AGE, SEX, AND LENGTH COMPOSITION OF CHINOOK SALMON FROM THE 2002 KUSKOKWIM RIVER SUBSISTENCE FISHERY

By

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ABSTRACT

Age, sex, and length (ASL) data were collected from chinook salmon harvested during the 2002 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 2,228 chinook salmon were sampled in 2002 (1,501 lower Kuskokwim River, 643 middle Kuskokwim River, and 84 upper Kuskokwim River samples), which is an increase over the 1,170 fish sampled in 2001 (1,010 lower Kuskokwim River, 130 middle Kuskokwim River, and 30 upper Kuskokwim River). Ages were determined for 2,014 of the fish (90.4%). Samples were collected from a variety of gear types, but most fish were caught in gillnets with a mesh size 8 inches or larger (i.e., large mesh gear). Age-1.2 chinook salmon accounted for 7.8% of the 2002 subsistence harvest, which was far less than the 23.4% average from escapement projects. Conversely, older aged chinook salmon (age 1.4, 1.5, and 1.6) accounted for 58.9% of the subsistence harvest, compared to an average of 43.3% at escapement projects. Female chinook salmon comprised 40.7% of the harvest, which was more than the 31.9% average from escapement projects.

Findings from 2002 provide the first complete year of baseline data for assessing the influence of the subsistence fishing schedule, which was instituted as a management tool in 2001 in response to Kuskokwim River chinook salmon being identified as a stock of concern by the Alaska Board of Fisheries. Preliminary comparison between samples collected in the lower and middle river shows comparable percentages of older age fish (58.2% and 60.6%) and females (41.3% and 39.8%). 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 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 2002 of 66,807 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.

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 preference of using large mesh sizes is as much to target larger chinook salmon as to avoid smaller species, whose numbers at times vastly exceeds chinook salmon.

Unlike subsistence fishers, commercial fishers have been restricted to use 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).

[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.

Chinook salmon spawning escapement is, by default, left to those fish that escape the gauntlet of subsistence and commercial gillnets. Hypothetically, the ASL composition of the escapement should favor that fraction of the adult chinook salmon population not selected for by gillnets.

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 second 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 2002, fishers in the lower Kuskokwim River accounted for 86%[3] of the total Kuskokwim River chinook salmon subsistence harvest; with Bethel households accounting for 30% of the harvest. In contrast, fishers in the middle and upper Kuskokwim River accounted for about 10% and 4% 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. Escapement improved in 2001 and 2002 (Ward et al. 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 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

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

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 and larger chinook salmon passing upstream of the lower Kuskokwim upriver, including the spawning grounds.

Study Area

The study area partitions villages and associated fish camps into three reporting areas: 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). The river was divided into these three segments because of 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. Mesh size preferences may also differ in response to possible "sieving effect", whereby the proportion of larger chinook salmon theoretically diminishes as you proceed upstream due to selective harvesting downstream with large mesh gillnets.

The lower Kuskokwim River 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 and McGrath Native Village Council (MNVC) focused on the upper Kuskokwim River.

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 ADFG, ONC, KNA or MNVC.

At the start of the fishing season, 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 by telephone, through referrals from village organizations, or when encountered at fish camps along the river. 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 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 were 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. By the nature of our collection method we tried to overcome the non-random or non-systematic nature of our sampling by collecting as many ASL samples as possible throughout the month of June. We are conducting what Geiger and Wilbur (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) might represent the harvest by gear and through time. If effort is expanded to collect many samples then the assumption would be that when many fish are available (i.e., harvested) many samples would be collected and therefore be self-weighting by gear and area over the time period samplers are working. 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 and Wilbur 1990) was used to sample the Kuskokwim River subsistence chinook fishery during 2002. We collected as many samples as possible, spanning all gear types, from each area. 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 area were to be used to apportion the harvest estimate from that area by age and sex. Large samples for any area would also allow us to post stratify by time and gear.

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. 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, standard error 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. Lower and middle river data were further stratified by three gillnet mesh size ranges: (1) 6-inch or less, (2) greater than 6 inches but less than 8 inches, and (3) 8-inch or greater. ASL data collected from 8-inch and greater gillnets for the lower and middle Kuskokwim reporting areas were also divided into temporal strata based on the weekly subsistence-fishing schedule

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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.

Data collected and thought representative of each stratum (area, gear, and time) were summarized for age, sex, and length composition. The proportion 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.

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-six participants collected 2,228 ASL samples in 2002 from chinook salmon harvested near seven Kuskokwim River communities (Table 2). The lower river area accounted for 67% of the samples followed by the middle (29%) river and few samples from the upper river area (4%). Age was determined for 2,014 of the fish sampled, which was 2.8% of the estimated 66,807 chinook salmon harvested in the 2002 Kuskokwim subsistence fishery (Appendix C). Samples from drift and set gillnets were pooled by mesh size category for estimates of age and length composition. Overall 98% of the samples were collected from gillnet caught chinook salmon.

Twenty-four participants collected 1,501 ASL samples in 2002 from the chinook salmon harvest near the lower Kuskokwim River communities of Tuntutuliak, Napakiak, Bethel, and Akiachak (Table 2). Chinook salmon caught near Bethel accounted for 67% of the samples. Only gillnet caught chinook salmon were sampled and 82% were caught by gillnets with mesh size 8 inches or greater. The drift gillnets included 13 mesh sizes (4-, 5⅜-, 5½-, 6-, 6½-, 7-, 7¼-, 7½-, 7⅞-, 8-, 8⅛-, 8¼-, and 8½-inch mesh) and the set gillnets included five mesh sizes (6½-, 8-, 8¼-, 8½- and 8¾-inch mesh).

Seven participants collected 643 ASL samples in 2002 from the chinook salmon harvest near the middle Kuskokwim River communities of Aniak and Kalskag (Table 2). All chinook salmon sampled in the middle Kuskokwim River were caught in either drift or set gillnets (Table 2). The drift gillnets included three mesh sizes (6-, 7-, and 8-inch mesh), while the set gillnet included only 8-inch mesh. Nets with 8-inch mesh accounted for 87.8% of the samples.

Five participants collected 84 ASL samples in 2002 from chinook salmon harvest near the upper Kuskokwim River community of McGrath (Table 2). The fish were caught with either a drift gillnet hung with 8¼-inch mesh, a set gillnet hung with 4½-inch mesh, or with rod and reel. The 8¼-inch mesh drift gillnet accounted for 25.3% of the samples.

ASL Composition

The ASL composition of chinook salmon varied by area sampled (lower, middle, and upper river) and by the capture gear. All 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 53.3% age-1.4 fish, 34.0% age-1.3 fish, 7.8% age-1.2 fish, 4.8% age-1.5 fish, and 0.1% age-1.6 fish (Table 3). The prevalence of age-1.4 chinook salmon increased with increasing mesh size: 34.0% (6-inch or less), 50.0% (6½- to 7⅞-inch) and 55.4% (8-inch and greater). Age-1.3 chinook salmon were harvested in similar percentages in all mesh sizes (range: 32.0% to 34.8%) and age-1.2 fish occurred most frequently in the 6-inch or smaller mesh size, where they accounted for 32.0% of the samples.

Sex composition of aged samples pooled across all gear types was 41.3% female. The composition by gillnet mesh size category was: 49.5% female for mesh of 6-inch or less, 38.6% for 6½- to 7⅞-inch mesh, and 41.0% for mesh of 8-inch or larger (Table 3). The percent female by age ranged from 24% of age 1.2 and 1.3 to 54% of age 1.4 and 50% of age 1.5 chinook salmon.

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. Generally, mean length at age also increased with an increase in mesh size of the capture gear.

Middle Kuskokwim River

The age composition of chinook salmon from samples pooled across all gear types sampled from the middle Kuskokwim River, was 54.8% age-1.4 fish, 31.6% age-1.3 fish, 7.7% age-1.2 fish, 5.8% age-1.5 fish, and 0.2% age-2.2 fish (Table 5). Age 1.4-fish were most prevalent in gillnets with 8-inch mesh, where they accounted for 56.3% of the samples. Age-1.2 fish occurred most frequent in gillnets of 6-inch or smaller mesh size, where they accounted for 23.1% of the samples.

Sex composition of aged samples pooled across all gear types was 39.8% female. The sex composition by gillnet mesh size was: 36.5% female for gillnets with mesh of 6-inch or less, 38.9% for 7-inch mesh, and 40.2% for mesh of 8-inch or larger (Table 5). The percent female also increased with age from 14% at age 1.2 to 54% at age 1.4 and 70% at age 1.5.

Length composition of aged samples from the middle Kuskokwim River also varied by sex and gear type (Table 6). Overall, females tended to be larger at age than males. The mean length of older chinook salmon (1.3 and 1.4) was also larger from samples of gillnet mesh sizes of 8 inches and greater as compared to the smaller mesh sizes.

Upper Kuskokwim River

Age composition, pooled across all gear types sampled from the upper Kuskokwim River, was 60.0% age-1.4 fish, 22.7% age-1.3 fish, 9.3% age-1.2 fish, and 8.0% age-1.5 fish (Table 7). Sex composition of aged samples pooled across all gear types was 30.7% females. Length composition of aged samples from the upper Kuskokwim River showed a different pattern from the middle and lower (Table 8). Overall, females tended to be smaller at age than males and chinook salmon sampled from 8-inch and larger mesh gillnets were larger than those of the same age caught by rod and reel.

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 5th for the lower Kuskokwim area and June 12th for the middle. Each area was divided into four temporal strata: 5 through 8 June, 12 through 15 June, 19 through 22 June, and 26 through 29 June in the lower Kuskokwim and 12 through 15 June, 19 through 22 June, 26 through 29 June, and 19 July for the middle area. Days between these weekly strata were closed to subsistence fishing.

The age composition varied little among weekly strata for the lower Kuskokwim (Table 3). There was no obvious pattern of changing composition over time by age-sex category (Table 3) or mean length by age-sex category (Table 4). Few samples were collected to represent the week of June 26 (77) but even without this stratum a temporal trend was not discernable.

