KUSKOKWIM COMMERCIAL SALMON FISHERY

Area Description and Gear Types

Significant numbers of all 5 species of Pacific salmon return to the Kuskokwim area and at statehood, commercial fishing districts were established. District 1, the lower Kuskokwim District, is located in the lower 125 miles of the Kuskokwim River from Eek Island upstream to Bogus Creek. District 2 is about 50 miles in length and is located in the middle Kuskokwim River from above District 1 to the Kolmakov River near Aniak. An upper Kuskokwim River fishing district, District 3, was defined at Statehood, but has been closed to commercial fishing since 1966. Salmon returning to spawn in the Kuskokwim River are targeted by commercial fishermen in District 1 and 2. District 4, the Quinhagak fishing district, is a marine fishing area that encompasses about 5 miles of shoreline adjacent to the village of Quinhagak. The Kanektok and Arolik Rivers are the primary salmon spawning streams that enter District 4. District 5, the Goodnews Bay fishing district, a second marine fishing area, was established in 1968. District 5 encompasses the marine waters within Goodnews Bay and the Goodnews River is the major salmon spawning stream that enters District 5 (Figure 156). Commercial salmon fishing gear throughout the Kuskokwim area is limited to gillnets.

History of the Commercial Salmon Fishery

Although fishermen first commercially harvested salmon in the Kuskokwim area in 1913, the commercial salmon fishery did not mature until statehood. Small mild-cure commercial salmon operations were conducted in or near Kuskokwim Bay while the Kuskokwim River fishery remained virtually undeveloped. During the 1930s when dog teams were used extensively for freight hauling, a "quasi-commercial" fishery operated in the McGrath area of the Kuskokwim River for the sale of dried, subsistence-caught salmon for dog food. This fishery declined as the use of dog teams for freight declined, and the Kuskokwim area experienced little commercial fishing effort until after Statehood (Jonrowe et al. 1983).

During the 1960s and 1970s the commercial salmon fisheries in the Kuskokwim area were considered experimental. The adaptive fishery management approach was to increase commercial use while monitoring subsistence use and obtaining information on the relationship between catches and returns (Jonrowe et al. 1983). In the 1980s, the management strategy changed from one of commercial harvest guidelines to an escapement objective-based strategy. Harvest levels generally increased until the mid-1990s. Since then, the commercial salmon fishery has been characterized by lower fishing effort levels, lower harvests, and collapsing salmon prices. The intent of the current commercial salmon fisheries management program is to sustain the runs, ensure subsistence needs are met, and with a precautionary approach, provide some opportunity for commercial fishermen to harvest available surpluses. Annual management reports written by ADF&G staff for the Kuskokwim area since the 1960s, provide detailed fishery data and insight into the management program. See Ward et al. (2003).

Commercial harvests of Chinook salmon in the Kuskokwim area peaked in the 1980s when the 10-year annual average harvest was about 70,000 fish (Figure 157, Panel A). Average harvests in the 1990s dropped to about 45,000 fish, while harvests since 2000 have dropped further still to about 22,000 fish. Commercial harvests of sockeye salmon from the Kuskokwim area increased from the 1960s through the 1990s with decadal annual averages increasing from about 5,000 fish in the 1960s to 15,000 fish in the 1970s to 110,000 fish in the 1980s to about 160,000 fish in the 1990s (Figure 157, Panel B). Annual commercial harvests of sockeye salmon since 2000 have averaged about 70,000 fish. Kuskokwim area coho salmon commercial harvests increased each decade, from about 40,000 fish in the 1960s to 150,000 fish in the 1970s to 500,000 fish in the 1980s to about 550,000 fish in 1990s (Figure 157, Panel C). Annual commercial harvests since 2000 have averaged about 300,000 coho salmon. Kuskokwim area chum salmon commercial harvests increased from the 1960s to the 1970s and subsequently peaked in the 1980s when about 560,000 fish were caught per year (Figure 157, Panel E). Decadal annual commercial harvests of chum salmon averaged about 330,000 fish in the 1990s and since 2000 have averaged about 60,000 fish. Abundance of chum salmon in the 1990s and 2000s was less than it was the 1980s. In more recent years, little processor interest coupled with very low prices has had a great impact on chum salmon commercial harvests. Few pink salmon are commercially harvested in the Kuskokwim area. Peak harvest levels occurred in the 1970s and 1990s when average annual harvest levels were about 20,000 fish (Figure 157, Panel D). Cumulative commercial harvests in the Kuskokwim area since 2000 are about the same as occurred in the 1970s and represent about 40% of the harvest levels that took place in the 1980s and 1990s (Figure 157, Panel F).

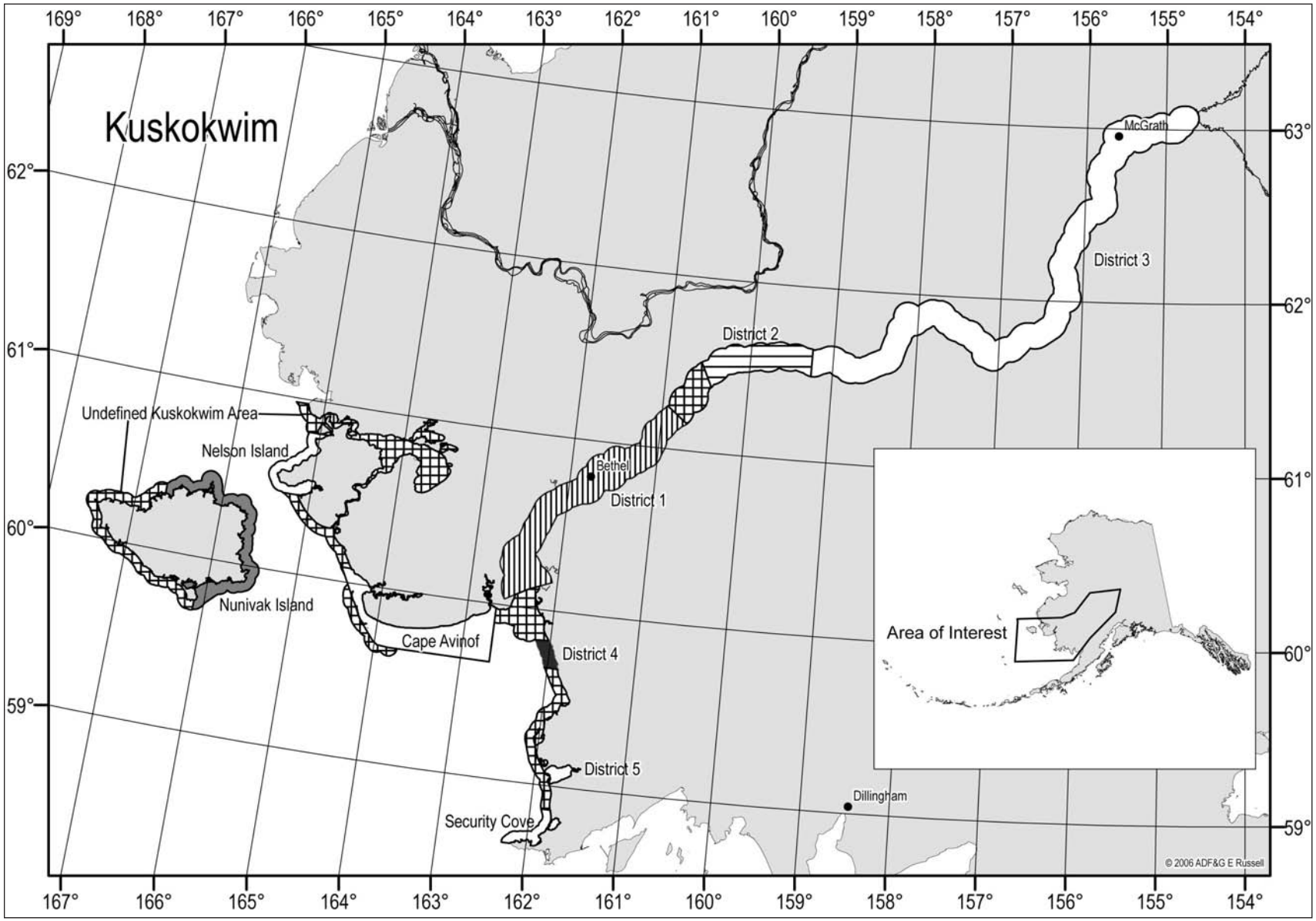

Figure 156. Kuskokwim area commercial salmon fishery.

Other Salmon Harvests

The subsistence salmon fishery in the Kuskokwim is one of the largest subsistence salmon fisheries in North America. The Kuskokwim area contains 38 communities consisting of about 4,500 households and about 1,700 of those households participate in the annual subsistence salmon fishery (Ward et al. 2003). Harvest of salmon for subsistence use is as high as 650 pounds of salmon per capita in some Kuskokwim area communities.

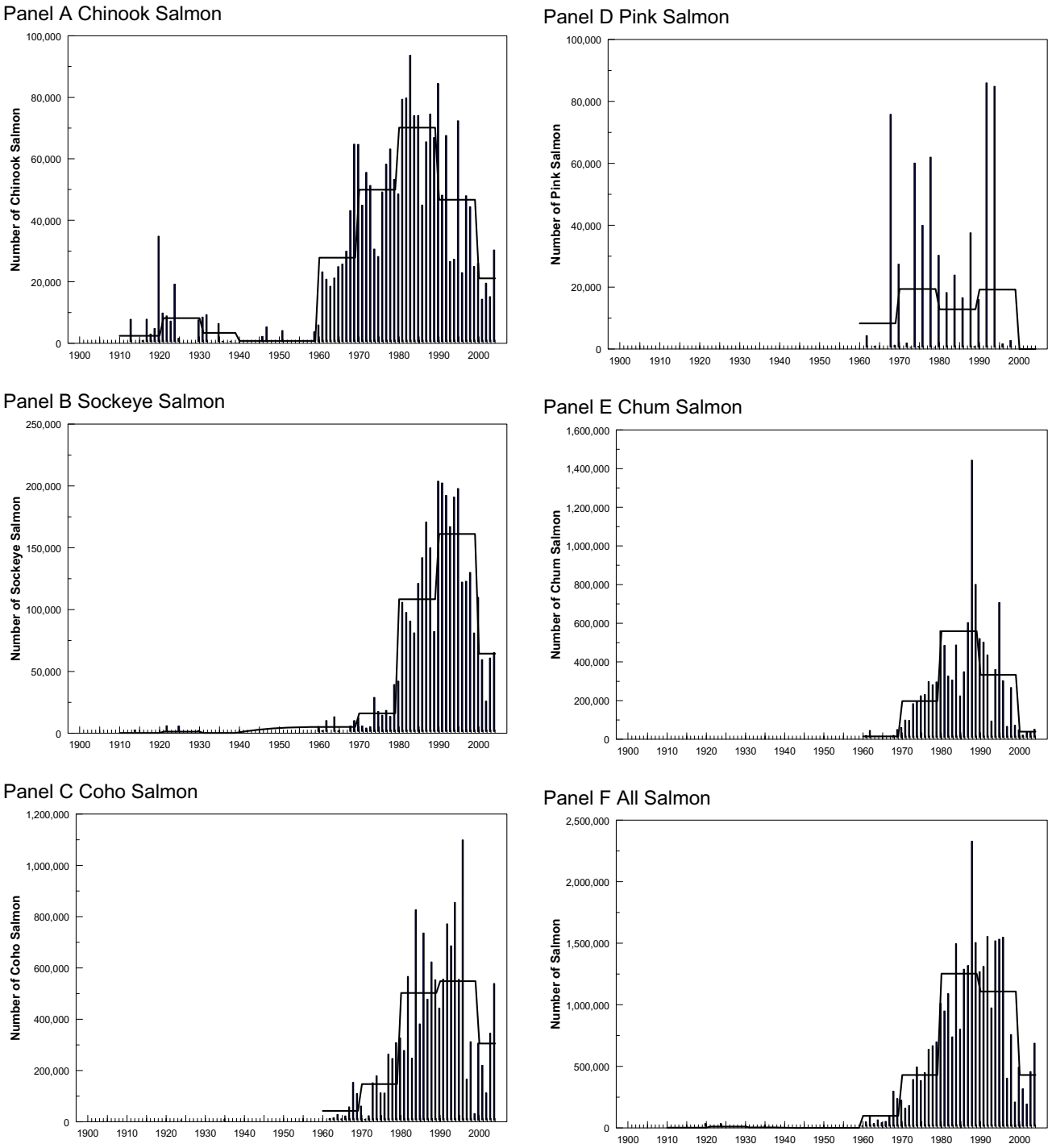

Figure 157. Commercial salmon harvests in the Kuskokwim from 1900–2004; bars provide annual catches and lines provide decade averages.

Residents in the Kuskokwim area have depended upon fishery resources, including salmon, as a source of food for centuries. Traditional fishing methods and materials available to fishermen such as spears, dip nets, fish traps, and willow or caribou strip gillnets limited the historic harvest, were slowly supplanted by more efficient gear such as linen gillnets, thus enabling the fishery to expand. Since statehood, continued improvements in fishing gear, particularly the use of nylon gillnets, have further improved subsistence salmon fishing efficiency. Peak subsistence salmon harvests in the Kuskokwim area occurred during the 1930s coincident with peak activity of the "quasi-commercial" McGrath fishery when annual harvests were as high as 750,000 fish (Jonrowe 1983). The largest annual documented subsistence harvest of salmon in the Kuskokwim area since statehood was in 1964 when about 440,000 fish were taken. Estimated annual subsistence harvests of salmon in the Kuskokwim area averaged about 300,000 fish in the 1960s, 240,000 fish in the 1970s, 250,000 fish in the 1980s, 240,000 fish in the 1990s, and about 200,000 fish since 2000. Chinook, sockeye, coho, and chum salmon are all important components of the Kuskokwim area subsistence salmon harvest (Figure 158). During the past 15 years, the annual subsistence harvest has remained relatively stable while the commercial harvests have been significantly reduced (Figure 159).

Relatively small numbers of salmon are harvested from the Kuskokwim area by sport fishermen. Estimated sport harvests of salmon from the Kuskokwim area since 1980 average from 6,000 to 7,000 fish per year with the harvest trend relatively stable (Table 30). The primary species harvested by sport fishermen have been Chinook and coho salmon. Since 2000, the sport fishery has accounted for less than 1% of the documented salmon harvests in the Kuskokwim area.

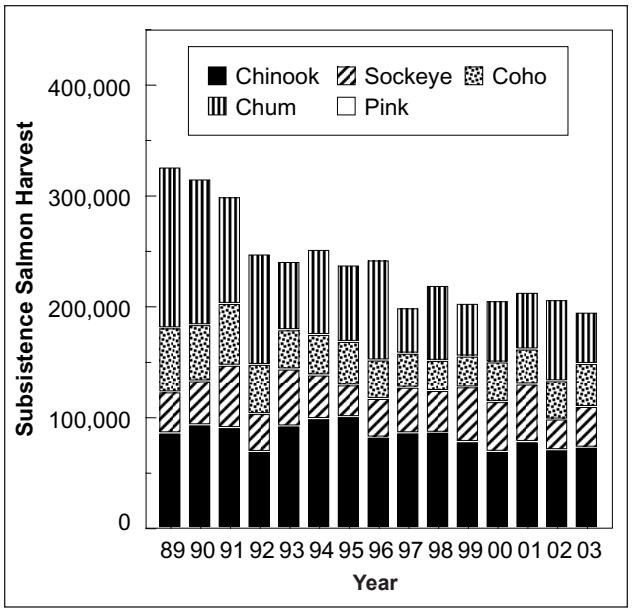

Figure 158. Subsistence harvests of salmon in the Kuskokwim area, 1989–2003.

