to 8 inch mesh

Figure 2. Sex composition, by mesh size, of king salmon sampled in the Lower Kuskokwim River subsistence fishery.

(5) Age composition from all gear types (Figure 3):

(a) Age-3 = 0.1%.

(b) Age-4 = 6.7%.

(c) Age-5 = 44.2%.

(d) Age-6 = 42.1%.

(e) Age-7 = 6.7%.

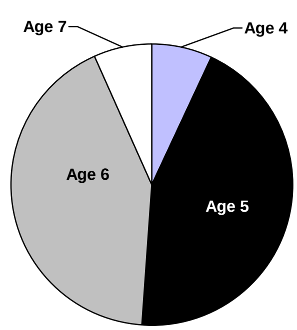


Figure 3. Age composition king salmon subsistence samples

(6) Mean length at age, by sex, was:

(a) Age-4 male = 549mm

(b) Age-5 male = 740mm

(c) Age-5 femal 773mm

(d) Age-6 male = 823mm

(e) Age-6 femal 855mm

(f) Age-7 male = 858mm

(g) Age-7 femal 898mm

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