For the middle Kuskokwim area the percentage of age-1.4 fish tended to decrease over time from 72.3% to 46.2%, while the percentage of age-1.2 fish increased over time from 0.8% to 15.4% (Table 5). The percentage of female chinook salmon also decreased over time from 43.7% to 30.8%. Average length of male and female age-1.3 fish tended to decrease over time, where as the average length of age-1.4 fish varied (Table 6). Sample sizes for the last two strata were small (61 and 26 aged chinook salmon).

Subsistence Harvest ASL Composition

The total estimated subsistence harvest of Kuskokwim River chinook salmon in 2002 was 66,807 (ADF&G 2003; 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 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 2002 chinook harvest included 35,904 age-1.4 fish (53.7%), 22,239 age-1.3 fish (33.3%), 5,227 age-1.2 fish (7.8%), 3,383 age-1.5 fish (5.1%), 42 age-1.6 fish (0.1%), and 11 age-2.2 chinook salmon (less than 0.1%). Estimated sex composition was 39,643 males (59.3%) and 27,164 females (40.7%). Eighty-six percent of the harvest was taken in the lower river, including 23,723 female chinook salmon. In contrast only 3,063 chinook salmon were estimated to be harvested in the upper river, of which only 939 were female.

A summary findings from the 2002 sampling program was distributed to participants and interested groups in March 2002 (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 area across time represent the true ASL composition of the season total harvest for that area (lower, middle, upper).

During the postseason subsistence harvest 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 are used (<1%). 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. It is likely that much less than 20% of the chinook salmon are captured with that gear given its efficiency compared to gillnets. Seventy-nine 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 2002 was dominated by gillnet caught chinook salmon. This compares with 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 36% in the middle river. Only gillnet caught chinook salmon were sampled from these two areas. It is likely that our mixture of gears is representative of those used this season.

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. Most samples came from early June when historic catch calendar analysis indicates that most of the harvest occurs.

Overall the chinook harvest in 2002 (66,807) was less than the harvest in 2001 (73,610). The age compositions of the harvests were similar with a few less age-1.4 fish in 2002 (53.7% versus 60.6%), and a few more age-1.2 chinook salmon in 2002 (7.8% versus 4.6%). The sex composition estimate included more female chinook salmon in 2002 (27,164 versus 26,080 in 2001; Table 7) but estimates of percent females differ by about 5%.

There is some indication, that the 2002 proportion of females is biased high due to erroneous sex determination. For example, nearly half of the 31 lower river age-1.2 fish caught in 6-inch gillnets were reported as female (Table 3); whereas, less than 1% of the fish in this age group were female in sex confirmed fish sampled by ADF&G (DuBois and Molyneaux 2000). The ADF&G samples consisted of 789 fish from the Kuskokwim River commercial fishery in 1997, 1998, and 1999. The possible disparity found in 2002 is rooted in just one or two participants; still, the occurrence casts a broader shadow of doubt over all the samples. The 2001 samples, while similar in sex composition to 2002, had an incidence of female age-1.2 chinook salmon more comparable to that found in the ADF&G sex-confirmed fish. If all age 1.2 chinook salmon were assumed male in 2002 the percent female would only decrease to 38.9%.

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, but all participants may not have diligently followed the directive. Field staff from the coordinating organizations should redouble their efforts to insure that participants are indeed confirming the sex of fish.

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). Most notable, male age-1.2 chinook salmon comprised 6.0% of the subsistence harvest, but comprised 23.4% of the escapement as averaged across the six monitored tributary escapement projects. Estimates at escapement projects ranged from 12.6% to 43.7%, and are all above the 6.0% observed in the subsistence fishery. The incidence of age-1.2 fish in the subsistence fishery only increases to 7.8%, if age-1.2 females are included, as the above discussion of possible sex determination errors would suggest. Furthermore, age-1.4, -1.5, and -1.6 chinook salmon, combined, were 58.9% of the subsistence harvest, but averaged only 43.5% of the escapement (Table 10, Figure 3). Age-1.3 chinook salmon, however, were about even in abundance at 33.3% and 30.4%. For all of these age classes, the composition observed in the subsistence harvest fell within the range of estimates across the six escapement projects.

The subsistence harvest included a higher percentage of female chinook salmon (40.7%) than did the escapement (average of 31.9%; Table 10). Furthermore, the 40.7% females observed in the subsistence fishery was greater than the percentage observed at any of the six escapement projects, which ranged between 20.8% to 40.6% females.

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 and sex 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 81% 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 to predict responses to directional selection on chinook salmon show that modest shifts in average size at age can occur (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); however, 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 practice 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; however, such an action would again meet with considerable social resistance, 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 both in 2001 and 2002, 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 two 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, 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.

Findings from this study offer mixed results on this issue. The percentage of age-1.4 and -1.5 chinook salmon was highest in samples from the upper Kuskokwim River (Figure 4), which is contrary to the expected results. The percentage of female chinook salmon, however, did tend to be lower in the upper Kuskokwim River, which is in agreement with the expected results (Figure 5). Furthermore, the average length of female chinook salmon was greater than, or equal to, males of the same age in the lower and middle river, but the opposite was observed in the upper river with males being larger than females (Figure 6).

These finding may be confounded for at least two 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 2002 (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 to be discernable 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. Results from the 1994 annual subsistence survey, however, do list that of 497[6] 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). Results from the current study more closely resemble the 1967 findings, with 81% of the 2002 samples being collected from large mesh gillnets (Table 2).

A second avenue of bias is erroneous sex determination. Despite the requirement that participants confirm the sex of each fish through internal examination of gonads, there is some indication of erroneous sexing in that 23% of the age-1.2 chinook salmon were recorded as being females (Tables 9); whereas sex confirmation studies by ADF&G indicate that the percentage should be less than 1% (DuBois and Molyneaux 2000). The likelihood of error in sexing the age-1.2 fish in turn, casts some suspicion on the accuracy of the sex determination in the other older aged fish. Accurate sex determination has been a repeated challenge at other projects as well (DuBois and Molyneaux 2000, Linderman et al. 2003).

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 was relatively uniform for chinook salmon harvested in the lower Kuskokwim River (Figure 7). In the middle Kuskokwim River, however, the percentage of age-1.4 fish decrease over time from 72.3% to 46.2%, and most of the change was observed in males (Figure 8). There was a concurrent increase in age-1.2 fish from 0.8% to 15.4%. The percentage of female chinook salmon also decreased over time in the middle Kuskokwim River, from 43.7% to 30.8%. The changes observed in the middle Kuskokwim

[6] 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.

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; Kwethluk, Kisaralik, and Tuluksak Rivers) are present only in the lower river fishery further confounding 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 13 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 accounts 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.

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. Results from 2002 indicate, as described earlier, that more emphasis needs to be put on sex confirmation.

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 this 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 2002 Kuskokwim River chinook salmon subsistence harvest included 35,904 age-1.4 fish (53.7%), 22,239 age-1.3 fish (33.3%), 5,227 age-1.2 fish (7.8%), 3,383 age-1.5 fish (5.1%), 42 age-1.6 fish (0.1%), and 11 age-2.2 fish (Table 9).
- Sex composition of the harvest included 39,643 males (59.3%) and 27,164 females (40.7%), although the female component may be biased high due to possible errors in the sex determination (Table 9).

Comparison of the Subsistence and Escapement ASL Compositions

- Age composition of the subsistence harvest differed from escapements (Figure 3):
  1. Age 1.2 male salmon comprised 6.0% of the subsistence harvest, but escapement averaged 23.4%.
  2. Age-1.4, -1.5, and -1.6 fish comprised 58.9% of the subsistence harvest, but escapement averaged 43.3%.
  3. Age-1.3 chinook salmon were near even in the two populations (33.3% and 30.4%)
- Female chinook salmon composed 40.7% of the subsistence harvest, but escapements averaged 31.9%; however, the subsistence harvest percentage may be biased high due to possible errors in the sex determination (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.

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 decrease over time from 72.3% to 46.2%, age-1.2 fish increased from 0.8% to 15.4%, and the percentage of female chinook salmon decreased over time from 43.7% to 30.8% (Figure 8).

Adequacy of Sample Sizes and Participation

- Unknown how representative samples are of total harvest. Assume ASL composition of pooled samples adequate to represent total harvest from 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

- 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 include more samples from rod and reel, and fish wheel subsistence harvest in each reporting area.

- 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 salmon fishing in the Kuskokwim River in 2002 (Ward et al. 2003).

Reporting Area	Number of Households Reporting Types Gear Used						
	Set Gillnet	Drift Gillnet	Fish Wheel	Rod & Reel	Seine	Spear	Total
Lower Kuskokwim River	200	882	0	199	0	0	1,281
	16%	69%	0%	16%	0%	0%	100%
Middle Kuskokwim River	35	115	2	86	0	0	238
	15%	48%	1%	36%	0%	0%	100%
Upper Kuskokwim River	46	36	0	55	0	0	137
	34%	26%	0%	40%	0%	0%	100%
Drainage Total	281	1033	2	340	0	0	1,656
	17%	62%	0%	21%	0%	0%	100%

[a] Used for all species of salmon caught.

Table 2. Sample distribution by gear type and location in the 2002 Kuskokwim River chinook salmon subsistence harvest ASL sampling program.

Gear type	Lower Kuskokwim					Middle Kuskokwim			Upper Kuskokwim	Total
	Tuntutuliak	Napakiak	Bethel [c]	Akiachak	Lower Kuskokwim Subtotals	Kalskag [b]	Aniak	Middle Kuskokwim Subtotal	McGrath	
Rod & reel									34	34
Subtotal					0			0	34	34
Percent					0%			0%	2%	2%
Gillnets										
8-3/4 inch mesh										0
8-1/2 inch mesh	76	33		17						126
8-1/4 inch mesh	11	228	22	13					21	295
8-1/8 inch mesh			254							254
8.0 inch mesh	43		499	28		208	352			1,130
Subtotal					1,224			560	21	1,805
Percent					55%			25%	1%	81%
7-7/8 inch mesh			6							6
7-1/2 inch mesh			40							40
7-1/4 inch mesh	20		30							50
7.0 inch mesh			41				23			64
6-1/2 inch mesh			31							31
Subtotal					168			23	0	191
Percent					8%			1%	0%	9%
6.0 inch mesh			3	34		50	10			97
5-7/8 inch mesh				3						3
5-1/2 inch mesh			50							50
5-3/8 inch mesh			9							9
4-1/2 inch mesh									29	29
4.0 inch mesh			10							10
Subtotal					109			60	29	198
Percent					5%			3%	1%	9%
Subtotal [a]	150	261	995	95	1,501	258	385	643	84	2,228
Percent	7%	12%	45%	4%	67%	12%	17%	29%	4%	100%
Number of Participant Samplers	1	3	18	2	24	4	3	7	5	36

[a] Sample size includes unaged chinook salmon samples.