Commercial Salmon Fishery Users

As of August 2005, a total of 770 limited entry gillnet permits were valid for commercial fishing in the Kuskokwim area. While most available commercial fishing permits were fished through the mid-1990s, only a portion of the commercial salmon permits have been fished since then (Figure 160). Annual numbers of permits fished in 2002 (407), 2003 (438), 2004 (467), and 2005 (484) were about 60% of those legally eligible.

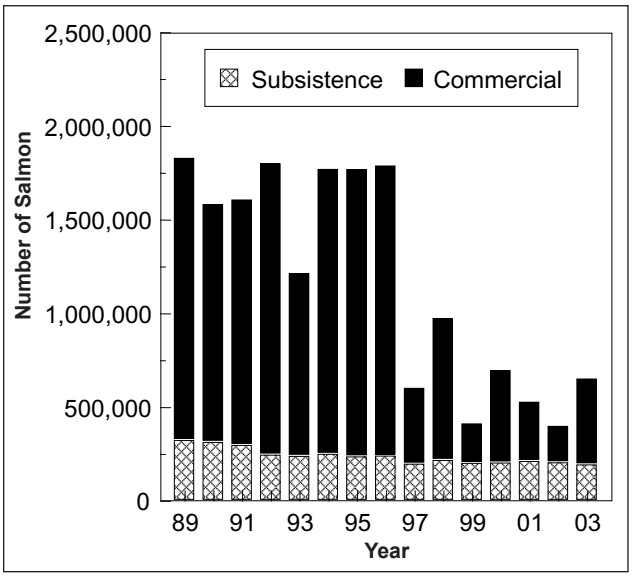

Figure 159. Subsistence and commercial harvests of salmon in the Kuskokwim area, 1989–2003.

Table 30. Average annual harvest of salmon in the Kuskokwim sport fishery.

Species	1980–1989	1990–1999	2000–2004
Chinook	1,381	1,861	1,179
Sockeye	323	756	462
Coho	2,899	3,147	4,885
Pink	231	145	125
Chum	1,094	740	263
Total	5,928	6,649	6,914

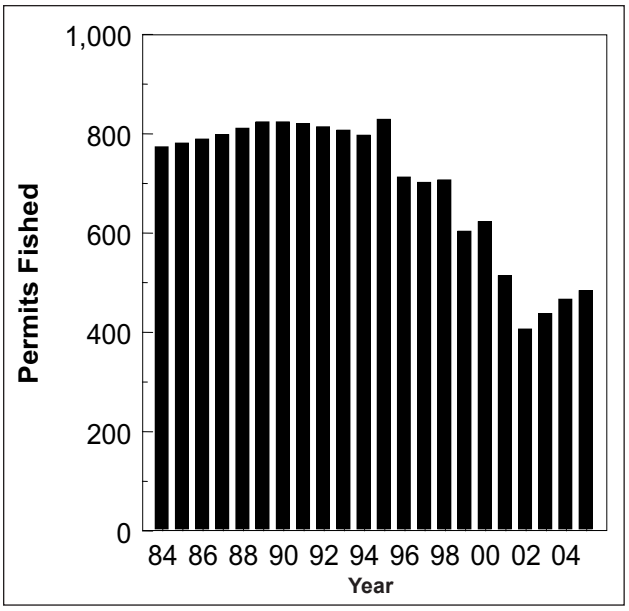

Figure 160. Number of commercial salmon gill net permits actually fished in the Kuskokwim area in the years 1984–2005.

Exvessel Value

As the commercial salmon fishery in the Kuskokwim area developed after statehood, it provided a valuable source of increasing annual income to residents in rural Alaska through the 1980s. The exvessel value of the Kuskokwim area commercial salmon fishery, adjusted for inflation to 2004 dollars, peaked in 1988 when the fishery provided in excess of $20 million (Figure 161), providing an important source of income to a cash poor rural area of Alaska. Since the late 1980s, sporadic market demand for salmon from rural areas of Alaska and lower prices paid for those salmon commercially harvested has eroded the exvessel value of the commercial fishery in the Kuskokwim area. Value of the annual harvests during the first half of the 1990s were always in excess of $5 million (adjusted for inflation to 2004 dollars), but during the latter part of the 1990s, the value decreased to levels as low as $2 million. The lowest value occurred in 2002 when the exvessel value of the fishery was only about $750,000. Values since then have increased with the 2005 commercial salmon fishery exvessel value being in excess of $1.1 million.

While lower catch levels certainly contributed to the lower exvessel value of the Kuskokwim area commercial salmon fishery, a significant portion of the loss in value was because fishermen have been paid much less per pound for salmon that have been sold. In 1988, for instance, commercial fishermen in the Kuskokwim area were paid an average price of $1.30 per pound for Chinook salmon and in 2005, fishermen were only paid $0.59 per pound, a decrease of 55% (Table 31). In 1988, fishermen were paid $0.40 per pound for chum salmon; since then, the price per pound for commercially caught chum salmon in the Kuskokwim area steadily decreased to a price per pound of $0.05 in 2005 (Table 31), about 12% of the price per pound paid in the late 1980s.

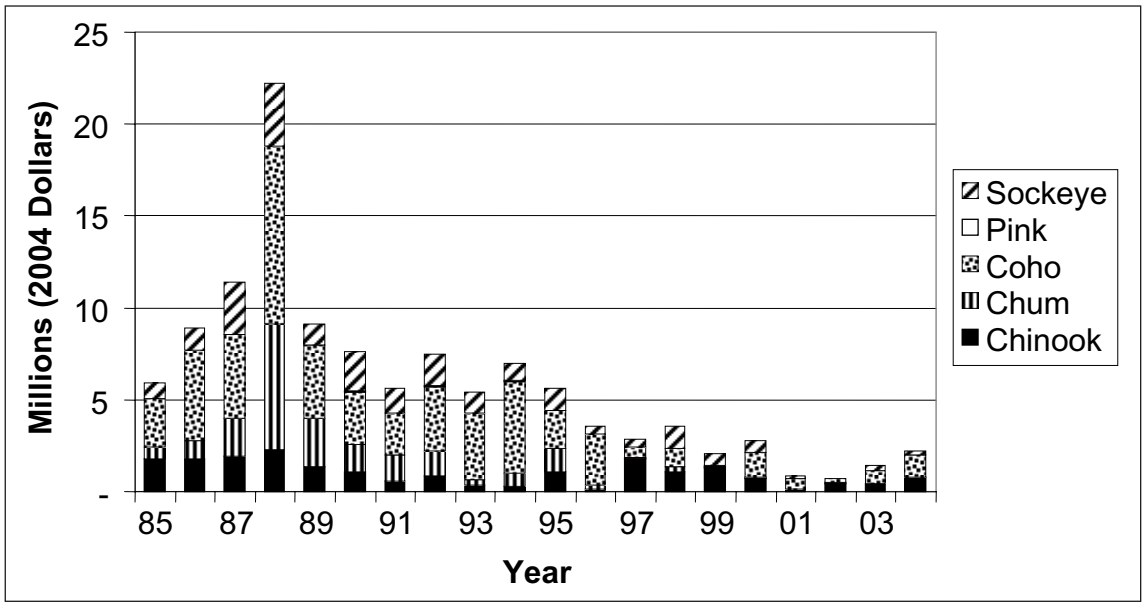

Figure 161. Exvessel value of the Kuskokwim commercial salmon fishery, 1985–2004, adjusted for inflation into 2004 dollars.

Table 31. Average price paid per pound of salmon commercially harvested in the Kuskokwim area.

Species	1988	1994	2000	2005
Chinook	$1.30	$0.51	$0.39	$0.59
Sockeye	$1.42	$0.53	$0.55	$0.55
Coho	$1.25	$0.57	$0.28	$0.27
Chum	$0.40	$0.21	$0.10	$0.05
Pink	$0.15	$0.08	$0.10	$0.05

Exvessel income per permit fished in the Kuskokwim area in 1988, expressed in nominal dollars, was in excess of $15,000. However, as prices and market interest in commercial salmon fisheries in rural Alaska have dropped, the income per permit fished has markedly decreased (Figure 162). In 2002, the average income per permit fished in the Kuskokwim area was only about $800—a 95% reduction from the peak income in 1988. The income per permit fished has increased since 2003, but only to between $2,000 and $3,000. Were the Kuskokwim area commercial fishery to generate the same level of exvessel income at the current time as the levels in the late 1980s, the commercial harvests would have to be more than 3-fold the peak harvest levels to simply compensate for the reduced price for commercially sold salmon at the current time.

Management

Management of Kuskokwim area salmon fisheries is complex. Annual run sizes and timing is often uncertain when decisions must be made, mixed stocks are often harvested several weeks and hundreds of miles from their spawning grounds, allocative issues divide downriver and upriver users as well as subsistence, commercial, and sport users, and the Kuskokwim area itself is immense. In 1988, the Board of Fisheries formed the Kuskokwim River Salmon Management Working Group in response to users seeking a more active role in management of fisheries (Whitmore and Martz 2005). Working group members represent the various interests and geographic locations throughout the Kuskokwim River who are concerned with salmon management. The Working Group has become increasingly active in the preseason, inseason, and postseason management of Kuskokwim River salmon fisheries. The Working Group meets 10 to 15 times per year to review available information and provide advice and input into the active management of Kuskokwim River salmon fisheries. Working Group meetings provide a valuable forum for area fishermen, user representatives, community representatives, advisory committee and council members, and State and Federal fishery managers to come together to discuss issues relevant to sustained yield fishery management and how to provide for the subsistence priority.

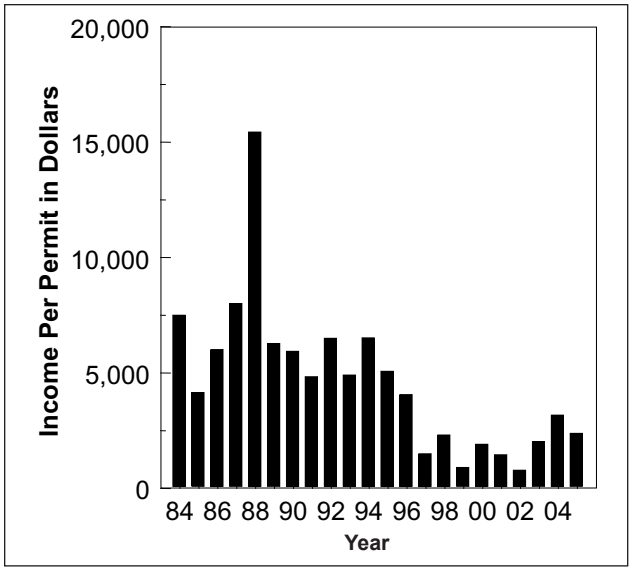

Figure 162. Average exvessel income for commercial salmon permits fished in the Kuskokwim area in the years 1984–2005.

Inseason management of the various Kuskokwim area salmon fisheries is based upon salmon run abundance and timing indicators, including data obtained through the Bethel test fishery, subsistence harvest reports, tributary escapement monitoring projects, and when available, commercial catch per unit of effort data. Inseason run timing models are used to predict subsequent escapement levels using historic run passage information. With the advent of the Working Group process, management of the Kuskokwim River fisheries has become more and more precautionary, and is much more conservatively managed than other areas in Alaska. Various Federal agencies and local tribal organizations collaborate with ADF&G staff in a wide variety of data collections pertinent to salmon management. The Board of Fisheries designated Kuskokwim River Chinook and chum salmon as stocks of yield concern in 2000 based upon perceived lower run sizes.

Over the last 10 to 20 years, the fishery management program in the Kuskokwim area has become both more precautionary and more complex with the addition of several Board of Fisheries management plans, improved inseason and postseason stock status information, and more intensive inseason user group reviewing management of the salmon fisheries. From 2000 to 2004, ADF&G Division of Commercial Fisheries managers issued from 25 to 50 emergency orders per

year to regulate these salmon harvests (Figure 163).

Over the last 10 years, as increasing concern for Kuskokwim area salmon developed, several large-scale funding sources have been used to improve the salmon monitoring program. The historic run monitoring program in the Kuskokwim area consisted of documenting commercial harvests, monitoring subsistence harvests, and tracking trends in salmon escapement largely through aerial surveys. The only long-term, on-the-grounds, escapement monitoring projects in the Kuskokwim area during the 1980s were efforts to count salmon as they passed into the Goodnews, Kanektok, Holitna, and Aniak rivers. Currently, ADF&G, either on its own or in collaboration with other organizations, conducts detailed, on-the-grounds, escapement monitoring of salmon in more than a dozen locations in the Kuskokwim area. These more recent efforts, made possible with new funding sources, have focused on obtaining accurate counts of salmon into spawning streams through the use of weirs, towers, sonar, and or mark–recapture techniques. The information obtained from these efforts has greatly improved the short-term data base for salmon resources in the Kuskokwim area and, if funded over a time frame of several decades, will provide an improved set of information for documentation of stock status of Kuskokwim area salmon.

Escapement goals currently in effect for management of salmon fisheries in the Kuskokwim area are listed in ADF&G (2004). There are 12 sustainable escapement goals in effect for Chinook salmon, 3 for sockeye salmon, 3 for coho salmon, and 4 for chum salmon. A few of the better data sets available for tracking Kuskokwim area salmon escapement trends follow.

The Kogrukluk River is a tributary of the Holitna River and has the most extensive salmon escapement data in the Kuskokwim area. The Kogrukluk River joins the Holitna River 138 miles upstream of the Holitna River's confluence with the Kuskokwim. The Holitna River and the Kuskokwim River join 335 miles upstream from the mouth of the Kuskokwim River. A tower was used to count salmon escapements from 1969 to 1978. Starting in 1976, a weir was installed downstream from the tower location and since then, annual salmon escapements have been counted at this site. Through this project, high quality counts of Chinook, chum and coho salmon escapements have been made. The Chinook salmon escapement goal is from 5,300 to 14,000 fish. Escapements in each of the last 5 years have been within or above this level, and spawning abundance of Chinook salmon in this river is as high now as has been documented historically. Only in 2 of the last 18 years (11%) has the escapement been below or close to the lower bound of the escapement goal (Figure 164). The chum salmon escapement goal is 15,000 to 49,000 fish. Escapements in each of the last 5 years have been within or above this level and spawning abundance of chum salmon in this river is as high now as has been documented historically. Only in 3 of the last 18 years (17%) has the escapement been below the lower bound of the escapement goal (Figure 165). The 2005 escapement of chum salmon

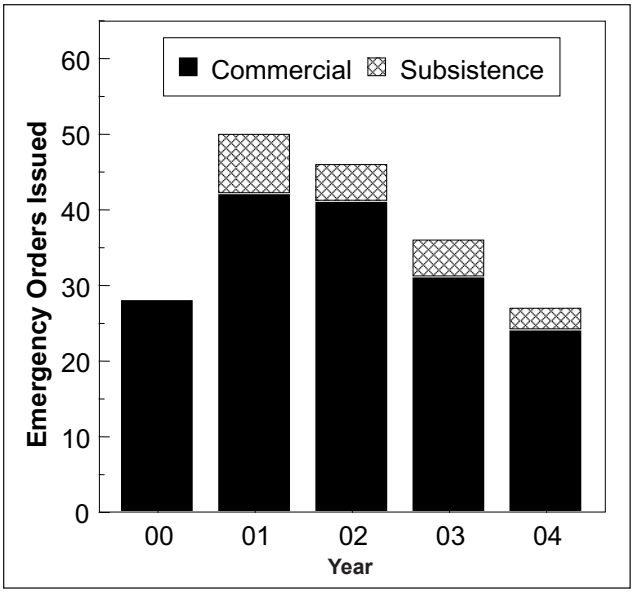

Figure 163. Number of emergency orders issued for management of Kuskokwim area commercial and subsistence fisheries, 2000–2004.