[b] Includes both Upper Kalskag and Lower Kalskag.

[c] Samples collected by ADF&G staff are from Bethel.

Table 3. Age and sex composition of chinook salmon samples from the lower Kuskokwim River subsistence fishery, 2002.

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 %
6/6 - 7/8	97	M	16	16.5	19	19.6	0	0.0	13	13.4	1	1.1	0	0.0	49	50.5
6 inch or less mesh		F	15	15.5	12	12.4	0	0.0	20	20.6	1	1.0	0	0.0	48	49.5
		Total	31	32.0	31	32.0	0	0.0	33	34.0	2	2.1	0	0.0	97	100.0
6/12 - 24	158	M	16	10.1	41	25.9	0	0.0	35	22.2	5	3.1	0	0.0	97	61.4
6 1/2 - 7 7/8 inch mesh		F	1	0.7	14	8.9	0	0.0	44	27.8	2	1.3	0	0.0	61	38.6
		Total	17	10.8	55	34.8	0	0.0	79	50.0	7	4.4	0	0.0	158	100.0
6/5 - 8	110	M	4	3.6	34	30.9	0	0.0	35	31.8	4	3.6	0	0.0	77	70.0
8 inch and greater mesh		F	0	0.0	6	5.5	0	0.0	27	24.6	0	0.0	0	0.0	33	30.0
		Subtotal	4	3.6	40	36.4	0	0.0	62	56.4	4	3.6	0	0.0	110	100.0
6/12 -15	642	M	25	3.9	159	24.8	0	0.0	164	25.5	11	1.7	0	0.0	359	55.9
8 inch and greater mesh		F	8	1.2	58	9.0	0	0.0	197	30.7	19	3.0	1	0.2	283	44.1
		Subtotal	33	5.1	217	33.8	0	0.0	361	56.2	30	4.7	1	0.2	642	100.0
6/19 - 22	282	M	18	6.4	78	27.6	0	0.0	69	24.4	10	3.6	0	0.0	175	62.1
8 inch and greater mesh		F	1	0.3	18	6.4	0	0.0	80	28.4	8	2.8	0	0.0	107	37.9
		Subtotal	19	6.7	96	34.0	0	0.0	149	52.8	18	6.4	0	0.0	282	100.0
6/26 - 29	77	M	2	2.6	19	24.7	0	0.0	22	28.6	2	2.6	0	0.0	45	58.4
8 inch and greater mesh		F	0	0.0	7	9.1	0	0.0	22	28.5	3	3.9	0	0.0	32	41.6
		Total	2	2.6	26	33.8	0	0.0	44	57.1	5	6.5	0	0.0	77	100.0
6/5 - 29	1,111	M	49	4.4	290	26.1	0	0.0	290	26.1	27	2.4	0	0.0	656	59.0
8 inch and greater mesh		F	9	0.8	89	8.0	0	0.0	326	29.3	30	2.7	1	0.1	455	41.0
All Dates Combined		Total	58	5.2	379	34.1	0	0.0	616	55.4	57	5.1	1	0.1	1,111	100.0
6/5 - 7/8	1,366	M	81	5.9	350	25.6	0	0.0	338	24.7	33	2.4	0	0.0	802	58.7
All Gear Types		F	25	1.8	115	8.4	0	0.0	390	28.6	33	2.4	1	0.1	564	41.3
		Total	106	7.8	465	34.0	0	0.0	728	53.3	66	4.8	1	0.1	1,366	100.0

Table 4. Mean length (mm) of chinook salmon samples from the lower Kuskokwim River subsistence fishery, 2002.

Sample Dates Gear	Sex		Age Class 1.2	2.2	1.3	1.4	1.5	1.6
6/6 - 7/8	M	Mean Length	537		659	790	940	
6 inch or less mesh		Range	450-660		504-750	630-895	940-940	
		Sample Size	16	0	19	13	1	0
	F	Mean Length	519		677	819	892	
		Range	450-580		600-750	740-920	892-892	
		Sample Size	15	0	12	20	1	0
6/12 - 24	M	Mean Length	571		695	792	853	
6 1/2 - 7 7/8 inch mesh		Range	495-730		602-820	675-901	800-910	
		Sample Size	16	0	41	35	5	0
	F	Mean Length	520		703	821	820	
		Range	520-520		500-800	655-950	800-840	
		Sample Size	1	0	14	44	2	0
6/5 - 8	M	Mean Length	605		751	816	846	
8 inch and greater mesh		Range	525-720		645-950	610-1010	780-890	
		Sample Size	4	0	34	35	4	0
	F	Mean Length			751	846		
		Range			620-860	670-1045		
		Sample Size	0	0	6	27	0	0
6/12 - 15	M	Mean Length	560		719	801	869	
8 inch and greater mesh		Range	472-690		500-920	580-1020	760-960	
		Sample Size	25	0	159	164	11	0
	F	Mean Length	566		743	833	870	780
		Range	420-630		610-890	530-950	780-970	780-780
		Sample Size	8	0	58	197	19	1
6/19 - 22	M	Mean Length	557		712	814	875	
8 inch and greater mesh		Range	471-651		520-890	660-1000	773-970	
		Sample Size	18	0	78	69	10	0
	F	Mean Length	620		773	840	875	
		Range	620-620		639-880	709-942	770-955	
		Sample Size	1	0	18	80	8	0
6/26 - 29	M	Mean Length	575		728	845	840	
8 inch and greater mesh		Range	530-620		640-810	720-950	830-850	
		Sample Size	2	0	19	22	2	0
	F	Mean Length			786	824	920	
		Range			710-910	700-950	870-950	
		Sample Size	0	0	7	22	3	0
6/5 - 29	M	Mean Length	563		721	809	866	
8 inch and greater mesh		Range	471-720		500-950	580-1020	760-970	
All Dates Combined		Sample Size	49	0	290	290	27	0
	F	Mean Length	572		753	835	876	780
		Range	420-630		610-910	530-1045	770-970	780-780
		Sample Size	9	0	89	326	30	1
6/5 - 7/8	M	Mean Length	560		715	807	866	
All Gear Types		Range	450-730		500-950	580-1020	760-970	
		Sample Size	81	0	350	338	33	0
	F	Mean Length	538		739	833	873	780
		Range	420-630		500-910	530-1045	770-970	780-780
		Sample Size	25	0	115	390	33	1

Table 5. Age and sex composition of chinook salmon samples from the middle Kuskokwim River subsistence fishery, 2002.

Sample Dates Sample Area Gear	Sample Size (n)	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 %
6/6 - 7/8	52	M	12	23.1	10	19.2	0	0.0	10	19.3	1	1.9	0	0.0	33	63.5
6 inch mesh		F	0	0.0	3	5.8	0	0.0	14	26.9	2	3.9	0	0.0	19	36.5
		Total	12	23.1	13	25.0	0	0.0	24	46.2	3	5.8	0	0.0	52	100.0
6/12 - 24	18	M	3	16.7	6	33.3	0	0.0	2	11.1	0	0.0	0	0.0	11	61.1
7 inch mesh		F	0	0.0	2	11.1	0	0.0	5	27.8	0	0.0	0	0.0	7	38.9
		Total	3	16.7	8	44.4	0	0.0	7	38.9	0	0.0	0	0.0	18	100.0
6/12 - 15	119	M	0	0.0	22	18.5	0	0.0	43	36.2	2	1.7	0	0.0	67	56.3
8 inch mesh		F	1	0.8	4	3.3	0	0.0	43	36.1	4	3.3	0	0.0	52	43.7
		Subtotal	1	0.8	26	21.8	0	0.0	86	72.3	6	5.0	0	0.0	119	100.0
6/19 - 22	297	M	16	5.4	88	29.7	0	0.0	71	23.9	5	1.7	0	0.0	180	60.6
8 inch mesh		F	5	1.7	17	5.7	0	0.0	84	28.3	11	3.7	0	0.0	117	39.4
		Subtotal	21	7.1	105	35.4	0	0.0	155	52.2	16	5.4	0	0.0	297	100.0
6/26 - 29	61	M	3	4.9	19	31.2	0	0.0	12	19.7	2	3.3	0	0.0	36	59.0
8 inch mesh		F	0	0.0	3	4.9	0	0.0	18	29.5	4	6.5	0	0.0	25	41.0
		Subtotal	3	4.9	22	36.1	0	0.0	30	49.2	6	9.8	0	0.0	61	100.0
7/19	26	M	4	15.4	7	26.9	1	3.8	6	23.1	0	0.0	0	0.0	18	69.2
8 inch mesh		F	0	0.0	0	0.0	0	0.0	6	23.1	2	7.7	0	0.0	8	30.8
		Subtotal	4	15.4	7	26.9	1	3.8	12	46.2	2	7.7	0	0.0	26	100.0
6/12 - 7/19	503	M	23	4.6	136	27.0	1	0.2	132	26.3	9	1.8	0	0.0	301	59.8
8 inch mesh		F	6	1.2	24	4.8	0	0.0	151	30.0	21	4.2	0	0.0	202	40.2
All Dates Combined		Total	29	5.8	160	31.8	1	0.2	283	56.3	30	6.0	0	0.0	503	100.0
6/6 - 7/19	573	M	38	6.6	152	26.5	1	0.2	144	25.1	10	1.8	0	0.0	345	60.2
All Gear Types		F	6	1.1	29	5.1	0	0.0	170	29.7	23	4.0	0	0.0	228	39.8
		Total	44	7.7	181	31.6	1	0.2	314	54.8	33	5.8	0	0.0	573	100.0

Table 6. Mean length (mm) of chinook salmon samples from the middle Kuskokwim River subsistence fishery, 2002.