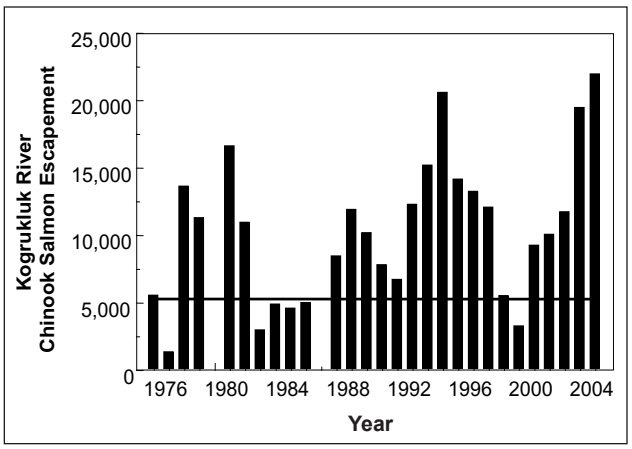

Figure 164. Weir-based counts of the Chinook salmon escapements in the Kugrukluk River from 1976–2005 (bars) and the lower end of the current ADF&G sustainable escapement goal range of 5,300–14,000 (line). Note: counts were not successfully conducted in 1980 and 1987.

in the Kogrukluk River was almost 200,000 fish, about 4-fold the upper end of the escapement goal range. The coho salmon escapement goal is 13,000 to 28,000 fish. Escapements in each of the last 6 years have been within or above this level, and spawning abundance of coho salmon in this river is as high now as has been documented historically. Only in 1 of the last 14 years (7%) has the escapement been below the lower bound of the escapement goal (Figure 166).

The Aniak River joins the Kuskokwim River 225 miles above the mouth of the Kuskokwim River. Chum salmon escapements in the Aniak River have been counted since 1980 with the aid of sonar at a site located about 12 miles above the confluence. This set of data provides the second-longest term, on-the-grounds, salmon stock assessment effort in the Kuskokwim River. The Aniak River chum salmon escapement goal is 210,000 to 370,000 fish. Escapements in each of the last 4 years have been within or above this level, and spawning abundance of chum salmon in this river is as high now as has been documented historically. During the 26 years from 1980 to 2005, chum salmon escapements have been successfully assessed in 19 of those years and in 14 of those years (74%) the escapement level has been within or exceeded the escapement goal. Only once in the last 10 years, in 2000, has the escapement level been less than the goal (Figure 167). The 2005 chum salmon escapement of almost 1.2 million fish exceeded the upper end of the goal range by more than 3-fold.

Since the 1970s, ADF&G has conducted aerial surveys of Chinook salmon in various tributaries of the Kuskokwim River and has established escapement goals for several of these spawning populations. In the lower portion of the Kuskokwim River drainage, escapement goals of 580 to 1,800 fish for the Kwethluk River, and 400 to 1,200 fish for the Kisaralik River, counted during peak surveys, have been established. In the middle portion of the Kuskokwim River drainage, escapement goals of 330 to 1,200 fish for the Salmon (Aniak) River, and 970 to 2,100 fish for the Holitna River, counted during peak surveys, have been established. In the upper portion of the Kuskokwim River drainage, escapement goals of 300 to 830 fish for the Gagarayah River, 340 to 1,300 fish for the Cheeneetnuk River, and 470 to 1,600 fish for the Salmon

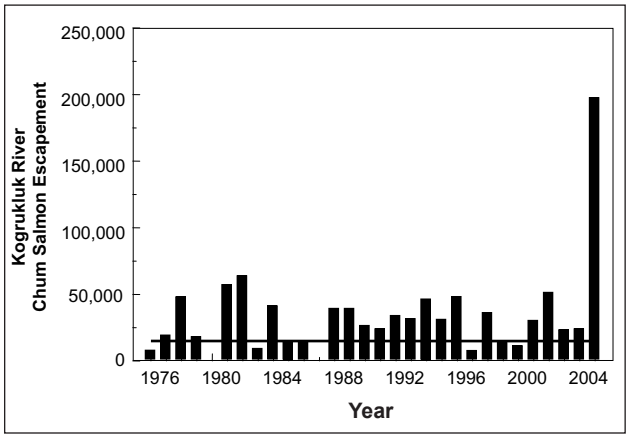

Figure 165. Weir-based counts of the chum salmon escapements in the Kugrukluk River from 1976–2005 (bars) and the lower end of the current ADF&G sustainable escapement goal range of 15,000–49,000 (line). Note: counts were not successfully conducted in 1980 and 1987.

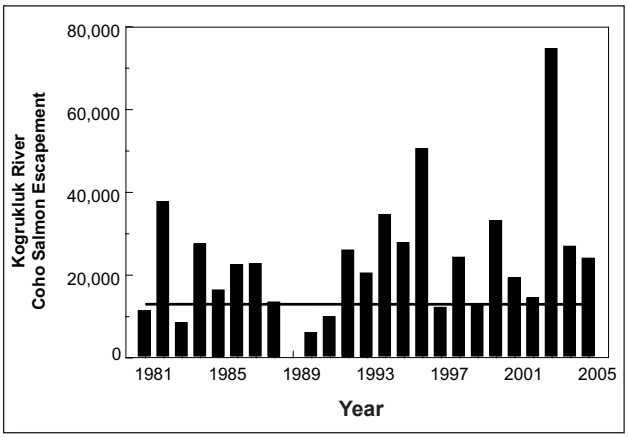

Figure 166. Weir-based counts of the coho salmon escapements in the Kugrukluk River from 1981–2005 (bars) and the lower end of the current ADF&G sustainable escapement goal range of 13,000–28,000 (line). Note: a count was not successfully conducted in 1989.

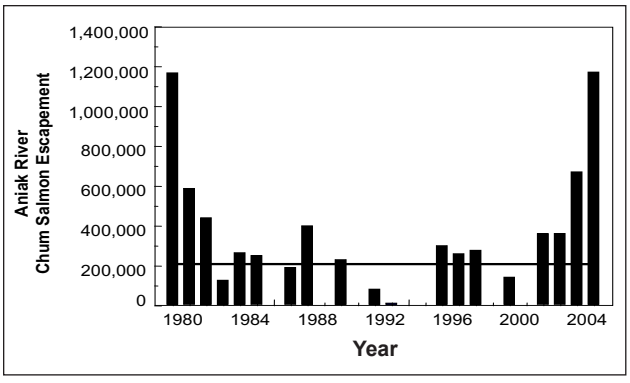

Figure 167. Sonar-based counts of the chum salmon escapements in the Aniak River from 1980–2005 (bars) and the lower end of the current ADF&G sustainable escapement goal range of 210,000–370,000 (line). Note: counts were not successfully conducted in 1986, 1989, 1991, 1994, 1995, 1999, and 2001.

(Pitka) River, counted during peak surveys, have been established. In the last 5 years from 2001 to 2005, successful aerial surveys have occurred in 30 of the possible 35 stream-year cells (7 streams × 5 years) and in only one of those cases (3%) —the Aniak River count in 2001—was the observed escapement less than the lower end of the escapement goal range for these 7 spawning stocks of Kuskokwim River Chinook salmon (Figure 168).

A weir located on the Middle Fork of the Goodnews River has been used to assist with salmon escapement enumeration since 1991. From 1981 to 1990, escapement estimates were taken at the same site based on tower counts. The Chinook salmon escapement goal is 2,000 to 4,500 fish; escapements in each year since 1993 have been within or above this level. In only 3 of the last 25 years (12%) has the escapement been below the lower bound of the escapement goal (Figure 169). The sockeye salmon escapement goal is 23,000 to 50,000 fish. In only 4 of the last 25 years (16%) has the escapement been below the lower bound of the escapement goal (Figure 170). Escapements in 2001 and 2002 were close to the lower bound of the escapement goal range, while escapements since 2003 have been well in excess of this level. The coho salmon escapement goal is a threshold level of 12,000 fish. The 1997 escapement was below the threshold, the 1999 escapement was very close to the threshold level and all other escapements since 1997 have been above the threshold (Figure 171). The chum salmon escapement goal is also a threshold level of 12,000 fish. Chum salmon escapement levels since 1991 have all exceeded the goal (Figure 172). Only in 3 of the last 25 years (12%) has the chum salmon escapement been below the threshold.

The long-term escapement enumeration programs in the Kuskokwim area provide similar stock status information. Salmon escapements in the Kuskokwim area are as abundant as documented historically and the vast majority of escapements documented over the

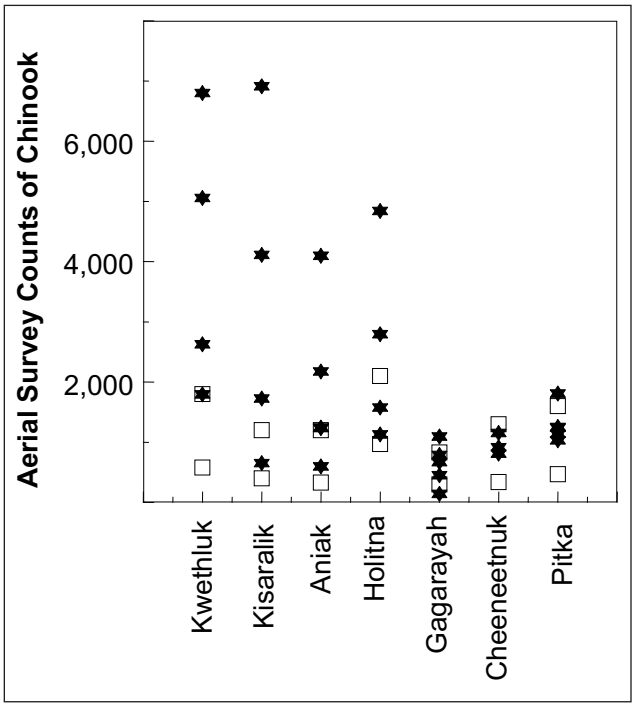

Figure 168. Aerial survey counts of Chinook salmon in 7 tributaries of the Kuskokwim River from 2001–2005 (stars) and the lower and upper sustainable escapement goal ranges for these 7 stocks of salmon (open squares).

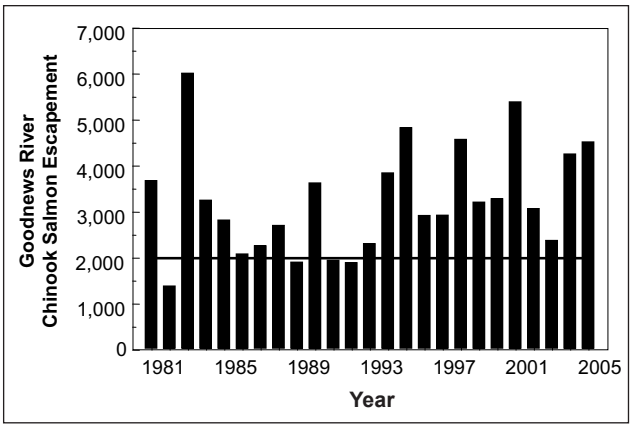

Figure 169. Escapement counts of Chinook salmon in the Goodnews River from 1981–2005 (bars) and the lower end of the current ADF&G sustainable escapement goal range of 2,000–4,500 (line).

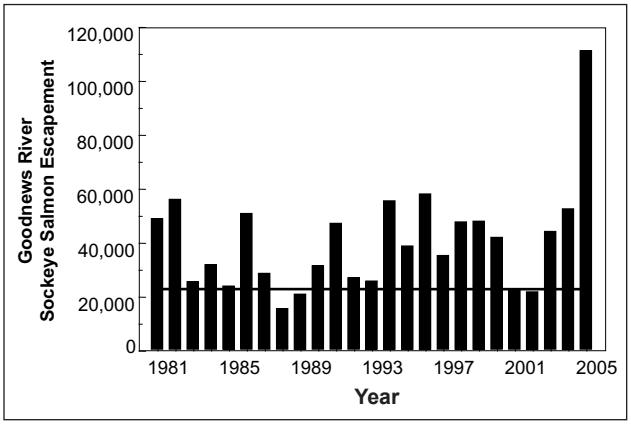

Figure 170. Escapement counts of sockeye salmon in the Goodnews River from 1981–2005 (bars) and the lower end of the current ADF&G sustainable escapement goal range of 23,000–50,000 (line).

past 25 years have met or exceeded established escapement goals. Salmon stocks in this area are healthy and could support additional fishing. Were additional fishing opportunity provided, it could economically benefit rural residents in a cash-poor area of Alaska.

Budget History and Fiscal Support

General funds allocated and used by the Division of Commercial Fisheries to manage salmon in the Kuskokwim area totaled about $960,000 in FY 05. This level of funding commitment by the State of Alaska represents a substantial increase over funding provided for management of these fisheries as they were being developed during the first 30 years after statehood. Over the last 10 years, the Division of Commercial Fisheries has worked with other resource agencies and with nongovernmental organizations with interests in the Kuskokwim area to plan and implement a variety of additional salmon stock assessment activities using nonstate moneys (mostly federal) to further augment the scientific information available for salmon stocks in the Kuskokwim area. Notable funding entities involved with these additional salmon stock assessment efforts include the Office of Subsistence Management and the Arctic–Yukon–Kuskokwim Sustainable Salmon Initiative. Often, these additional salmon stock assessment activities are carried out by mixed crews from partner agencies and organizations.

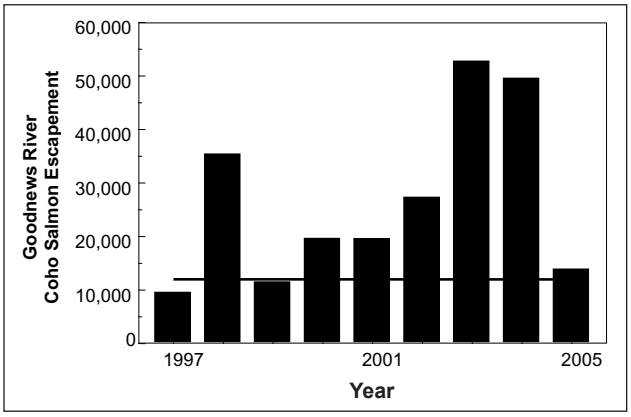

Figure 171. Escapement counts of coho salmon in the Goodnews River from 1997–2005 (bars) and the threshold sustainable escapement goal of 12,000 (line). Prior to 1997, the project was not conducted late enough to count coho salmon during the fall.

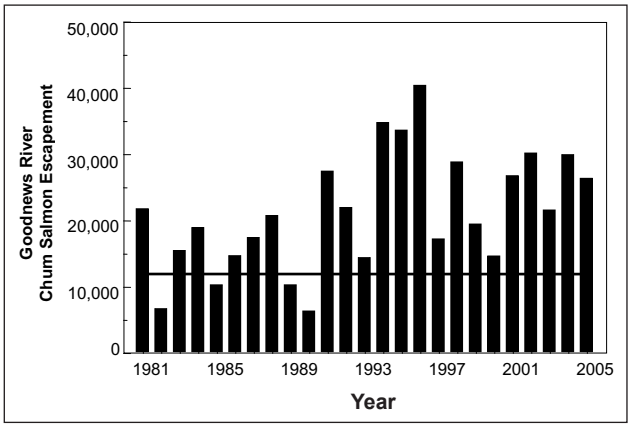

Figure 172. Escapement counts of chum salmon in the Goodnews River from 1981–2005 (bars) and the threshold sustainable escapement goal of 12,000 (line).

The Division of Commercial Fisheries and the salmon fishermen in the Kuskokwim area face several challenges. The Division of Commercial Fisheries is committed to managing fisheries on a sustained yield basis and the subsistence fishery has priority over the commercial fishery. The salmon stocks of the Kuskokwim area have been sustained at a high level and the large subsistence fishery has been sustained, although recently with substantial additional regulation. On the other hand, the commercial salmon fisheries of the Kuskokwim area have been greatly reduced as a result of the conservative precautionary management approach that has been implemented over the last 15 years.

The cost to the State of Alaska for the fishery management program currently in place in the Kuskokwim area is very high relative to the exvessel value of the commercial fishery. The State FY 05 direct management cost is about $960,000, and the 2005 salmon exvessel value is about $1.1 million. The current stock assessment program cannot be implemented without major nonstate funding support. If market interest in commercial salmon fisheries in the Kuskokwim area improves, significant additional commercial fishing could occur from a biological standpoint. However, if commercial markets for Kuskokwim area salmon do not result in improved prices paid to fishermen, a revised commercial fishery would not be likely to generate substantial improvement in the local rural economy. A major challenge to fishermen in the Kuskokwim area is developing niche markets to substantially increase the value of commercial landings of salmon, allowing them to increase earnings from commercial fishing. A major challenge to the Division of Commercial Fisheries is to continue to garner fiscal support for the comprehensive salmon stock assessment program currently implemented by agencies and nongovernmental organizations. Unless the commercial salmon fishery in the Kuskokwim area is managed in a less conservative and precautionary manner, there is little scientific and policy rationale for the extensive stock assessment program currently in place.

YUKON COMMERCIAL SALMON FISHERY

Area Description and Gear Types

The Yukon River is the largest river in Alaska, originating in British Columbia and flowing 2,300 miles to the Bering Sea. The Yukon River drainage encompasses about 330,000 square miles, or about one-third of the land mass of Alaska. The Yukon area includes all waters of the U.S. Yukon River drainage and all coastal waters from Point Romanof southward to the Naskonat Peninsula. Commercial fishing for salmon is allowed along the entire 1,200 mile length of the main stem Yukon River in Alaska and in the lower 225 miles of the Tanana River. The Yukon area includes 7 districts, 10 subdistricts, and 28 statistical areas which were established in 1961 and redefined in later years. The Coastal District was established in 1994, redefined in 1996, and is open for subsistence salmon fishing only. The lower Yukon area (Districts 1, 2, and 3) includes some coastal waters adjacent to the series of mouths of the Yukon River and extends upstream to river mile 301 (the break between Districts 3 and 4). The upper Yukon area (Districts 4, 5 and 6) is that portion of the Yukon above river mile 301 extending to the U.S.–Canada border and includes the lower Tanana River (Figure 173).

Significant runs of Chinook, chum, and coho salmon return to the Yukon River and are harvested in Alaska by subsistence, commercial, personal use, and sport fishermen as well as in Canada in aboriginal, commercial, sport, and domestic fisheries. Spawning populations of Chinook salmon occur throughout the Yukon River drainage in tributaries from as far downstream as the Archuelinuk River, located approximately 80 miles from the mouth, to as far upstream as the headwaters of the Yukon River in Canada, over 2,000 miles from the mouth. Chum salmon in the Yukon are comprised of 2 distinct types, summer-run fish and fall-run fish. Summer chum salmon are characterized by earlier run timing, rapid maturation in freshwater, and smaller size. They tend to spawn in runoff streams in the lower 500 miles of the drainage and in the Tanana River drainage. Fall chum salmon are characterized by later run timing, robust body shape, and larger size. They tend to spawn in spring-fed streams including portions of the Tanana, Porcupine, and Chandalar River drainages as well as in various streams in the Yukon Territory including the main stem Yukon River. Coho salmon spawn discontinuously throughout the Alaska portion of the Yukon River drainage, primarily in tributaries in the lower 700 miles of the drainage and in the Tanana River drainage. Sockeye salmon are uncommon in the Yukon River drainage. Although pink salmon return to the lower part of the drainage, few are utilized in fisheries.

Commercial fishing is conducted in the lower Yukon with set gillnets and drift gillnets, while in the upper Yukon, fish wheels are used in addition to set and drift gillnets. Subsistence fishing is primarily conducted with the same gear types and many of the subsistence fishermen are also commercial fishermen.

History of the Commercial Salmon Fishery

The first recorded commercial harvest of salmon in the Alaskan portion of the Yukon River drainage occurred in 1918. Relatively large harvests of Chinook, chum, and coho salmon occurred from 1919 to 1921. Much of that harvest occurred outside of the river mouth due to restrictions within the Yukon River itself. The commercial fishery was closed from 1925 to 1931 because of concerns for the existing inriver subsistence fishery. Commercial fishing for Chinook salmon was again allowed in 1932 at a reduced level and has continued since that time. Commercial utilization of chum and coho salmon resumed in 1952 and occurred from 1952 to 1954, 1956, and since 1961.

The peak decadal harvest of Chinook salmon occurred in the 1980s when almost 130,000 fish were commercially harvested per year (Figure 174, Panel A). Commercial harvests averaged about 97,000 fish in the 1990s, and about 27,000 fish since 2000. During the 1980s and 1990s, the Alaska Board of Fisheries implemented guideline harvest ranges for Yukon River Chinook salmon of 60,000 to 120,000 fish caught in District 1 and 2, 1,800 to 2,200 fish caught in District 3, 2,250 to 2,850 fish caught in District 4, 2,400 to 2,800 fish caught in District 5A, 5B, and 5C, 300 to 500 fish caught in District 5D, and 600 to 800 fish caught in District 6. Concerns for possible overharvest of annual Chinook salmon runs resulted in some reduction in annual harvests starting in the late 1980s and continuing through the mid- to late 1990s. Poor runs in the late 1990s and early 2000s resulted in very restrictive management of Yukon River Chinook salmon commercial fisheries, culminating with the complete closure of the commercial fishery in 2001 and very conservative management since then.

Sockeye salmon have only been commercially harvested in the Yukon River fishery in 8 of the years since 1960 and the cumulative harvest in those years was only 48 fish. Coho salmon have sometimes been an important component of the Yukon River commercial fishery but have been primarily taken incidentally to the directed fall chum salmon harvests. Commercial harvests of coho salmon in the Yukon peaked in the

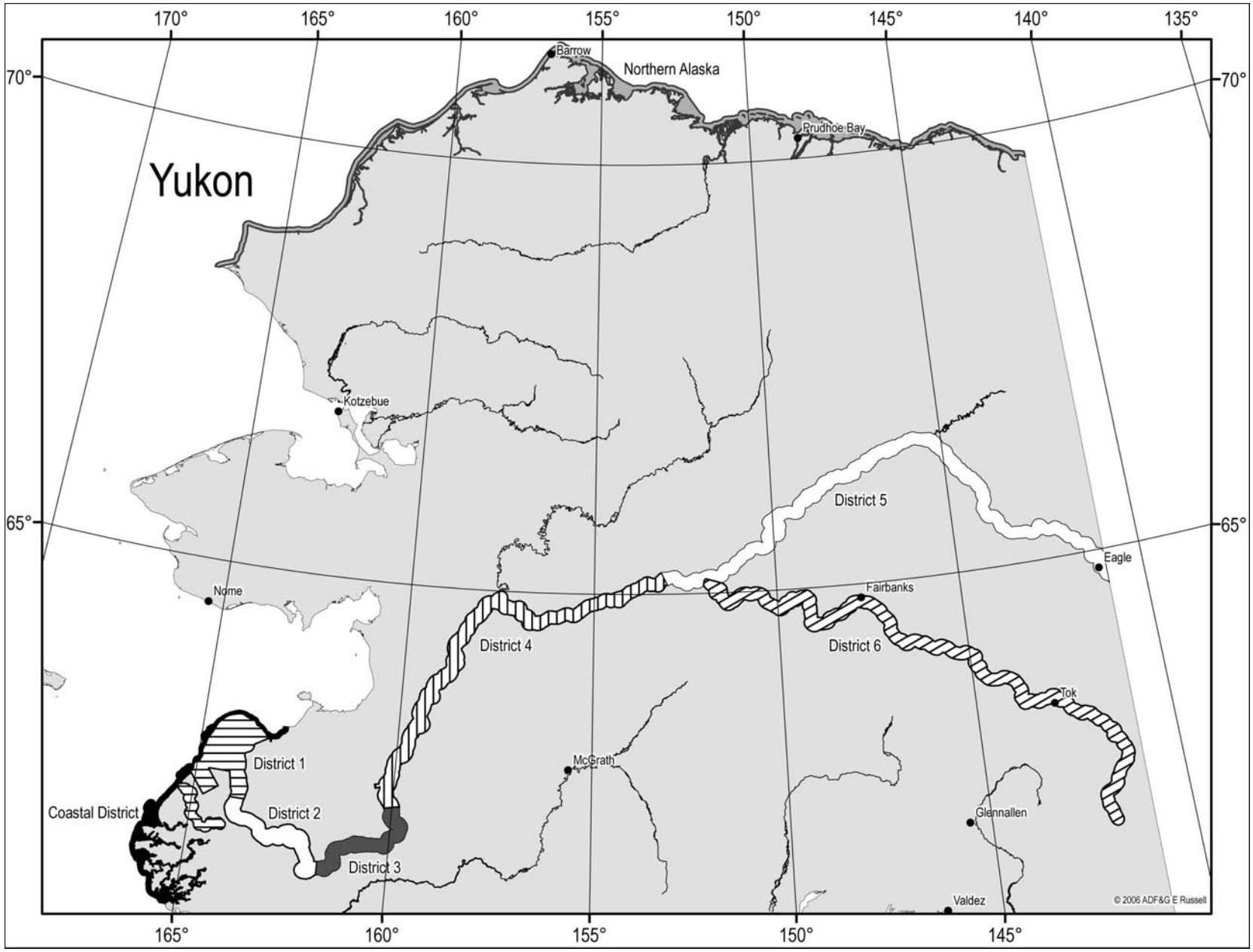

Figure 173. Yukon area commercial salmon fishery.

1980s when about 44,000 fish per year were harvested (Figure 174, Panel B). Annual harvests have been sporadic and averaged about 30,000 fish per year in the 1990s and 17,000 fish per year since 2000. The Alaska Board of Fisheries established the Yukon Drainage Coho Salmon Management Plan in 1998, which allows a directed coho salmon commercial fishery under special and unique conditions that are unlikely to be met. Commercial harvests of pink salmon in the Yukon River have been small due to an extremely limited market. Since statehood, commercial sales of pink salmon from the Yukon River only occurred from 1988 to 1990 with annual harvests being 1,057 fish in 1998, 17 fish in 1989, and 743 fish in 1990.

Commercial chum salmon fishing in the Yukon area peaked in the 1980s when harvests averaged about 1.3 million fish per year (Figure 174, Panel C). Average annual harvests in the 1990s were about 480,000 fish and since 2000 were about 48,000 fish.

Summer chum salmon harvests in the commercial fishery peaked in the 1980s when about 1.1 million fish per year were harvested (Figure 175). The substantial increase in catch over levels observed in the 1970s was due to less restrictive gillnet mesh regulations, earlier openings of the fishery, greater availability of processing facilities, higher exvessel prices, and the occurrence of several very large runs. Commercial harvests of summer chum salmon averaged about 390,000 fish per year in the 1990s, and 15,000 fish per year since 2000. Summer chum salmon run sizes decreased in the early 1990s. Exvessel prices for chum salmon decreased in the 1990s and beginning in 1994, declining flesh markets severely limited the commercial harvests. In 1994, the Alaska Board of Fisheries adopted the Anvik River Chum Salmon Fishery Management Plan establishing regulations allowing for a commercial summer chum salmon roe fishery in the Anvik River. Low harvests of summer chum salmon for roe have occurred since 1997 because summer chum salmon runs to the Anvik River have been less than half that of the prior 15 years.

The directed commercial fishery for fall chum salmon began in 1961. Fall chum salmon harvests in the commercial fishery peaked in the late 1970s and 1980s when about 235,000 fish per year were harvested (Figure 176). Commercial harvests of fall chum salmon averaged about 88,000 fish per year in the 1990s, and about 32,000 fish per year since 2000. Lower fall chum salmon escapements in the mid-1980s resulted in more conservative management and reduced commercial harvests after 1986. In 1994, the Alaska Board of Fisheries adopted the Yukon Drainage Fall Chum Salmon Management Plan which has been has been modified several times since then. The plan calls for commercial fishing only when annual run size is projected to exceed 675,000 fall chum salmon. This ensures spawning escapement needs are met, as well as needs associated with Alaska subsistence fisheries and Canadian harvests. Because of this plan, commercial fisheries have only occurred in some years and harvest have been quite variable depending upon total run strength.

Total commercial salmon harvests in the Yukon peaked in the 1980s when about 1.5 million fish per year were harvested (Figure 174, Panel D). Commercial harvests of salmon have decreased substantially since then, averaging about 607,000 fish per year in the 1990s and about 92,000 fish per year since 2000.

Other Salmon Harvests

There are about 21,000 people living in rural portions of the Yukon River drainage and about 84,000 people living in the greater Fairbanks urban area. Many of the rural residents fish for salmon under subsistence regulations. Only a small portion of the urban residents fish for salmon under personal use regulations. Rural residents in the Yukon area have depended upon fishery resources, including salmon, as a source of food for centuries. Rural residents also use salmon as food for their dogs, which were used traditionally as draft animals. During the 1930s, airplanes began replacing dogs as primary mail and supply carriers, and during the 1960s, snow machines became more popular. In the 1980s, a renewed interest in the recreational use and racing of sled dogs caused an increase in subsistence utilization of salmon in the Yukon area. However, dependence upon salmon for dog food since the 1980s has decreased, although a large proportion of the coho, summer chum, and fall chum salmon harvested in subsistence fisheries is still used for dog food. A large portion of the Chinook salmon harvested by subsistence fishermen is used as human food. Subsistence and personal use harvests of salmon from 1975 to 2004 averaged about 325,000 fish per year. Subsistence and personal use of salmon in the Yukon averaged about 435,000 fish per year in the 1980s, 300,000 fish per year in the 1990s, and 175,000 fish per year since 2000 (Figure 177). Since 1975, Chinook salmon have comprised about 13% of the harvest, coho salmon about 9%, and summer and fall chum salmon each about 39%. Over the last 30 years, the annual subsistence harvests have remained relatively stable while the commercial harvests have been significantly reduced (Figure 178). The ratio of commercial to subsistence harvests in the Yukon area from 1975 to 1997 averaged about 3:1, and since 1998 the ratio has been about 0.33:1.

Relatively small numbers of salmon are harvested from the Yukon area by sport fishermen (Table 32). Estimated sport harvests of salmon from the Yukon area since 1980 average about 3,300 fish per year. The ratio of the commercial to sport harvests of salmon in the Yukon area over the past 25 years is about 400:1, ratios by species are about 75:1 for Chinook salmon, about 25:1 for coho salmon, and about 650:1 for chum salmon.

Commercial Salmon Fishery Users

As of August 31, 2005, there were 893 limited entry permits valid for salmon fishing in the Yukon; 758 (85%) were gillnet permits and the remaining 135 (15%) were fish wheel permits (Table 4). Participation by both gear groups has decreased since the 1980s, particularly participation by fish wheel fishermen (Figure 179). Compared to the 1980s, average participation since 2001 for the lower-river gillnet fishermen gear group was 84%, for the upper-river gillnet fishermen gear group the participation rate was 21%, and for the fish wheel gear group the participation rate was 13%.