Sample Dates Gear	Sex		Age Class 1.2	2.2	1.3	1.4	1.5	1.6
6/6 - 7/8	M	Mean Length	556		676	787	880	
6 inch mesh		Range	480-610		600-720	670-910	880-880	
		Sample Size	12	0	10	10	1	0
	F	Mean Length			633	828	760	
		Range			580-670	760-870	700-820	
		Sample Size	0	0	3	14	2	0
6/12-24	M	Mean Length	550		628	775		
7 inch mesh		Range	540-570		560-680	750-800		
		Sample Size	3	0	6	2	0	0
	F	Mean Length			655	814		
		Range			630-680	760-900		
		Sample Size	0	0	2	5	0	0
6/12 - 15	M	Mean Length			718	812	820	
8 inch mesh		Range			400-860	690-980	815-825	
		Sample Size	0	0	22	43	2	0
	F	Mean Length	530		766	833	911	
		Range	530-530		690-880	730-930	820-1000	
		Sample Size	1	0	4	43	4	0
6/19 - 22	M	Mean Length	555		714	799	846	
8 inch mesh		Range	450-625		500-920	650-1000	810-960	
		Sample Size	16	0	88	71	5	0
	F	Mean Length	516		744	844	875	
		Range	450-590		550-890	660-970	740-930	
		Sample Size	5	0	17	84	11	0
6/26 - 29	M	Mean Length	547		711	854	930	
8 inch mesh		Range	500-570		600-800	760-990	900-960	
		Sample Size	3	0	19	12	2	0
	F	Mean Length			730	801	845	
		Range			700-770	720-900	800-910	
		Sample Size	0	0	3	18	4	0
7/19	M	Mean Length	538	530	697	833		
8 inch mesh		Range	500-600	530-530	640-750	700-920		
		Sample Size	4	1	7	6	0	0
	F	Mean Length				860	815	
		Range				810-900	790-840	
		Sample Size	0	0	0	6	2	0
6/12 - 7/19	M	Mean Length	551	530	713	810	859	
8 inch mesh		Range	450-625	530-530	400-920	650-1000	810-960	
All Dates Combined		Sample Size	23	1	136	132	9	0
	F	Mean Length	518		746	836	871	
		Range	450-590		550-890	660-970	740-1000	
		Sample Size	6	0	24	151	21	0
6/6 - 7/19	M	Mean Length	552	530	707	808	861	
All Gear Types		Range	450-625	530-530	400-920	650-1000	810-960	
		Sample Size	38	1	152	144	10	0
	F	Mean Length	518		728	835	861	
		Range	450-590		550-890	660-970	700-1000	
		Sample Size	6	0	29	170	23	0

Table 7. Age and sex composition of chinook salmon samples from the upper Kuskokwim River subsistence fishery, 2002.

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	%
6/30 - 7/6	31	M	1	6.7	4	26.7	0	0.0	7	46.6	0	0.0	0	0.0	12	80.0
Rod and reel		F	0	0.0	2	13.3	0	0.0	1	6.7	0	0.0	0	0.0	3	20.0
		Total	1	6.7	6	40.0	0	0.0	8	53.3	0	0.0	0	0.0	15	100.0
7/1 - 17	25	M	4	9.7	7	17.1	0	0.0	13	31.7	0	0.0	0	0.0	24	58.5
4 1/2 inch mesh		F	2	4.9	1	2.4	0	0.0	10	24.4	4	9.8	0	0.0	17	41.5
		Total	6	14.6	8	19.5	0	0.0	23	56.1	4	9.8	0	0.0	41	100.0
7/7 - 11	19	M	0	0.0	3	15.8	0	0.0	11	57.9	2	10.5	0	0.0	16	84.2
8 1/4 inch mesh		F	0	0.0	0	0.0	0	0.0	3	15.8	0	0.0	0	0.0	3	15.8
		Total	0	0.0	3	15.8	0	0.0	14	73.7	2	10.5	0	0.0	19	100.0
6/30 - 7/17	75	M	5	6.6	14	18.7	0	0.0	31	41.3	2	2.7	0	0.0	52	69.3
All Gear Types		F	2	2.7	3	4.0	0	0.0	14	18.7	4	5.3	0	0.0	23	30.7
		Total	7	9.3	17	22.7	0	0.0	45	60.0	6	8.0	0	0.0	75	100.0

Table 8. Mean length (mm) of chinook salmon samples from the upper Kuskokwim River subsistence fishery, 2002.

Sample Dates Gear	Sex		Age Class 1.2	2.2	1.3	1.4	1.5	1.6
6/30 - 7/6	M	Mean Length	608		711	833		
Rod and reel		Range	608-608		685-750	760-875		
		Sample Size	1	0	4	7	0	0
	F	Mean Length			590	775		
		Range			480-700	775-775		
		Sample Size	0	0	2	1	0	0
7/1 - 7/17	M	Mean Length	518		674	820		
4 1/2 inch mesh		Range	459-584		560-737	730-991		
		Sample Size	4	0	7	13	0	0
	F	Mean Length	528		730	803	870	
		Range	509-546		730-730	770-850	839-890	
		Sample Size	2	0	1	10	4	0
7/1 - 7/17	M	Mean Length			851	943	1029	
8 1/4 inch mesh		Range			787-940	813-1067	991-1067	
		Sample Size	0	0	3	11	2	0
	F	Mean Length				957		
		Range				914-991		
		Sample Size	0	0	0	3	0	0
6/30 - 7/17	M	Mean Length	536		723	867	1029	
All Gear Types		Range	459-608		560-940	730-1067	991-1067	
		Sample Size	5	0	14	31	2	0
	F	Mean Length	528		637	834	870	
		Range	509-546		480-730	770-991	839-890	
		Sample Size	2	0	3	14	4	0

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

Reporting Area		Age Class													
		1.2		1.3		2.2		1.4		1.5		1.6		Total [b]	
	Sex	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Total Kuskokwim River-2001[f]	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
	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
Lower Kuskokwim River[c]	M	3,407	5.9	14,722	25.6	0	0.0	14,217	24.7	1,388	2.4	0	0.0	33,734	58.7
	F	1,052	1.8	4,837	8.4	0	0.0	16,404	28.6	1,388	2.4	42	0.1	23,723	41.3
	Subtotal	4,459	7.8	19,559	34.0	0	0.0	30,621	53.3	2,776	4.8	42	0.1	57,457	100.0
Middle Kuskokwim River[d]	M	417	6.6	1,668	26.5	11	0.2	1,580	25.1	110	1.7	0	0.0	3,785	60.2
	F	66	1.0	318	5.1	0	0.0	1,865	29.7	252	4.0	0	0.0	2,502	39.8
	Subtotal	483	7.7	1,986	31.6	11	0.2	3,445	54.8	362	5.8	0	0.0	6,287	100.0
Upper Kuskokwim River[e]	M	204	6.7	572	18.7	0	0.0	1,266	41.3	82	2.7	0	0.0	2,124	69.3
	F	82	2.7	123	4.0	0	0.0	572	18.7	163	5.3	0	0.0	939	30.7
	Subtotal	286	9.3	694	22.7	0	0.0	1,838	60.0	245	8.0	0	0.0	3,063	100.0
Total Kuskokwim River-2002[f]	M	4,028	6.0	16,961	25.4	11	0.0	17,063	25.5	1,579	2.4	0	0.0	39,643	59.3
	F	1,199	1.8	5,278	7.9	0	0.0	18,841	28.2	1,804	2.7	42	0.1	27,164	40.7
	Total	5,227	7.8	22,239	33.3	11	0.0	35,904	53.7	3,383	5.1	42	0.1	66,807	100.0

a Applied percentages for each geographic section are from samples collected in each geographic section.

b Subsistence harvest numbers correspond to draft data compiled by Subsistence Division.

c Includes harvests from communities Tuntutuliak to Tuluksak.

d Includes harvests from communities Lower Kalskag to Chuathbaluk.

e Includes harvests from communities Croked Creek to Telida.

f The number of fish in the "Total Kuskokwim River" is the sum of the lower, middle and upper geographic sections. Percentages are derived from the sums. North Kuskokwim Bay communities (Kipnuk, Kwigillingok and Kongiganak) are not included.

Table 10. ASL composition of the Kuskokwim River chinook salmon escapement, and subsistence harvest from 2002.

Information Source	Male 1.2 [a]	Male 1.3	Female 1.3	Male 1.4	Female 1.4	Male 1.5	Female 1.5
	Percent Age-Sex Category						
		Percen					
Takotna Weir	21.0	28.2	1.7	19.1	26.7		0.9
Tatlawiksuk Weir	22.8	16.8	2.9	17.3	37.9	0.9	2.7
Kogrukluk Weir	17.4	45.7	4.3	10.8	20.4	0.5	0.9
George Weir	12.6	17.1	1.2	27.4	33.5	2.3	5.9
Kwethluk Weir	43.7	27.1	4.6	11.0	16.5	0.6	1.8
Tuluksak Weir	23.1	26.3	6.0	7.9	12.7	0.5	1.4
Escapement Average	23.4	26.9	3.5	15.6	24.6	1.0	2.3
Subsistence Fishery	6.0 [a]	25.4	7.9	25.6	28.2	2.4	2.7
	Average Length by Age in (mm)						
Takotna Weir	554	679	820	765	867		827
Tatlawiksuk Weir	556	691	695	754	790	825	887
Kogrukluk Weir	563	684	777	769	857	945	882
George Weir	482	690	653	812	844	894	900
Kwethluk Weir	547	668	724	757	851	807	923
Tuluksak Weir	541	667	711	786	850	915	891
Escapement Average	541	680	730	774	843	877	885
Subsistence Fishery	556 [a]	713	735	811	833	872	868

	Season Percent Females	
	Females	Sample Size
Takotna Weir	30.0	98
Tatlawiksuk Weir	36.8	279
Kogrukluk Weir	25.5	466
George Weir	40.6	315
Kwethluk Weir	20.8	807
Tuluksak Weir	37.8	188
Weir Average	31.9	
Subsistence Fishery	40.7	

[a] Sex determinations of age-1.2 fish identified as females were assumed to be erroneous, and are included here under age-1.2 males fish.