Exvessel Value

The average annual exvessel value of the Yukon River commercial salmon fishery from 1985 to 2004 was about $5.5 million, ranging from zero in 2001 when the commercial fishery was closed to a high of about $12.9 million in 1988. Adjusted for inflation and expressed in 2004 dollars, the average annual exvessel value was about $7.75 million. Inflation-adjusted exvessel value ranged as high as about $20.5 million in 1988 when about 1.94 million salmon were harvested (Figure 180). As elsewhere in Alaska, value has trended downward during the last 15 years, although a minor upward trend is apparent since 2001. Unlike several other commercial salmon fisheries in Alaska, the reduction in exvessel value of the Yukon

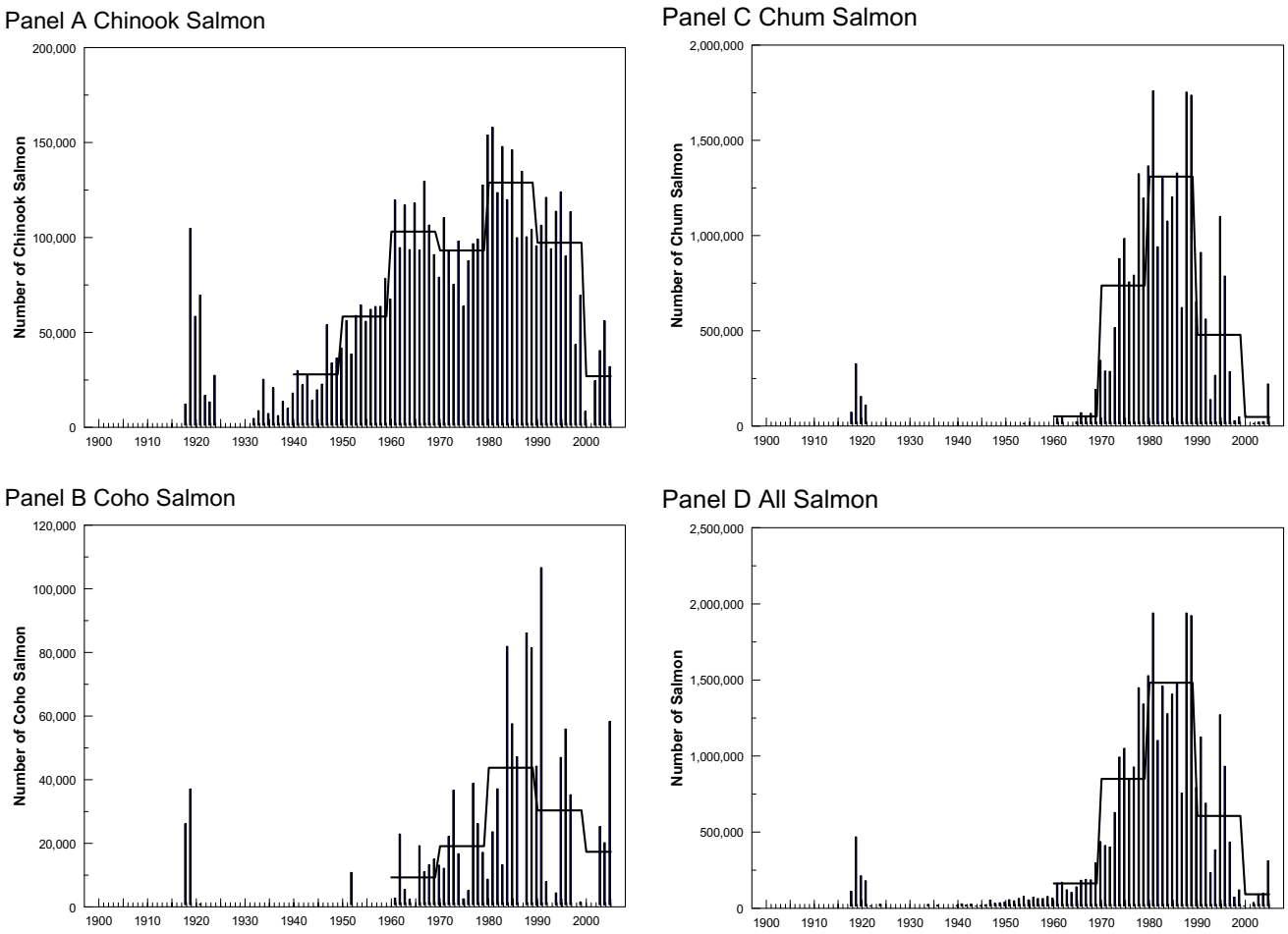

Figure 174. Commercial salmon harvests in the Yukon from 1900–2005; bars provide annual catches and lines provide decade averages.

commercial fishery since the mid-1990s is mostly due to seriously reduced catch levels for Chinook salmon and the almost complete loss of markets for some of the other species. Reduced prices paid for chum and coho salmon has played a much lesser part in reduced exvessel value of the Yukon commercial fishery than is the case for most other Alaskan salmon fisheries. From 1985 to 2004, Chinook salmon accounted for 77% of the inflation adjusted total exvessel value, followed by chum salmon (20%), and coho salmon (3%).

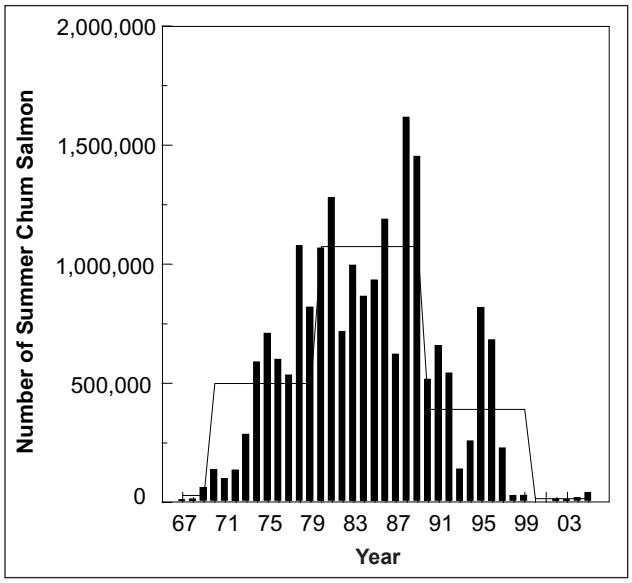

Figure 175. Commercial harvests of summer chum salmon in the Yukon from 1967–2005; bars provide annual catches and lines provide decade averages.

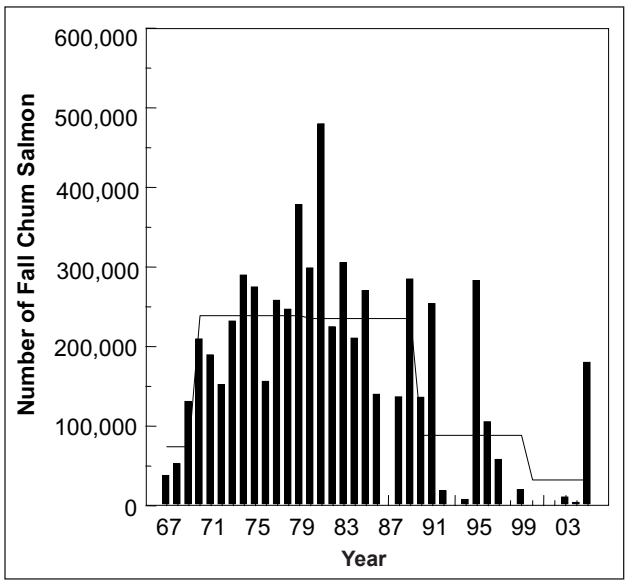

Figure 176. Commercial harvests of fall chum salmon in the Yukon from 1967–2005; bars provide annual catches and lines provide decade averages.

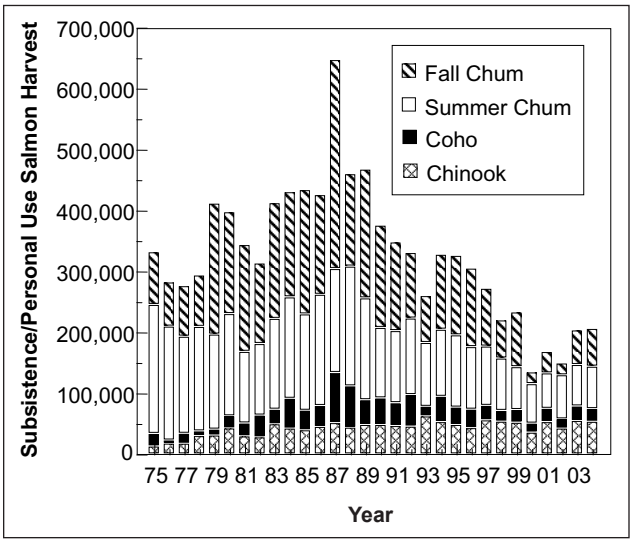

Figure 177. Subsistence and personal use harvests of salmon in the Yukon area, 1975–2004.

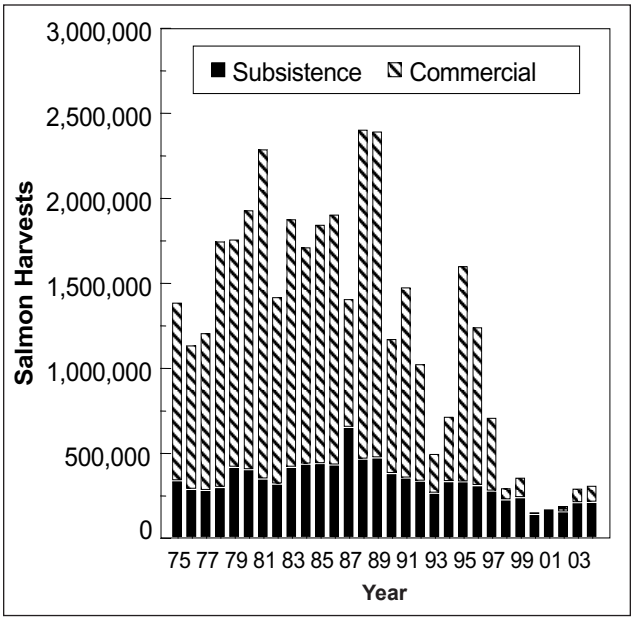

Figure 178. Subsistence and personal use versus commercial harvests of salmon in the Yukon area, 1975–2004.

Table 32. Average annual harvest of salmon in the Yukon sport fishery.

Species	1980–1989	1990–1999	2000–2004
Chinook	880	1,595	1,135
Sockeye	0	31	33
Coho	920	1,502	1,199
Pink	25	14	11
Chum	963	841	494
Total	2,788	3,983	2,872

Unlike prices paid to commercial fishermen in many salmon fisheries in Alaska, the price paid for Chinook salmon in the Yukon has not markedly decreased over the past 20 years (Figure 181). Prices paid for Chinook salmon in the Yukon in 2004 and 2005 are about the same as was the case in the late 1980s when prices paid for commercially harvested salmon across Alaska were at peak levels. On the other hand, prices paid for coho and chum salmon harvested in the Yukon has substantially decreased. In 1988, for instance, commercial fishermen in the lower Yukon were paid $0.66 per pound for summer chum salmon, $1.01 per pound for fall chum salmon, and $1.04 per pound for coho salmon. In 2004, the average price paid for chum salmon was $0.10 per pound, and the average price paid for coho salmon was $0.33 per pound.

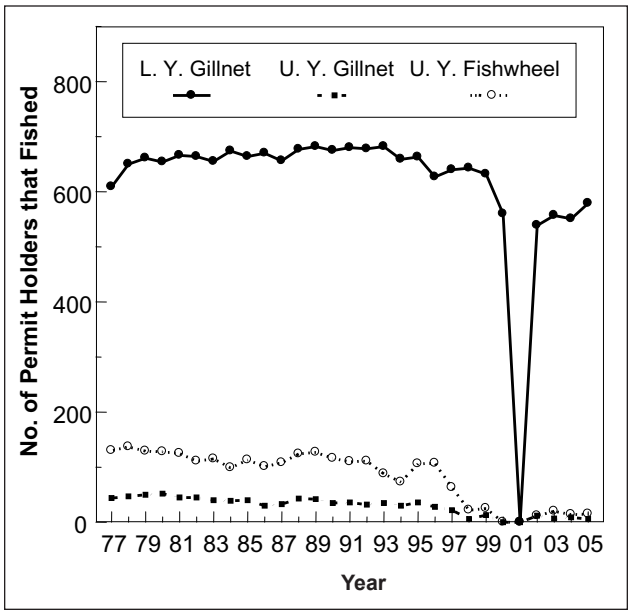

Figure 179. Number of limited entry permits that participated in commercial fisheries in the Yukon from 1977–2005 (L.Y. Gillnet = gillnet permits fished in the Lower Yukon River, U.Y. gillnet = gillnet permits fished in the Upper Yukon River, and U.Y. Fishwheel = fishwheel permits fished in the Upper Yukon River).

Management

The Yukon commercial and subsistence fisheries are managed by ADF&G with the goal of achieving and maintaining sustained production. Distinguishing between commercial and subsistence harvests of salmon is sometimes difficult with development of commercial salmon fisheries in which fishermen extract and sell only the roe and then use the stripped carcasses to meet subsistence needs. Management of the Yukon salmon fishery is difficult and complex because of the frequent inability to determine stock specific abundance and timing, overlapping multispecies salmon runs, increasing efficiency of the fishing fleet, the gauntlet nature of Yukon fisheries, allocation issues between lower-river and upper-river Alaskan fishermen, allocation and conservation issues between Alaska and Canada, and the immense size of the drainage. Salmon fisheries within the Yukon River may harvest stocks that are up to several weeks and over a thousand miles from their spawning grounds. Since the Yukon River fisheries are largely mixed stock fisheries, some tributary populations may be under- or overexploited in relation to

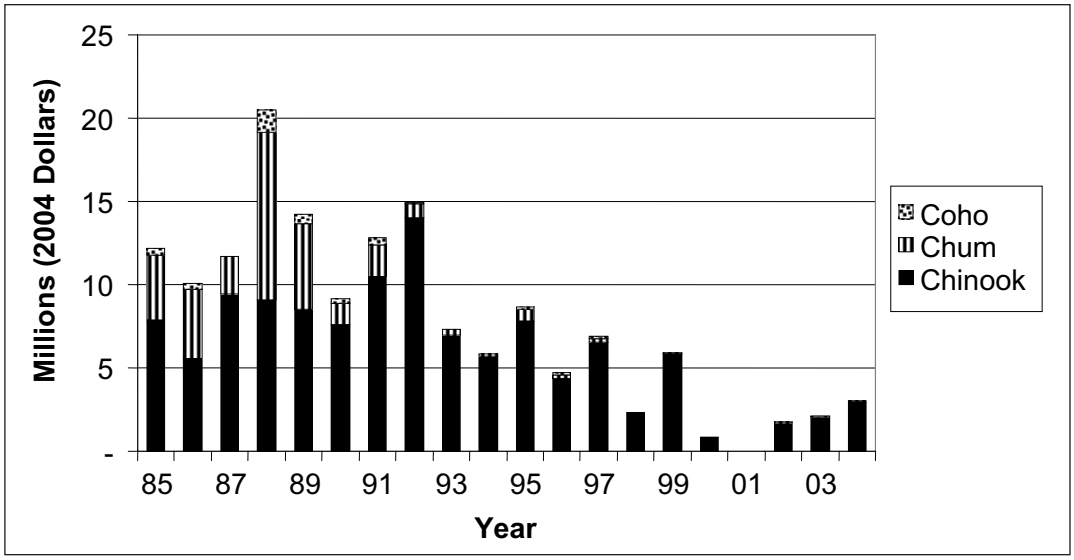

Figure 180. Exvessel value of the Yukon commercial salmon fishery, 1985–2004, adjusted for inflation into 2004 dollars.