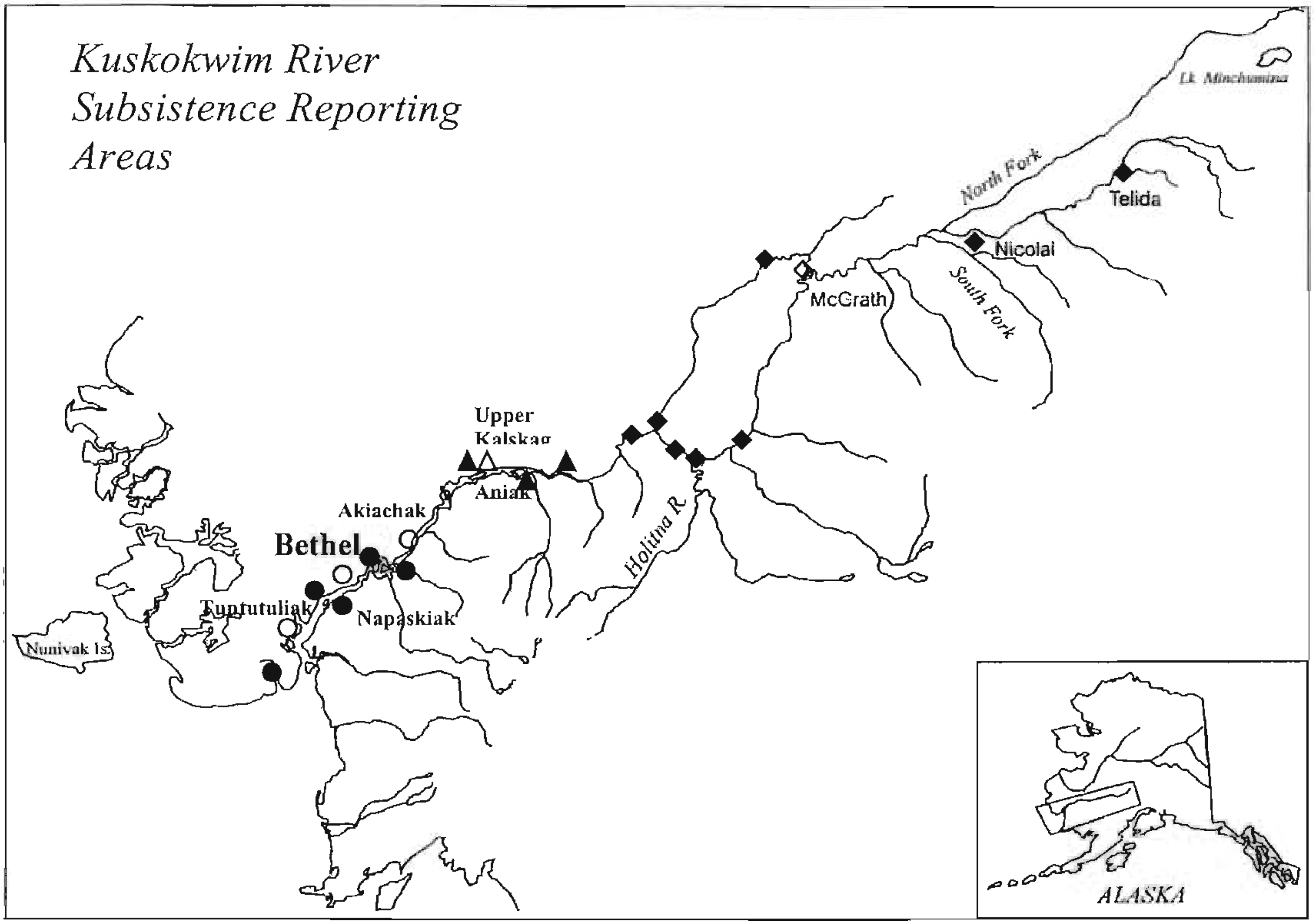


Figure 1. The Kuskokwim River drainage, with notation of village locations in the lower (circles), middle (triangles) and upper river (diamonds) reporting areas.

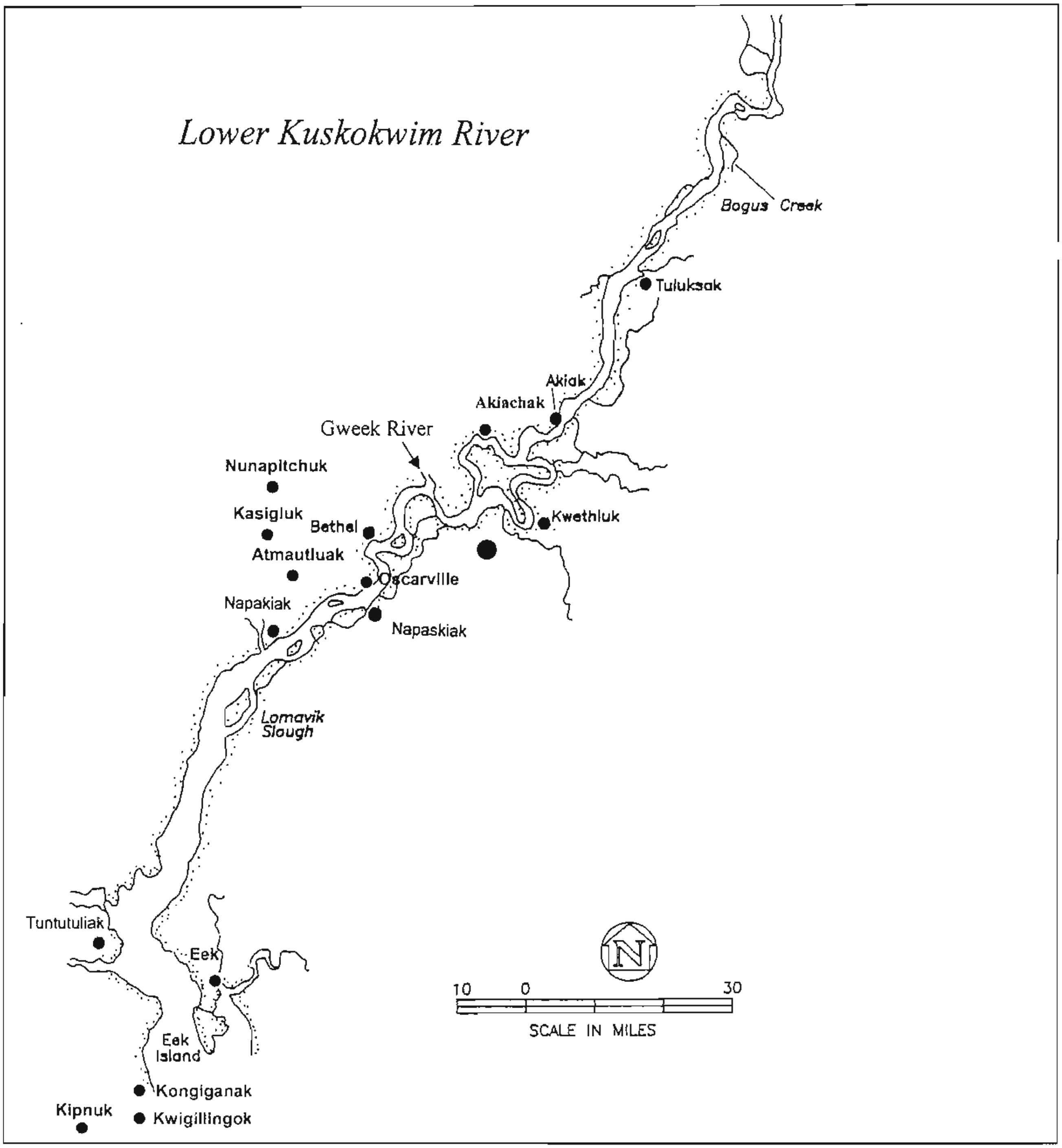


Figure 2. The lower Kuskokwim River reporting area, with notation of village locations.