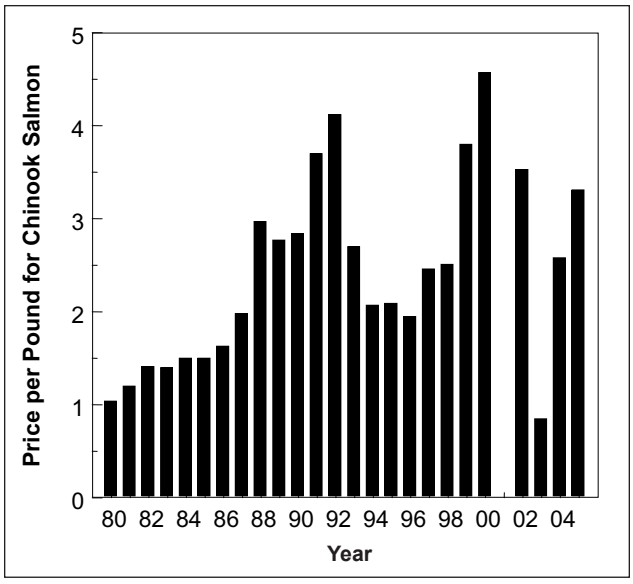

Figure 181. Average price per pound paid to commercial fishermen for the sales of Chinook salmon harvested from the Yukon, 1980–2005.

abundance. In Alaska, subsistence fisheries have priority over other types of use, and it is not possible to manage for individual stocks in most areas where commercial and subsistence fisheries occur. Agreements between the U.S. and Canada are in effect that commit ADF&G to manage Alaskan fisheries in a manner that provides adequate passage of salmon into Canada to both support Canadian fisheries and achieve desired spawning levels. In order to maintain the subsistence priority, meet U.S. and Canadian commitments, and provide for adequate spawning escapements, Alaskan Yukon River commercial salmon fisheries have to be managed conservatively.

Fishery management in the Yukon area by the Division of Commercial Fisheries is directly implemented by 2 area biologists and 2 assistant positions. One area biologist is directly responsible for management of the summer stocks (Chinook and summer chum salmon) and the other is directly responsible for management of the fall stocks (fall chum and coho salmon). As the respective stocks enter the Yukon River, each of the management biologists initially works out of the Emonak field office in the lower Yukon River assessing the runs and managing commercial and subsistence fisheries. As the runs move upriver, the area biologists relocate to the Fairbanks office located in the upper Yukon River and continue to assess and manage the salmon stocks. During the winter, these fishery management staff members work out of either the Fairbanks or Anchorage offices. Annual management reports, written by ADF&G staff since the early 1960s provide extensive and detailed fishery data and insight into the management program and fishery. See Vania et al (2002).

The commercial and subsistence salmon fisheries in the Yukon River are managed based upon perceived run strength and fishery management plans approved by the Alaska Board of Fisheries. During the fishing season, management is based upon both preseason and inseason run strength assessment information. Preseason information involves run forecasts based upon historic performance of parent spawning abundance and is generally expressed as runs that will be below average, average, or above average. Inseason run assessment includes abundance indices from test fishing, sonar counts of passing fish, mark–recapture estimates of run abundance, various escapement assessment efforts in tributaries, commercial and subsistence catch data, and catch per effort data from monitored fisheries. Several federal agencies, ADF&G, the Canadian Department of Fisheries and Oceans, Native organizations, and various organized groups of fishermen operate salmon stock assessment projects throughout the Yukon River drainage. The Division of Commercial Fisheries salmon fishery managers use this information to manage the Alaskan Yukon salmon fisheries. During the years from 2000 to 2004, based upon run strength information, Yukon fishery managers announced an average of 44 emergency orders per year (Table 33). These emergency orders implemented a combination of time and area openings and closures and gillnet mesh restrictions. Detailed information concerning each emergency order can be found in Yukon area management reports. For example, see Vania et al 2002.

Total utilization of Yukon River Chinook salmon represents the total harvest of these fish in the Yukon drainage in all Alaskan and all Canadian fisheries. Over the 44-year period from 1961 to 2004, total utilization of Chinook salmon in the Yukon averaged about 146,000 fish, ranging from a low of about 50,000 fish in 2000 to a high of about 220,000 fish in 1980 (Figure 182). From 2000 to 2004, mark–recapture estimates were implemented to estimate Chinook salmon passage past Russian Mission, and by accounting for both

Table 33. Number of emergency orders issued by Division of Commercial Fisheries Yukon area fishery managers for inseason management of Yukon salmon fisheries, 2000–2004.

Fishery	2000	2001	2002	2003	2004	Averages
Commercial	5	0	22	25	29	16
Subsistence	18	39	31	24	22	27
Personal Use	2	3	2	0	0	1
Totals	25	42	55	49	51	44

harvests in downstream fisheries and for escapements of Chinook salmon in tributaries downstream of Russian Mission, total annual run strength of Yukon River Chinook salmon can be estimated for those 5 years. Estimated in this manner, total runs of Yukon River Chinook salmon from 2000 to 2004 averaged about 303,000 fish and ranged from about 147,000 fish in 2000 to about 439,000 fish in 2001, about a 3-fold level of variation (Figure 182). The subtraction of total utilization from estimates of total runs provides annual estimates of total Yukon River escapements of Chinook salmon. Estimated in this manner, Yukon Chinook salmon escapements from 2000 to 2004 averaged about 218,000 fish and ranged from about 97,000 fish in 2000 to about 376,000 fish in 2001 (Figure 182). Annual harvest rates exerted on Chinook salmon by Yukon River fisheries from 2000 to 2004 averaged about 30%, ranging from about 15% in 2001 to about 39% in 2004 (Figure 183). These harvest rates are low in comparison to harvest rates exerted on most populations of Chinook salmon in Alaska and reflect the conservative fishery management regime in place.

The Pilot Station sonar assessment project successfully estimated annual passage of summer chum salmon in 1995 and from 1997 to 2005. An approximate estimate of the total run of summer chum salmon in the Yukon River can be obtained by adding (1) the sonar-based estimates of summer chum salmon passage at Pilot Station, (2) total utilization of summer chum salmon in Districts 1 and 2, and (3) chum salmon escapements in the East Fork of the Andreafsky River. The estimate is approximate because some of the harvest in District 2 takes place above Pilot Station and some other stocks of summer chum salmon spawn below Pilot Station. However, the Pilot Station counts are so much larger than the total catch and the monitored escapement that the total estimate is mostly based upon the sonar count (Figure 184). The total run of Yukon River summer chum salmon estimated in this manner averaged about 1.4 million fish annually in the 9-year period of 1995 and 1997 to 2004, ranging from a low

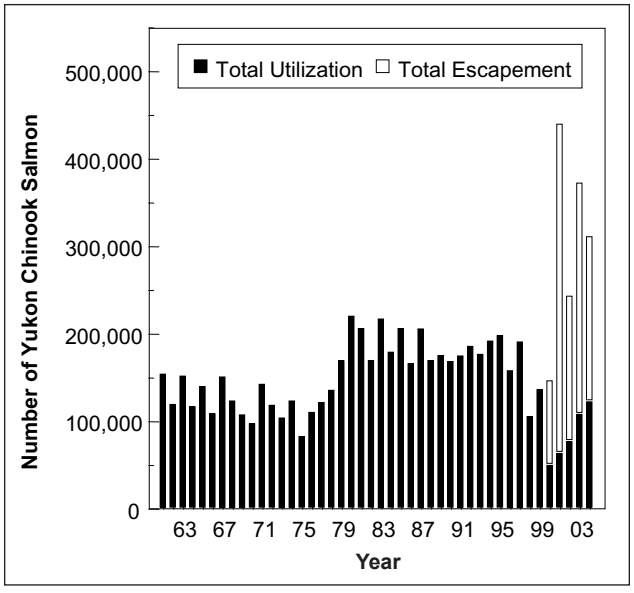

Figure 182. Total annual utilization (all Alaskan and Canadian harvests) of Yukon River Chinook salmon from 1961–2004 and total annual Yukon River Chinook escapements and total runs from 2000–2004.

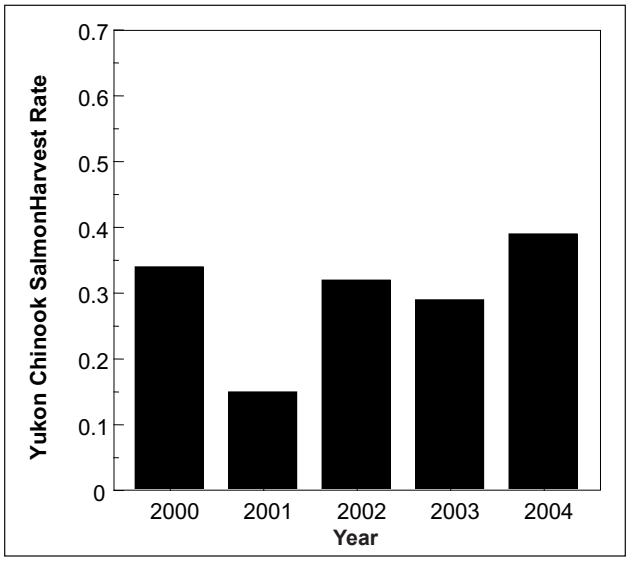

Figure 183. Estimated harvest rates exerted on Yukon Chinook salmon from 2000–2004.

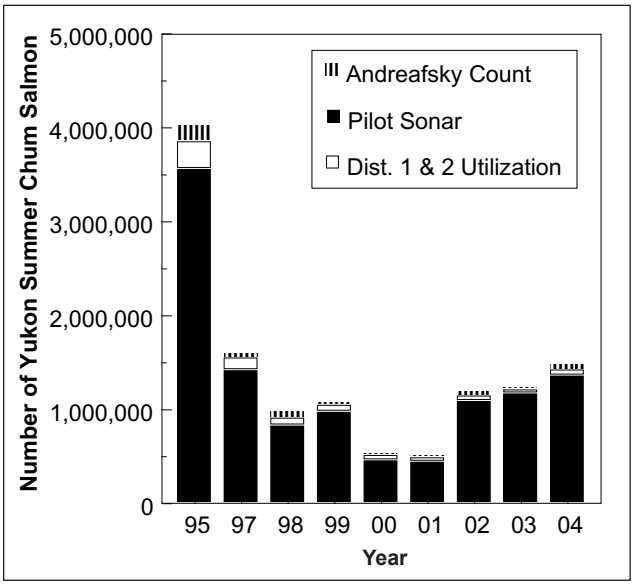

Figure 184. Approximate total runs of summer chum salmon in the Yukon River, 1995 and 1997–2004.

of about 515,000 fish in 2001 to about 4 million fish in 1995, almost an 8-fold level of variation. These annual total run estimates can be coupled with total annual inriver utilization to estimate harvest rates exerted on Yukon summer chum salmon for the years 1995 and 1997 to 2004 (Figure 185). Total harvest rates exerted by Yukon fisheries on summer chum salmon over those 9 years averaged about 12% and ranged from about 7% from 2002 to 2004 when the total runs averaged about 1.3 million fish to about 23% in 1995 when the total run was about 4 million fish. These harvest rates are low in comparison to harvest rates exerted on most Alaska salmon populations and reflect the combination of the conservative fishery management regime in place and the recent lack of summer chum markets.

Run reconstruction methods have been used to estimate total annual runs of fall chum salmon to the Yukon River for the years from 1974 to 2004. In 2005, Yukon River fall chum salmon escapement was estimated to have been in excess of 1.8 million fish, and the Alaska commercial harvest was about 180,000 fish. Complete Alaska subsistence and Canadian harvest estimates are not yet complete as of this writing and thus a minimum estimate of the total run in 2005 is about 2 million fall chum salmon. This minimum estimate is included in some of the averages that follow. Over the 32-year period from 1974 to 2005, the annual Yukon fall chum run averaged about 840,000 fish and ranged from a low of about 240,000 fish in 2000 to in excess of 2 million fish in 2005, a level of variation in excess of 8-fold (Figure 186). This level of overall annual run variation is not extreme in Alaska. For example, the annual run variation associated with Bristol Bay sockeye salmon over the 45-year period from 1960 to 2004 is about 25-fold, about 3 times that of the Yukon fall chum salmon runs over the past 32 years. The variation in annual runs of Kotzebue chum salmon is about 6-fold over the 43-year period from 1962 to 2004, ranging from about 264,000 fish to about 1.7 million fish (Eggers and Clark 2006), a level of annual run variation similar to that observed for Yukon fall chum salmon. The time series estimates of total runs for Yukon summer chum salmon is short, however, the level of variation of about 8-fold is similar to that for the fall chum salmon runs over the 32-year period from 1974 to 2005.

The run reconstruction data can be used to estimate harvest rates exerted on Yukon fall chum salmon for the years from 1974 to 2004 (Figure 187; Eggers 1999). Harvest rates over the 31-year period from 1974 to 2004 averaged about 37% and ranged from a low of about 7% in 2000 to a high of about 67% in 1982. Harvest rates exerted on Yukon fall chum salmon averaged about 49% in the 1970s and 1980s, about 30% in the 1990s, and about 11% since 2000. These harvest rates are low in comparison to harvest rates exerted on most Alaska salmon populations, especially the rates exerted since 1990, which reflect the conservative fishery management regime in place. Because coho salmon run timing is similar to fall chum salmon, and because for the most part, coho salmon are caught as an incidental species while fishermen target fall chum salmon, the pattern of harvest rates estimated for fall chum salmon

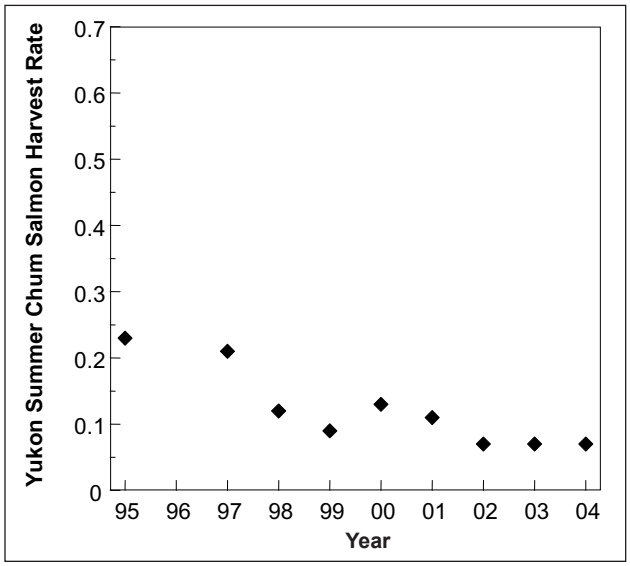

Figure 185. Estimated harvest rates exerted on Yukon fall chum salmon in 1995 and 1997–2004.

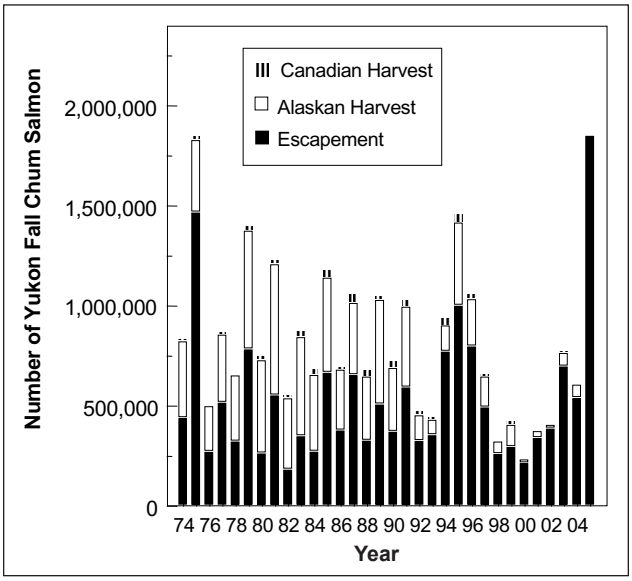

Figure 186. Total runs of fall chum salmon in the Yukon River, 1974–2005 (total harvests not yet available for 2005).

are probably reasonably representative of the harvest rate pattern exerted on Yukon coho salmon.