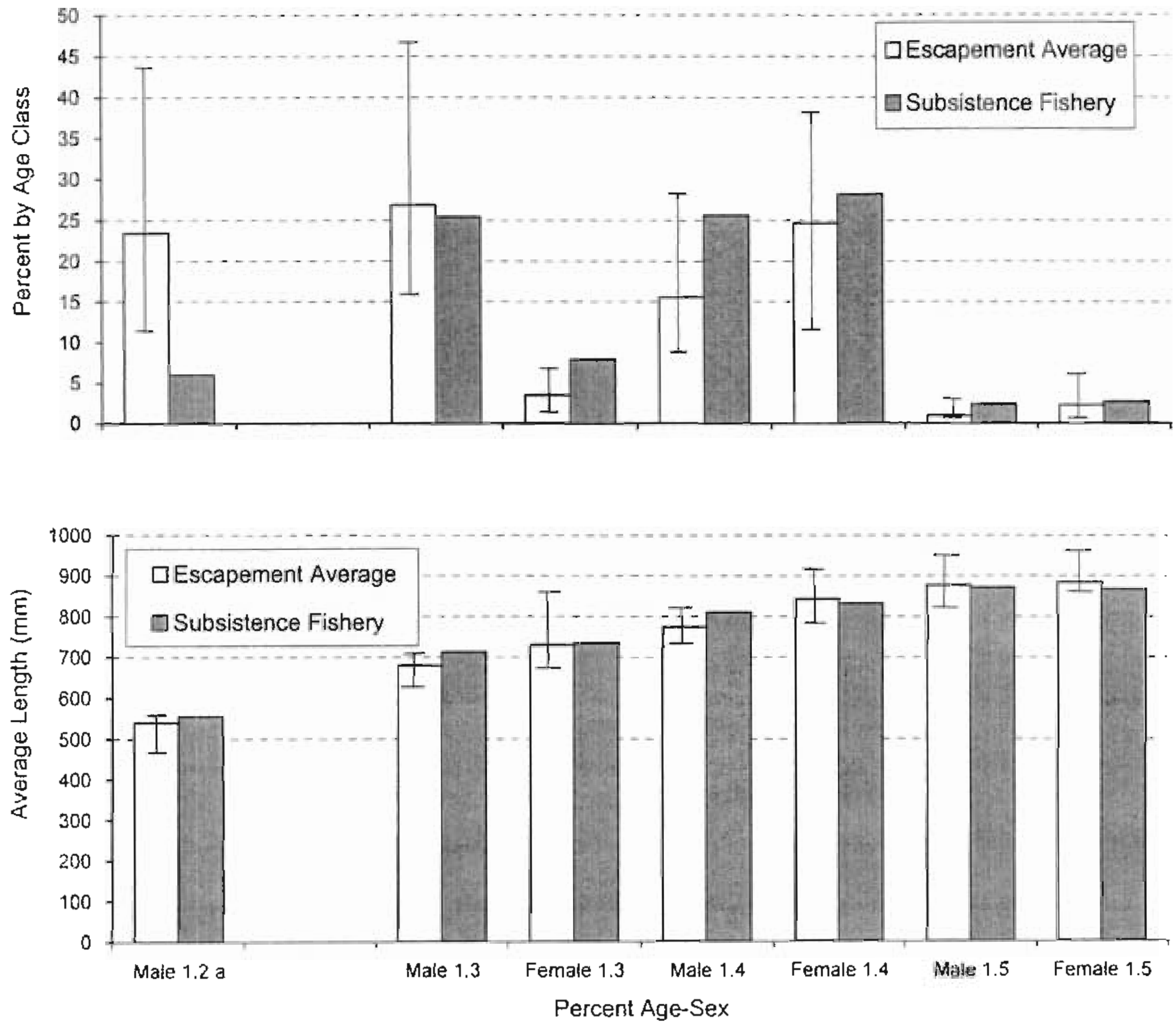


Figure 3. ASL composition of the Kuskokwim River chinook salmon subsistence harvest and escapement (with range) from 2002.

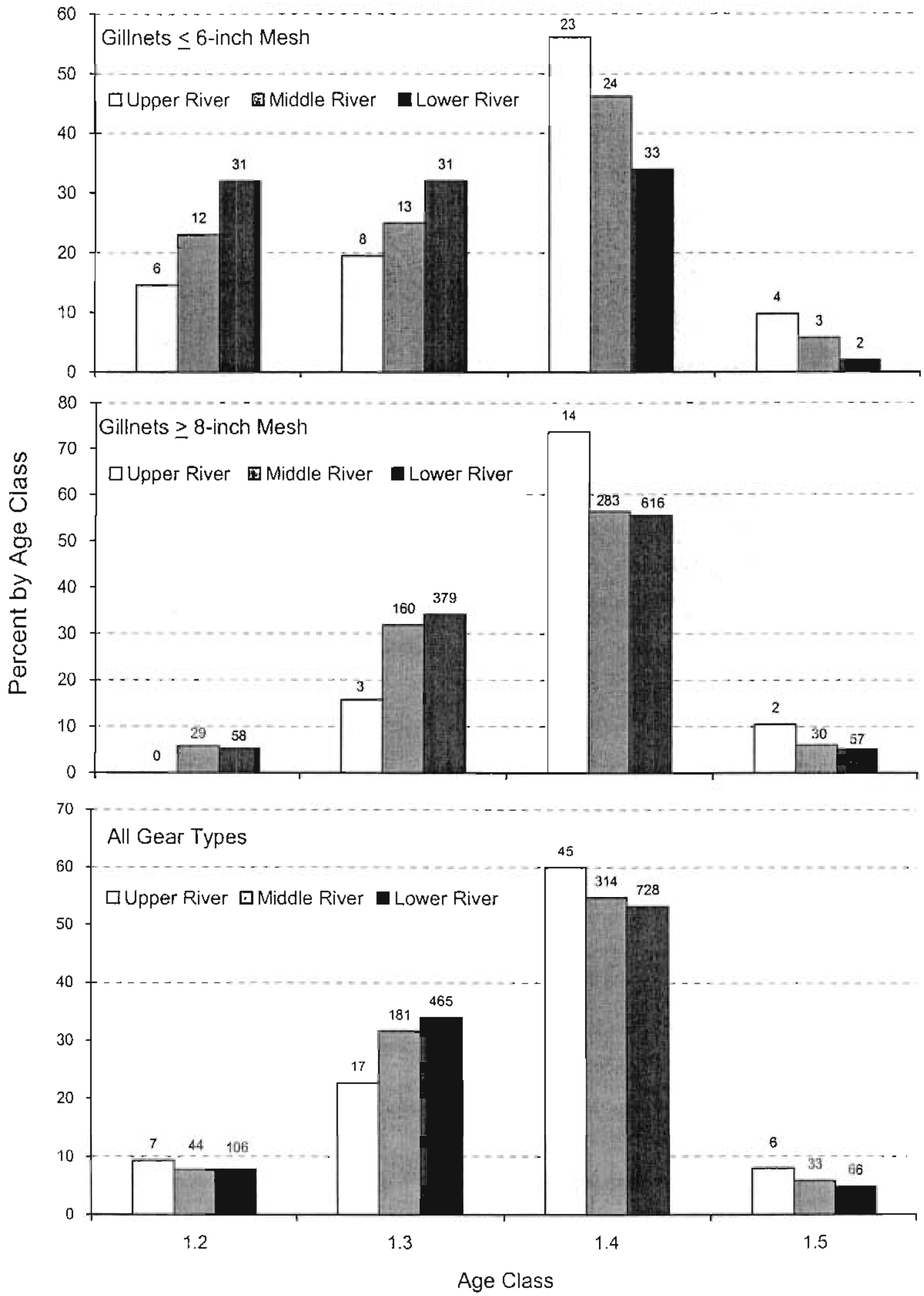


Figure 4. Age class composition of chinook salmon harvest by gear type in the upper, middle and lower Kuskokwim River subsistence fisheries, 2002. The number on the top of each bar is the sample size.

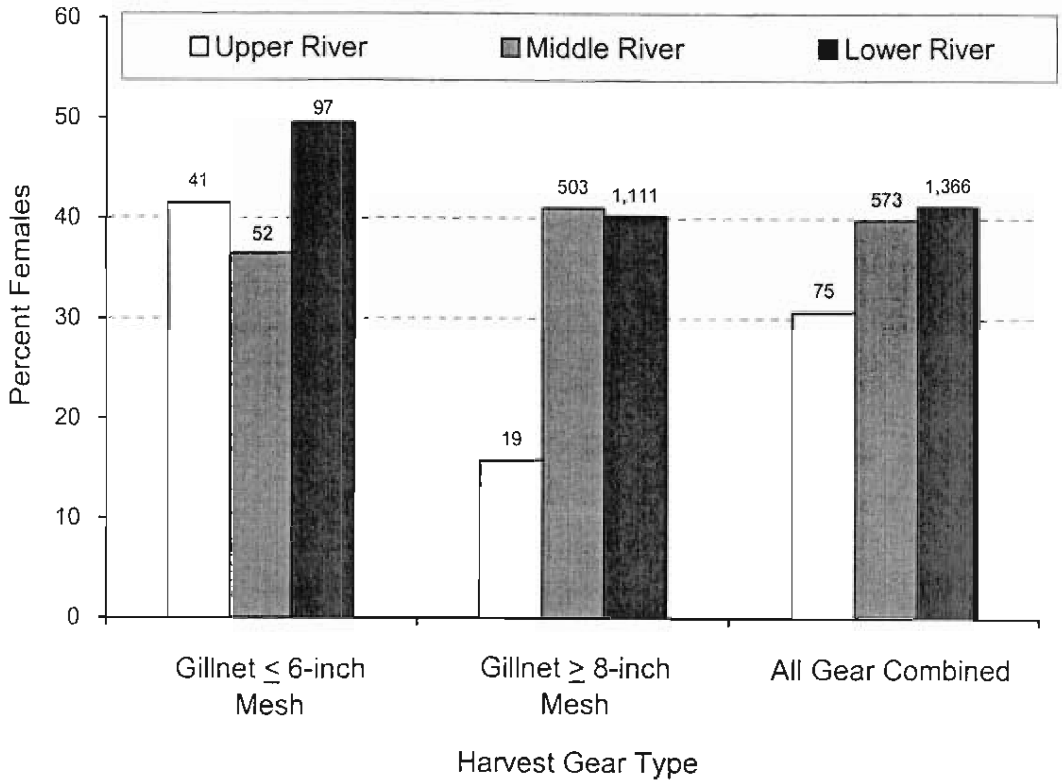


Figure 5. Percentage of female chinook salmon by gear type, harvested in the upper, middle, and lower Kuskokwim River subsistence fishery, 2002. The number on top of each bar is the sample size.

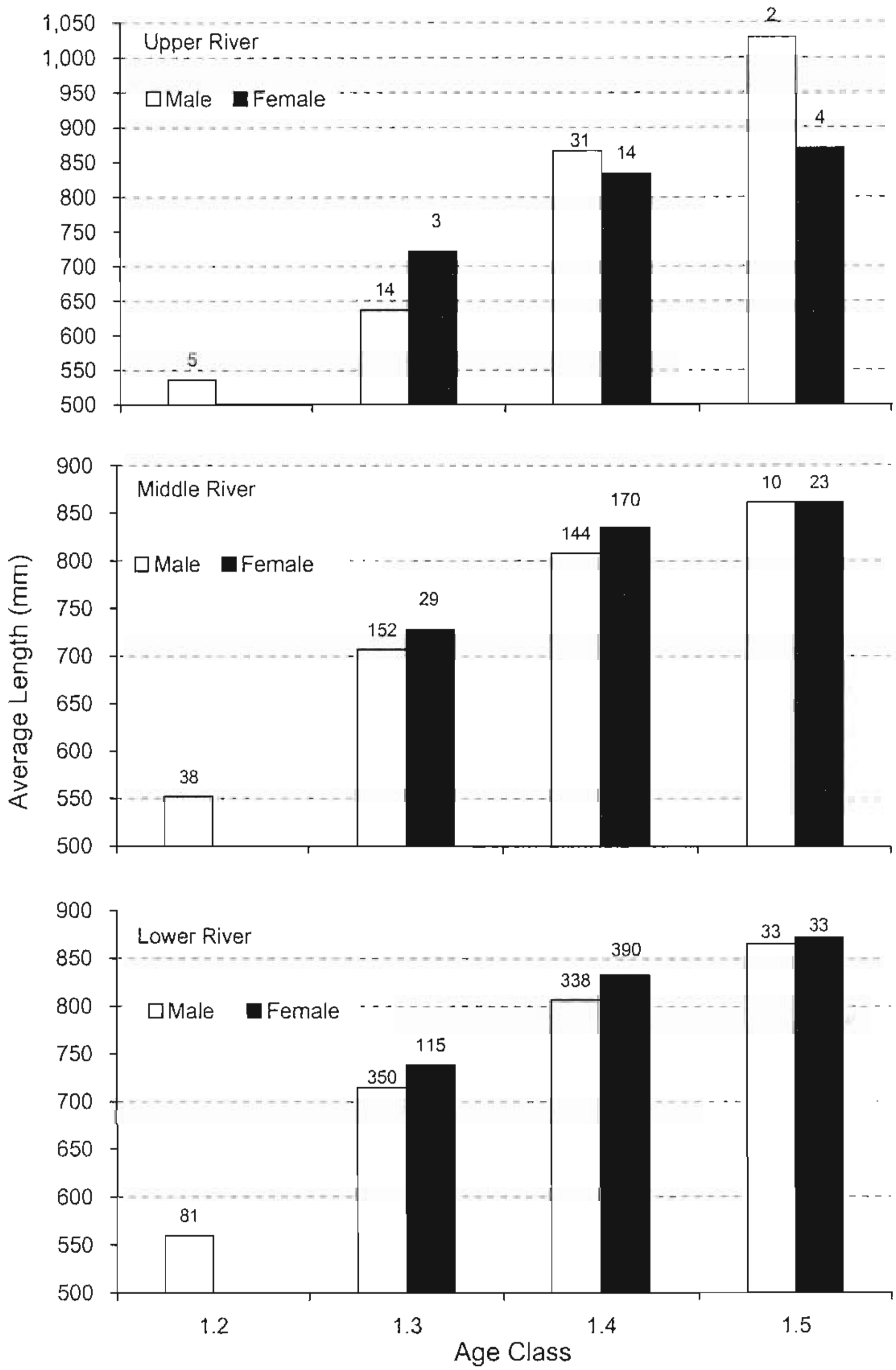


Figure 6. Average length by age and sex of chinook salmon harvested in the upper, middle and lower Kuskokwim River subsistence fisheries in 2002, for all gear types. The number on the top of of each bar is the sample size.

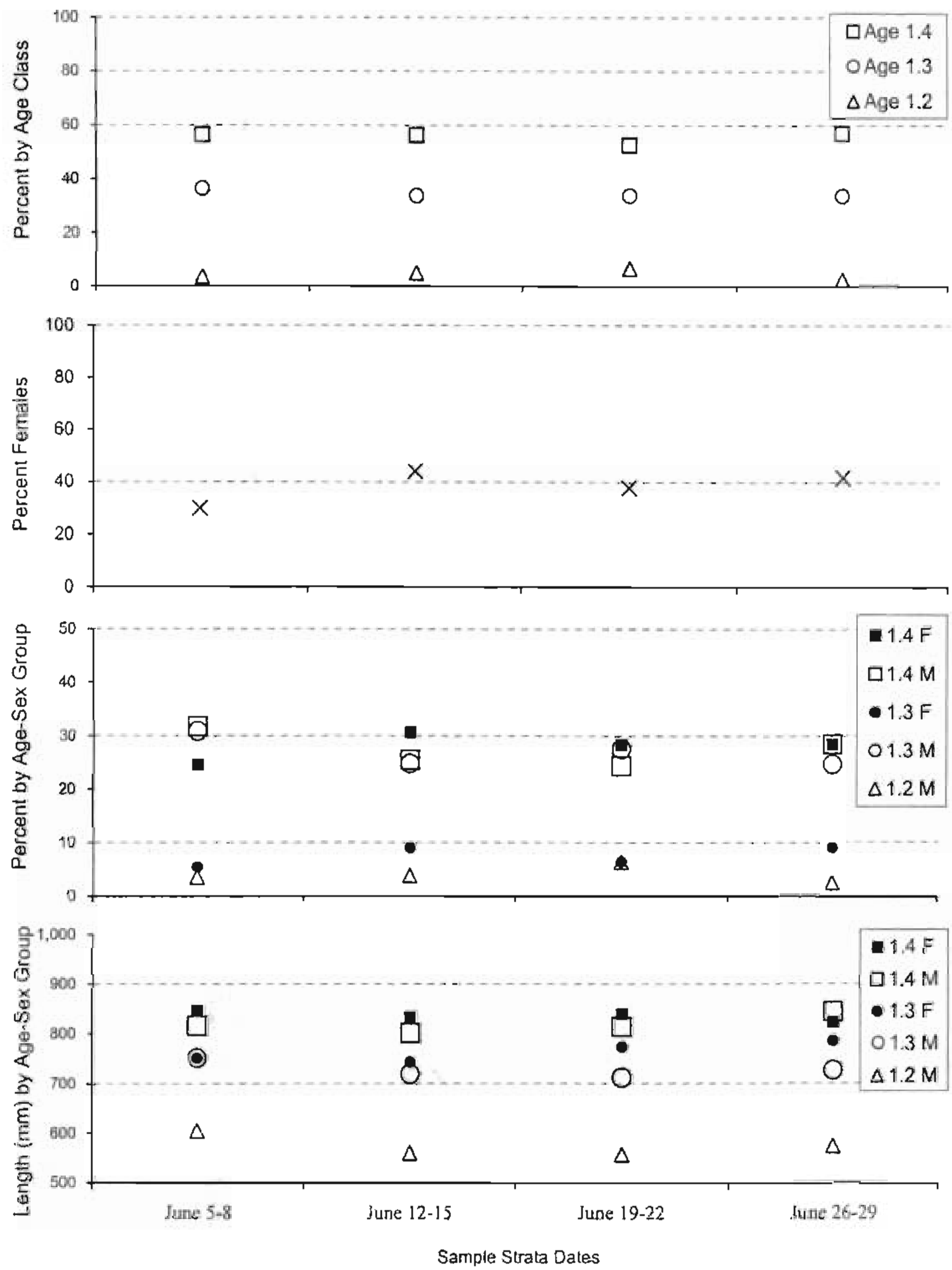


Figure 7. Temporally stratified ASL composition of chinook salmon harvested in the lower Kuskokwim River subsistence fishery with gillnets of 8-inch and larger mesh size, 2002.

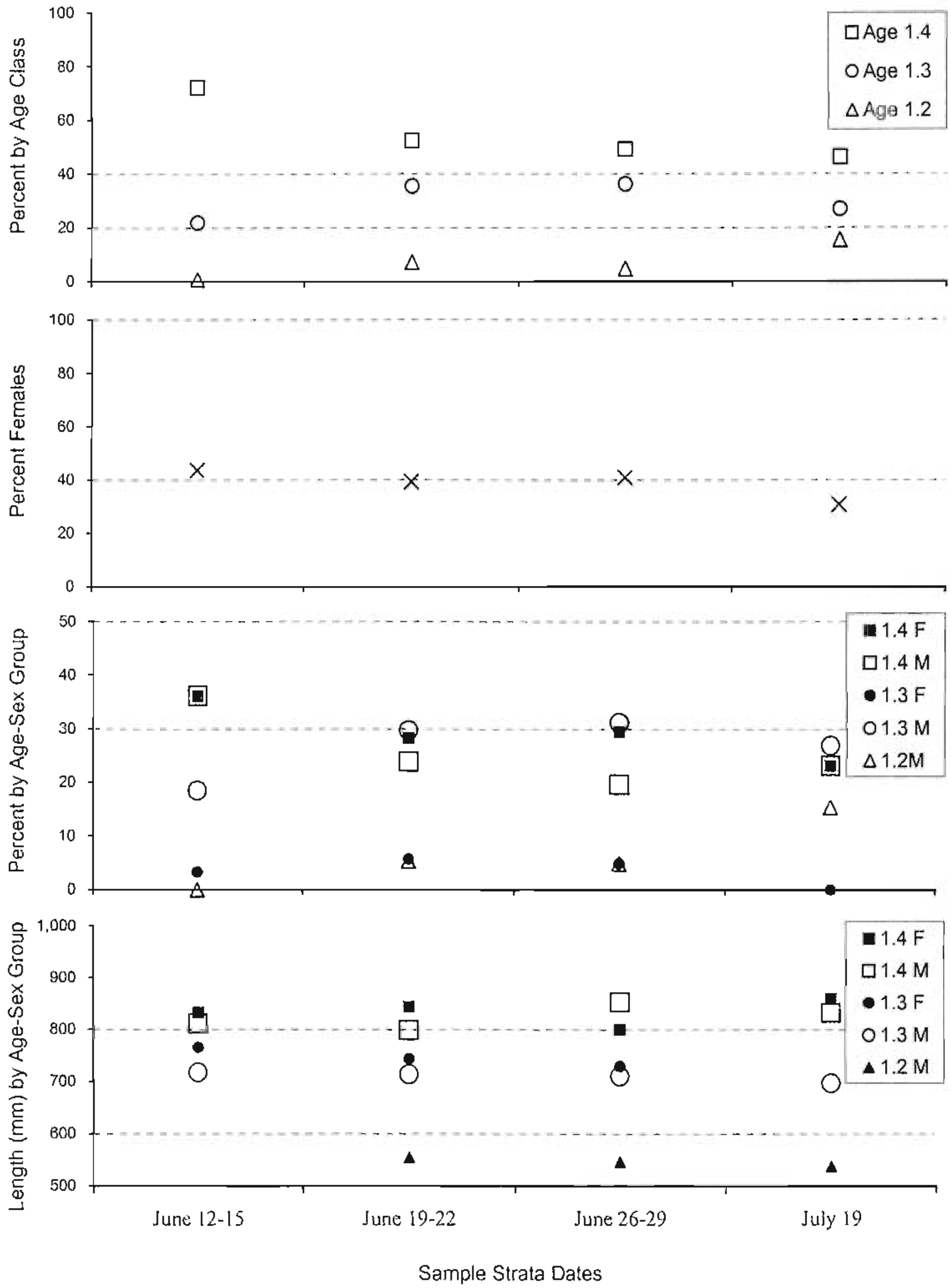


Figure 8. Temporally stratified ASL composition of chinook salmon harvested in the middle Kuskokwim River subsistence fishery with gillnets of 8-inch and larger mesh size, 2002.