Escapement goals currently in effect for management of salmon fisheries in the Yukon area are listed in ADF&G (2004). In the Yukon River drainage, ADF&G has established 2 biological escapement goals and 5 sustainable escapement goals for Chinook salmon. The biological escapement goal for the stock of Chinook salmon that spawns in the Chena River is 2,800 to 5,700 fish. In the 19 years from 1986 to 2004, only in 1989 did the Chena River stock of Chinook salmon fail to meet the established escapement goal (Figure 188). The annual escapement of Chinook salmon in the Chena River in 2005 was not assessed. The Salcha River stock of Chinook salmon has a biological escapement goal of 3,300 to 6,500 fish. The Salcha River Chinook salmon escapement goal has been met in 17 of the past 19 years (89%). Escapements in 1989 and 2001 failed to meet the goal (Figure 189).

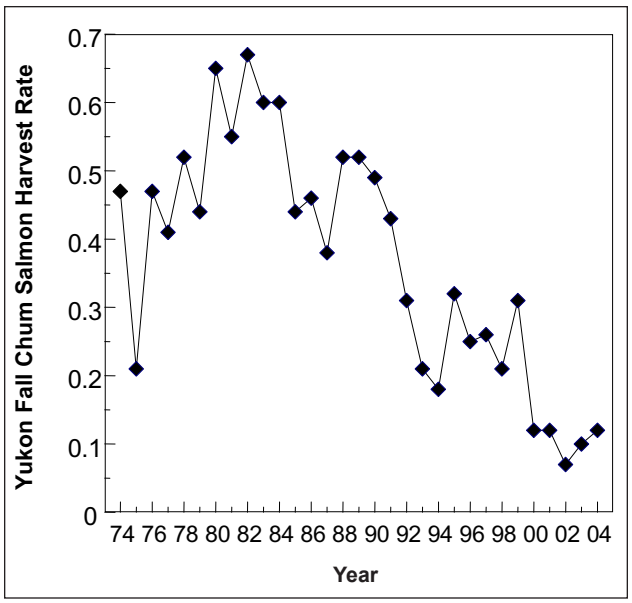

Figure 187. Estimated total harvest rates exerted on Yukon fall chum salmon, 1974–2004.

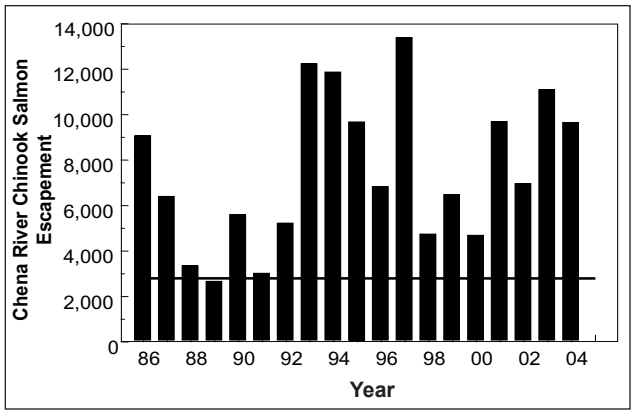

Figure 188. Chena River Chinook salmon escapements from 1986–2004 (bars) and the lower end of the ADF&G biological escapement goal range of 2,800–5,700 (line). Escapement not assessed in 2005.

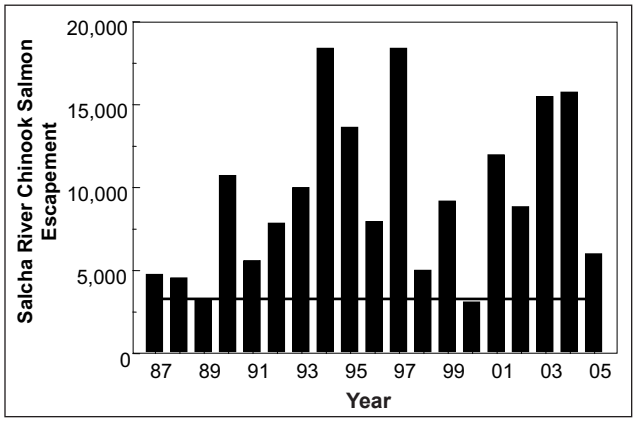

Figure 189. Salcha River Chinook salmon escapements from 1986–2005 (bars) and the lower end of the ADF&G biological escapement goal range of 3,300–6,500 (line).

Chinook salmon

There are 5 stocks of Chinook salmon in the Yukon River whose escapements are indexed by aerial surveys and where each has an established sustainable escapement goal. Figure 190 shows escapement observations for these 5 stocks over the period from 1996 to 2005. The East Fork of the Andreafsky River supports a spawning Chinook salmon population and has a sustainable escapement goal of 960 to 1,700 fish; escapement observations were not obtained in 1996, 1999, and 2003. The West Fork of the Andreafsky Chinook salmon population has a sustainable escapement goal of 640 to 1,600 fish; escapement observations were not obtained in 1998 and 1999. Chinook salmon spawn in the Anvik River and the sustainable escapement goal is 1,100 to 1,700 fish; escapement observations were not obtained in 1998, 1999, and 2003. The Chinook salmon sustainable escapement goal in the Nulato River is 940 to 1,900 fish; escapement observations were not obtained in 1996, 1997, 1999, 2000, 2003, and 2004. The Gisasa Chinook salmon population has a sustainable escapement goal of 420 to 1,100 fish; escapement observations were not obtained from 1996 to 2000 and 2003. Thus, there are 30 escapement observations out of the possible 50 stream by year cells from 1996 to 2005. In 25 of the 30 cases (83%), escapements met or exceeded the escapement goal.

Chum salmon

Two biological escapement goals have been established by ADF&G for summer chum salmon in the Yukon River drainage. The summer chum salmon spawning population in the East Fork of the Andreafsky River has a sustainable biological escapement goal of 65,000 to 130,000 fish. Assessment of the annual escapements occurred in 17 of the 25 years since 1981 (Figure 191). The escapement goal has been achieved in 9 of the 17 years (53%) and was last met in 1998. The Anvik River population of summer chum salmon has a biological escapement goal of 350,000 to 700,000 fish. The goal has been met or exceeded in 23 of the 26 years (88%) since 1980 (Figure 192), the 3 years when the goal was not met all occurred since 2000.

Seven biological escapement goals have been established by ADF&G for fall chum salmon in the Yukon River drainage, and several involve the same fish because some of the goals are nested. The overall biological escapement goal for the Yukon River drainage fall chum salmon is 300,000 to 600,000 fish (Figure 193). The goal has been met or exceeded in 25 of the 32 years (78%) since 1974; the goal was not met in 1976, 1980, 1982, 1984, and 1998 to 2000. The 2005 escapement was in excess of 1.8 million fall chum salmon and was the highest level of escapement

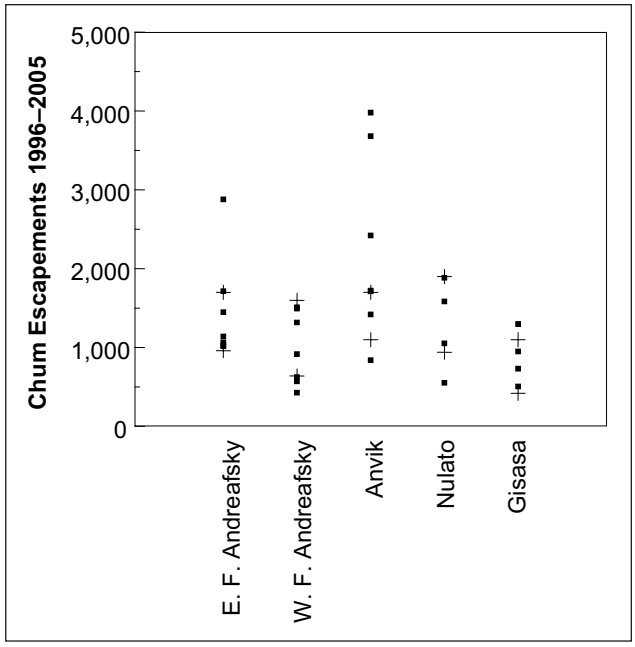

Figure 190. Chinook salmon escapements from 1996–2005 for 5 Yukon stocks assessed by aerial survey that have sustainable escapement goals (annual escapements shown as solid squares, lower and upper ends of sustainable escapement goal ranges shown as + signs).

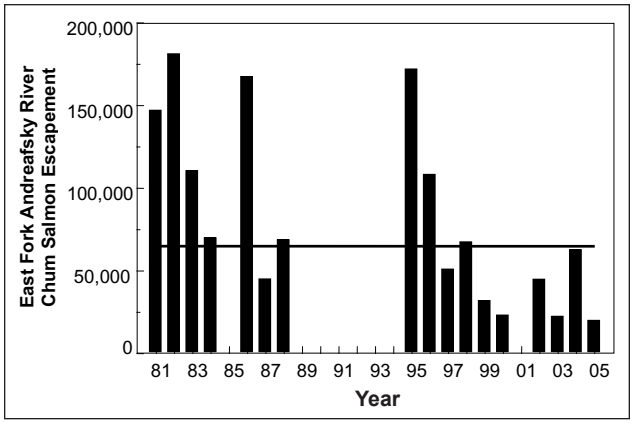

Figure 191. East Fork Andreafsky River summer chum salmon escapements from 1981–2005 (bars) and the lower end of the ADF&G biological escapement goal range of 65,000–130,000 (line). Escapement not assessed in 1985, 1989–1994, and 2001.

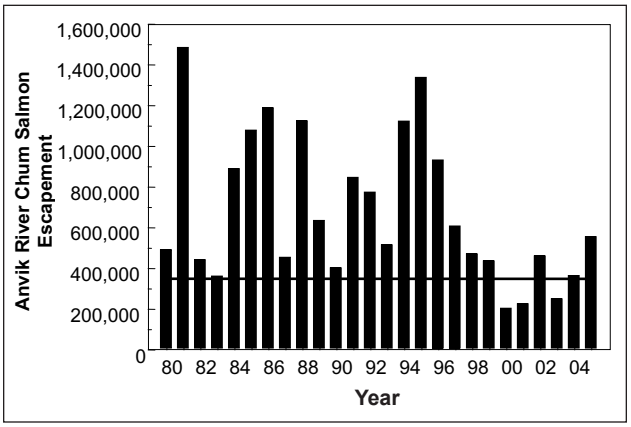

Figure 192. Anvik River summer chum salmon escapements from 1980–2005 (bars) and the lower end of the ADF&G biological escapement goal range of 350,000–700,000 (line).

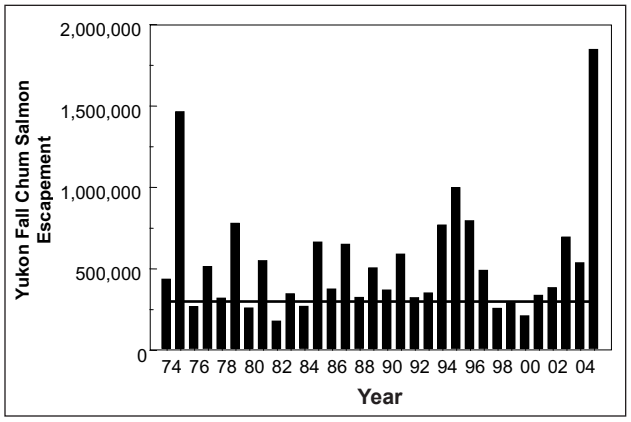

Figure 193. Run reconstruction estimates of the total Yukon fall chum salmon escapements from 1974–2005 (bars) and the lower end of the ADF&G biological escapement goal range of 300,000–600,000 (line).

ever observed. The biological escapement goal for fall chum salmon in the Tanana River is 61,000 to 136,000 fish. Annual escapements have met or exceeded the escapement goal in the Tanana River in 30 of the 32 years (94%) since 1974 (Figure 194); escapements did not achieve the goal in 1982 and 2000. Both the Delta River and the Toklat River are tributaries to the Tanana River. The biological escapement goal for the stock of fall chum salmon that spawns in the Delta River is 6,000 to 13,000 fish; the goal was met or exceeded in 29 of the 32 years (90%) since 1974. The annual escapements in 1980, 1982, and 2000 fell short of the goal (Figure 195). The biological escapement goal for the stock of fall chum salmon that spawns in the Toklat River is 15,000 to 33,000 fish; the goal was met or exceeded in 24 of the 32 years (75%) since 1974. The annual escapements in 1982, 1988, 1991, 1992, 1997, and 1999 to 2001 fell short of the goal (Figure 196). A biological escapement goal of 152,000 to 312,000 fish has been established for tributaries of the upper Yukon River; that goal has been met in 23 of the 32 years (72%) since 1974. Escapements in 1976, 1982, 1984, 1988, 1993, 1998 to 2000, and 2002 fell short of the current escapement goal (Figure 197). The biological escapement goal for fall chum salmon spawning in the Chandalar River is 74,000 to 152,000 fish, annual escapements since 1974 have met or exceeded the goal in 25 of the 32 years (78%). Escapements in 1976, 1978, 1982, 1984, 1988, 1993, and 2000 fell short of the goal (Figure 198). A biological escapement goal of 50,000 to 104,000 fish has been established for fish that spawn in the Sheenjek River; that goal has been met in 19 of the 32 years (60%) since 1974. Escapements in 1976, 1978, 1980, 1982, 1984, 1988, 1993, 1998 to 2000, and 2002 to 2004 fell short of the current escapement goal

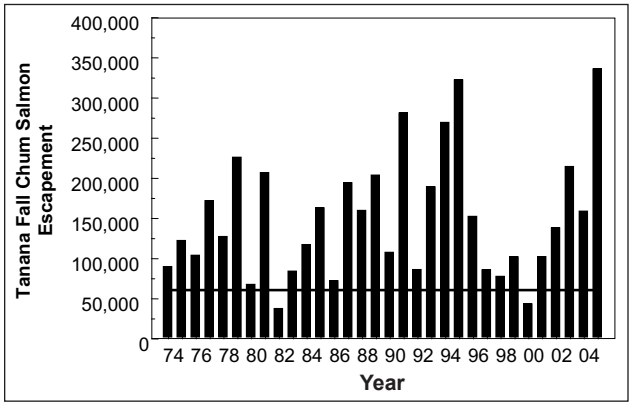

Figure 194. Mark–recapture estimates of the Tanana River fall chum salmon escapements from 1974–2005 (bars) and the lower end of the ADF&G biological escapement goal range of 61,000–136,000 (line).