Appendix A. Data form used for age-sex-length sampling of chinook salmon, 2002.

SUBSISTENCE KING SALMON DATA FORM

Name: ______________________________ Scale Card Number: __________

Sample Date: ____________ (month/ day/ year)

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

Gear Type: Drift Gillnet Set Gillnet Rod & Reel Fishwheel

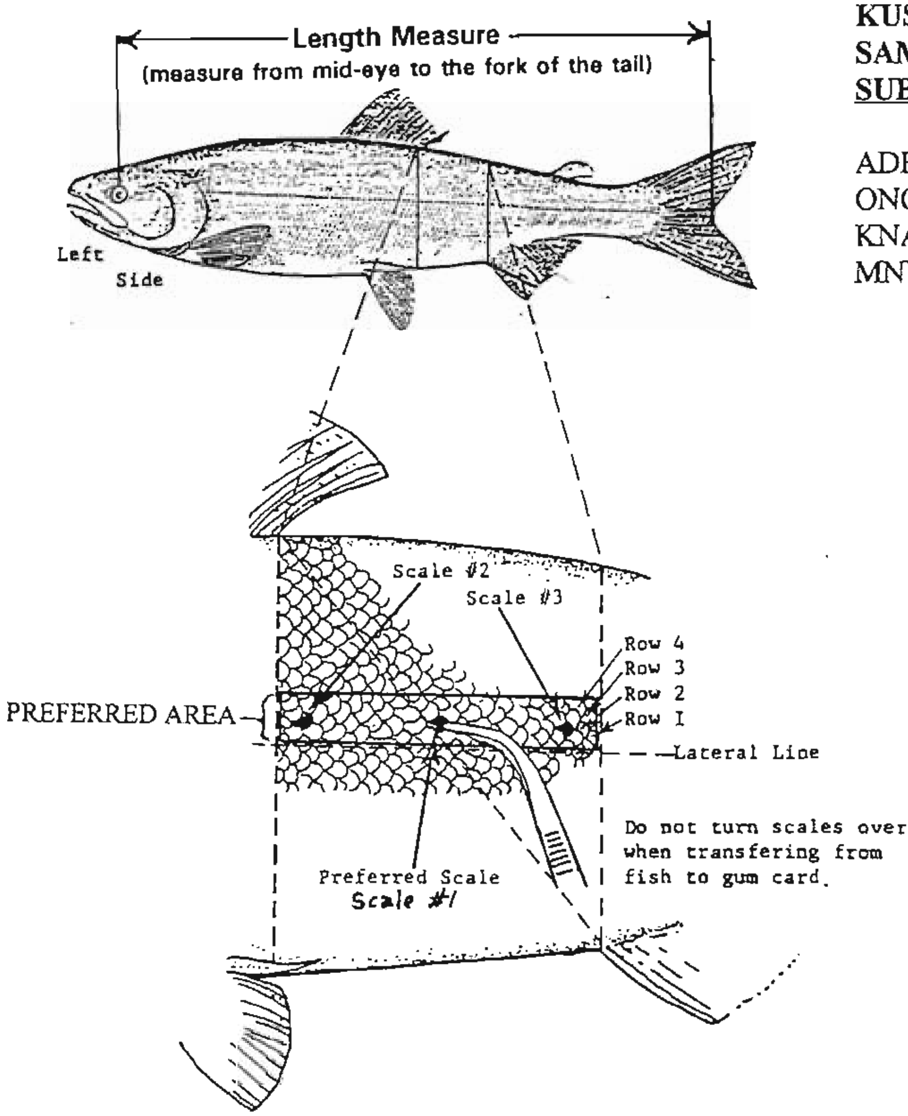
Mesh Size: __________ Did you cut every fish to look for eggs? Yes or No

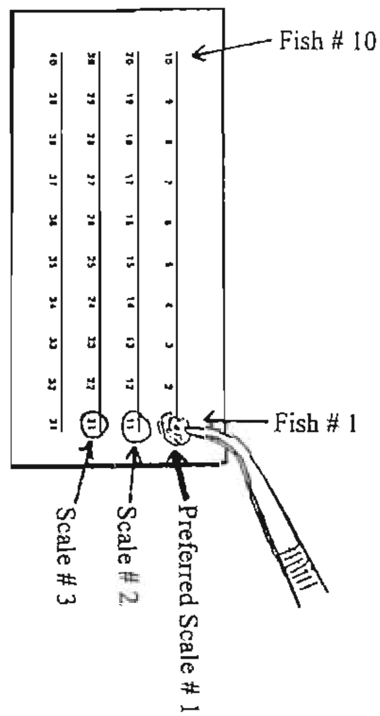
Fish Number	Sex (M or F)	Length (mm)	Comments
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

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

KUSKOKWIM RIVER SAMPLING PROGRAM FOR SUBSISTENCE KING SALMON

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





Age-Sex-Length Sampling Instructions

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 and 2002 (ADF&G 2003).

Community	Year	
	2001	2002
Kipnuk [a]	1	1
Kwigillingok [a]	0	0
Kongiganak [a]	1,454	808
N. Kuskokwim Bay	1,455	809
Tuntutuliak	2,993	3,632
Eek	1,728	2,432
Kasigluk [a]	588	381
Nunapitchuk	3,250	3,883
Atmautluak	740	1,282
Napakiak	2,290	1,931
Napaskiak	4,662	3,856
Oscarville	1,753	953
Bethel	27,209	19,305
Kwethluk	6,127	6,429
Akiachak	6,445	6,860
Akiak	3,369	3,340
Tuluksak	2,451	2,364
Lower Kuskokwim	63,605	56,648
Lower Kalskag	2,181	1,210
Upper Kalskag	1,014	1,420
Aniak	2,524	2,994
Chuathbaluk	627	663
Middle Kuskokwim	6,346	6,287
Crooked Creek	508	790
Red Devil	175	248
Sleetmute	473	516
Stony River	139	293
Lime Village	262	not surveyed
McGrath	360	700
Takotna	5	9
Nikolai	282	507
Telida [a]	0	0
Upper Kuskokwim	2,204	3,063
Kuskokwim River	73,610	66,807

[a] Kipnuk, Kwigillingok, Kasigluk, and Telida data are from calander reporting only.

Age-Sex-Length Sampling from Subsistence Harvested King Salmon in 2002

Subsistence fishers in the Kuskokwim River collected information from their king salmon harvests to help biologists better understand the age, size and sex of the king salmon harvested for subsistence. The following information is a summary of those findings:

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

(2) A total of 2,144 king salmon were sampled from Kuskokwim River harvests near Tuntutuliak, Napakiak, Bethel, Akiachak, Kalskag, Aniak and McGrath.

(3) Samples were collected from a variety of gear types (Figure 1):
- (a) 15 drift gillnet mesh sizes (4, 4-1/2, 5-3/8, 5-1/2, 5-7/8, 6, 6-1/2, 7, 7-1/4, 7-1/2, 7-7/8, 8, 8-1/8, 8-1/4 and 8-1/2 inches),
- (b) 3 set gillnet mesh sizes (4, 8 and 8-1/4 inches),
- (c) and rod and reel gear;
- (d) 83% were from gillnets with mesh size of 8 inches or larger.

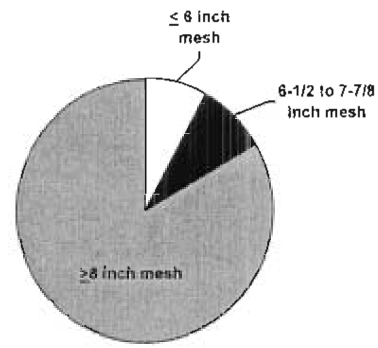
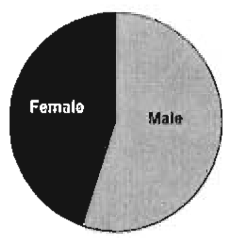
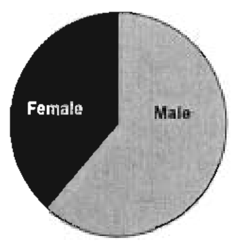


Figure 1. Mesh size composition of king salmon samples collected in the Kuskokwim River subsistence fishery.

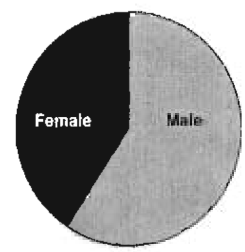
(4) Sex composition by mesh size was (Figure 2):
- (a) 45 % female for less than or equal to 6 inch mesh,
- (b) 39 % female for 6-1/2 to 7-7/8 inch mesh,
- (c) and 47% female for greater than or equal to 8 inch mesh.



Sex composition for less than or equal to 6 inch mesh



Sex composition 6-1/2 to 7-7/8 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 Kuskokwim River subsistence fishery.

(5) Age composition from all gear types (Figure 3):
- (a) Age-3 = 0.1%
- (b) Age-4 = 7.8%
- (c) Age-5 = 32.9%
- (d) Age-6 = 54.0%
- (e) Age-7 = 5.2%

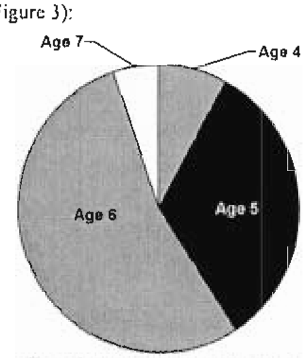


Figure 3. Age composition king salmon subsistence samples

(6) Mean length at age, by sex, was:
- (a) Age-4 male = 556mm
- (b) Age-5 male = 713mm
- (c) Age-5 female = 735mm
- (d) Age-6 male = 811mm
- (e) Age-6 female = 833mm
- (f) Age-7 male = 872mm
- (g) Age-7 female = 868mm

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