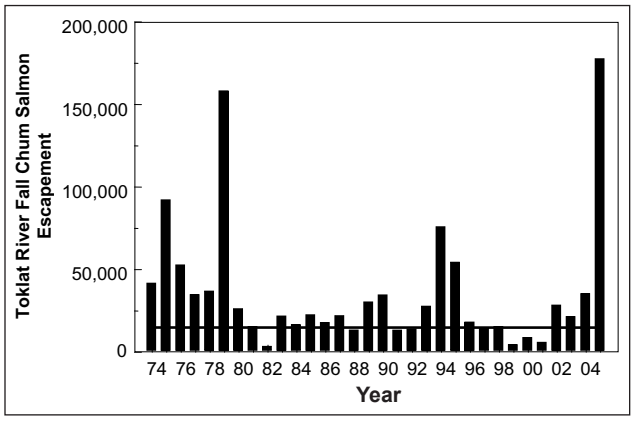

Figure 196. Estimates of the Toklat River fall chum salmon escapements from 1974–2005 (bars) and the lower end of the ADF&G biological escapement goal range of 15,000–33,000 (line).

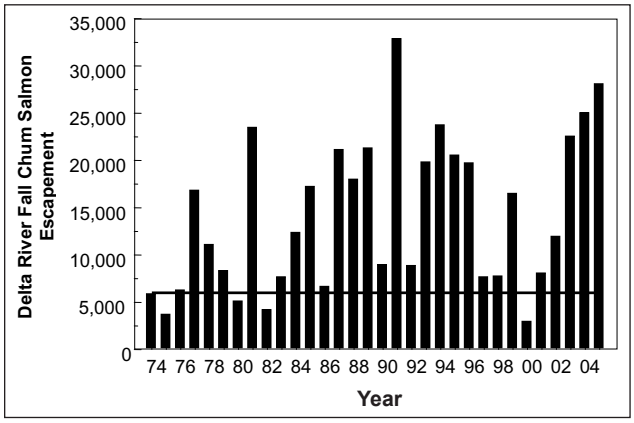

Figure 195. Estimates of the Delta River fall chum salmon escapements from 1974–2005 (bars) and the lower end of the ADF&G biological escapement goal range of 6,000–13,000 (line).

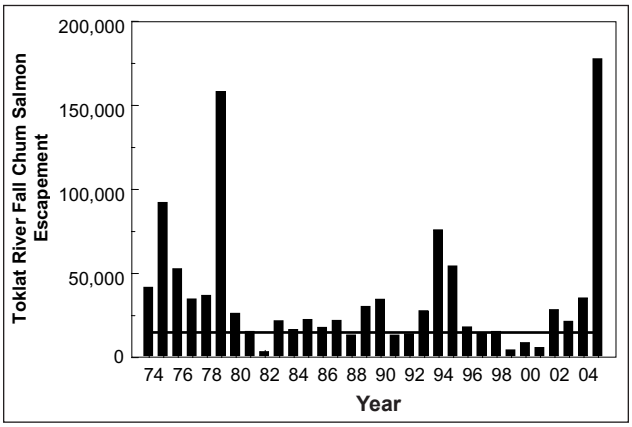

Figure 197. Estimates of the fall chum salmon escapements in tributaries of the upper Yukon from 1974–2005 (bars) and the lower end of the ADF&G biological escapement goal range of 152,000–312,000 (line).

(Figure 199). The escapement of fall chum salmon in the Sheenjek River in 2005 was almost 440,000 fish, the highest level ever observed.

There are 2 fall chum salmon passage goals that were negotiated in an agreement with Canada. The passage goal for the mainstem Yukon is 65,000 fish and this level has been observed in half of the years since 1974, but exceeded in each of the last 4 years (Figure 200). The passage goal for the Fishing Branch River is 15,000 fish and this level has been met or exceeded in 28 of the last 32 years (87%) including the last 3 years (Figure 201). The 2005 passage was in excess of 120,000 fall chum salmon, about 8-fold the goal and the second highest passage ever observed.

Coho salmon

The only escapement goal in place in the Yukon River drainage for coho salmon is for the Delta Clearwater River, a tributary to the Tanana River. The sustainable escapement goal for coho salmon in the Delta Clearwater River is 5,200 to 17,000 fish and that goal has been met or exceeded in 25 of the 32 years (78%) since 1992. Escapements fell short of the goal from 1974 to 1978, 1980, and 1992 (Figure 202). The annual escapements since 2001 have been exceptionally strong.

Budget History and Fiscal Support

In FY 05, the Division of Commercial Fisheries budget allocation for state funding for Yukon salmon was $1,038,100. Summer season management was $420,100 and fishery monitoring was $104,300. Fall season management was $365,300 and fishery monitoring was $79,600. Other state-funded activities included Anvik sonar assessment with an allocated budget of $49,800 and an allocation of $19,000 for

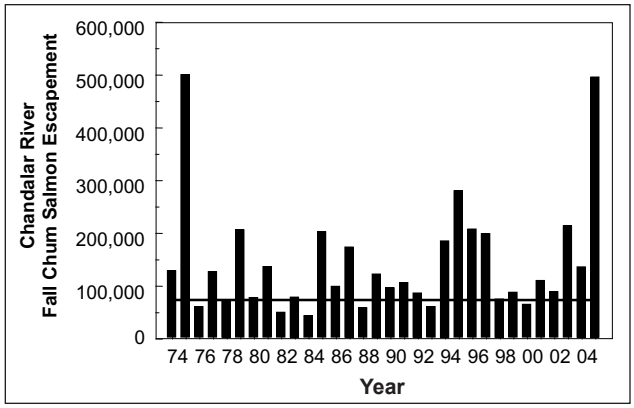

Figure 198. Sonar based estimates of the Chandalar River fall chum salmon escapements from 1974–2005 (bars) and the lower end of the ADF&G biological escapement goal range of 74,000–152,000 (line).

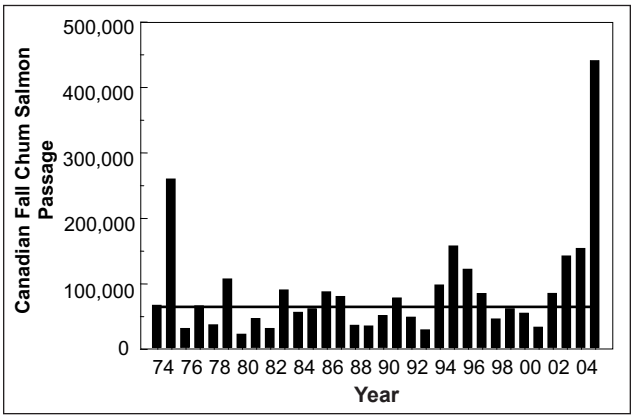

Figure 200. Estimates of the passage of fall chum salmon into Canada from 1974–2005 (bars) and the threshold value of 65,000 fish negotiated through treaty agreements.

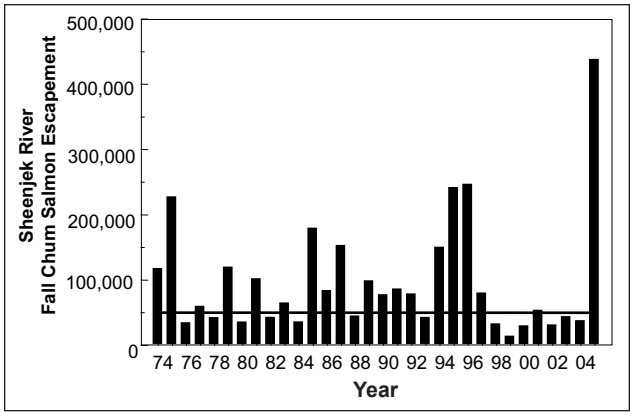

Figure 199. Sonar based estimates of the Sheenjek River fall chum salmon escapements from 1974–2005 (bars) and the lower end of the ADF&G biological escapement goal range of 50,000–104,000 (line).

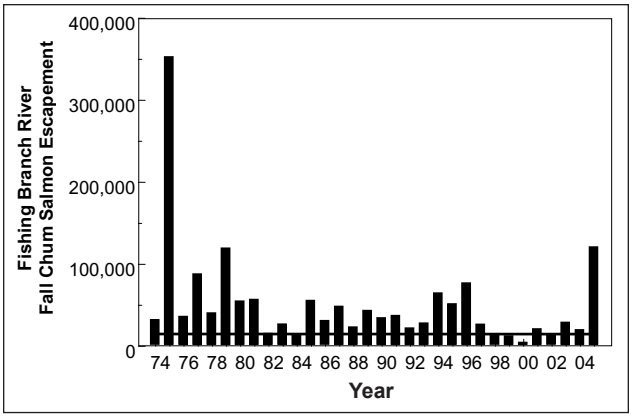

Figure 201. Weir based estimates of the Fishing Branch River fall chum salmon escapements from 1974–2005 (bars) and the threshold passage level of 15,000 fish negotiated through treaty agreements.

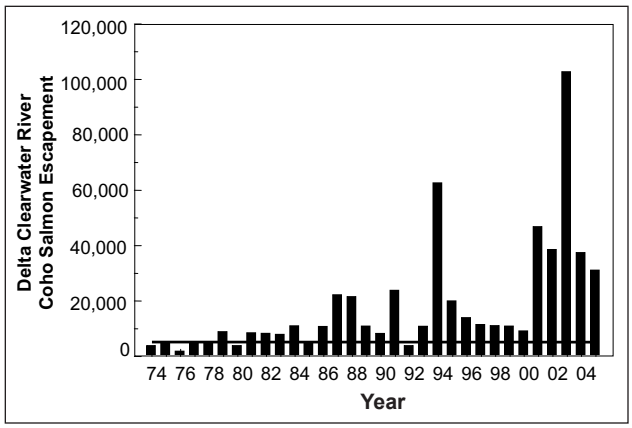

Figure 202. Counts of coho salmon in the Delta Clearwater River from 1974–2005 (bars) and the lower end of the ADF&G sustainable escapement goal range of 5,200–17,000 (line).

test fishing in the Upper Yukon. Additional state-funded stock assessment efforts were implemented and funded in FY 05, but were included within the AYK Regional Administrative unit, the Statewide genetics unit, or elsewhere. Federal funding of about $850,000 associated with the U.S.–Canada Yukon agreement was used by ADF&G for salmon stock assessment in the Yukon in fiscal year 2005. Other funding sources used for Yukon salmon stock assessment by ADF&G in fiscal year 2005 included grants from the Federal Office of Subsistence and grants from the AYK Sustainable Salmon Initiative. Various federal agencies, the Canadian Department of Fisheries and Oceans, Native organizations, nongovernmental organizations, and fishing groups used funding from a variety of sources to conduct salmon stock assessments in the Yukon River in FY 05. Due to the large number of participants involved with Yukon salmon stock assessment and the varied funding sources, it is difficult to get a total picture of the current annual cost of the Yukon salmon stock assessment and management program. However, clearly the cost was several million dollars and likely in the vicinity of about $5 million. Annual costs associated with assessment and management of Yukon salmon over the last several years has exceeded the exvessel value of the commercial fishery. Coordination and communication among the various participants involved with salmon stock assessment in the Yukon represents a significant work load for Yukon salmon management staff.

The Division of Commercial Fisheries faces several challenges associated with management of Yukon salmon fisheries. Long-term stock assessment information is needed to assess how various salmon stocks that spawn in the Yukon River drainage can support sustained fisheries. Little stock assessment information is available for Yukon salmon prior to statehood and most stock assessment information collected during the 1960s and 1970s consisted of aerial surveys that were conducted on a periodic basis and provide very crude estimates of spawning abundance. Long-term and accurate estimates of the abundance and composition of spawning stocks is needed along with estimates of the harvests of those salmon in the various fisheries of the Yukon drainage. Much progress toward these objectives has been made since the late 1980s, especially over the last decade. However, the time series for many such data sets is relatively short. Obtaining such information in the Yukon is expensive and difficult due to the remoteness of the area.

Although Chinook salmon are commercially the most valuable salmon in the Yukon, assessing total abundance of Chinook salmon has been one of the more challenging aspects of stock assessment in the Yukon River drainage. Assessment using sonar has been attempted over the last 20 years, but success in the lower river has been elusive. Recent efforts to assess Chinook salmon passage at Eagle, below the U.S.–Canada border, look promising, and coupled with genetic stock identification, may provide breakthrough, cost-effective technology for annual assessments of Chinook salmon in the Yukon River drainage. Reasonably complete assessment of summer chum salmon is feasible but expensive, and given commercial interest in the summer chum salmon stocks of the Yukon, may or may not be cost-effective. Reasonably complete assessment of fall chum salmon currently exists in the Yukon. A significant challenge for salmon management in the Yukon is using the various stock assessment efforts effectively to make the best possible decisions for managing the gauntlet of fisheries in the Yukon River drainage. An area for future research is development and implementation of fishery management models.

The commercial fishing industry in the Yukon faces other challenges. Over the past 10 years, low prices paid for chum salmon, and the relative lack of commercial enterprises interested in marketing these fish, has greatly limited the commercial fishery and its potential economic benefits in a cash poor rural area of Alaska. The challenge to fishermen in the Yukon is 2-fold: (1) developing niche markets to substantially increase the value of commercial chum salmon landings, allowing them to increase earnings from commercial salmon fishing; and (2) continuing support for comprehensive stock assessment programs implemented by agencies and nongovernmental organizations that ensure opportunity for commercial fishing that will not negatively affect salmon stock status nor subsistence utilization of salmon stocks in the Yukon River drainage.

NORTON SOUND COMMERCIAL SALMON FISHERY

Area Description and Gear Types

All 5 species of Pacific salmon are present in the Norton Sound area. In 1959 and 1960 Division of Commercial Fisheries biologists conducted resource inventories that indicated harvestable surpluses of salmon were available in several river systems of Norton Sound. The Division of Commercial Fisheries and Board of Fish and Game established regulations for development of commercial salmon fisheries in Norton Sound and encouraged processors to explore and develop these fisheries after statehood in an effort to provide economic benefits to this part of rural Alaska. Norton Sound was subdivided into 6 subdistricts: (1) subdistrict 1 or the Nome subdistrict, (2) subdistrict 2 or the Golovin subdistrict, (3) subdistrict 3 or the Moses Point subdistrict, (4) subdistrict 4 or the Norton Bay subdistrict, (5) subdistrict 5 or the Shaktoolik subdistrict, and (6) subdistrict 6 or the Unalakleet subdistrict (Figure 203). The Port Clarence district is located north of Norton Sound and south of the Kotzebue area and does not support a commercial fishing industry. Subsistence fishing for salmon does occur in Port Clarence and in this report those catches are combined with Norton Sound subsistence information.

Only gillnet gear is used for commercial salmon fishing in Norton Sound.

History of the Commercial Salmon Fishery

Commercial salmon fishing first began in Norton Sound in the Unalakleet and Shaktoolik areas in 1961. Most of the early interest in commercial fishing involved Chinook and coho salmon that were harvested, cleaned, and flown to Anchorage for further processing. A single freezer ship purchased and processed chum and pink salmon during 1961. In 1962, 2 floating cannery ships operated, and commercial fishing extended into Norton Bay, Moses Point, and Golovin Bay. The peak in salmon canning operations occurred in 1963. Since the early 1960s, markets have been sporadic, with fishermen in some subdistricts often being unable to attract buyers for the entire season. The most consistent markets are at Unalakleet and Shaktoolik. The intent of the commercial salmon fisheries management program is to sustain the runs, ensure subsistence needs are met and provide opportunity for commercial fishermen to harvest available surpluses. Annual management reports for the Norton Sound area, written by ADF&G staff since the 1960s provide detailed fishery data and insight into the management program and fishery. See Kohler et al. (2005).

Commercial harvests of Chinook salmon peaked in the 1980s when the 10-year annual average harvest was about 8,000 fish (Figure 204, Panel A). Average harvests in the 1990s dropped slightly to about 7,000 fish while harvests in the last few years dropped even more. Commercial harvests of sockeye salmon have always been minor. Only in 1988 were more than 1,000 sockeye salmon harvested, while most years the harvest has been less than 200 fish (Figure 204, Panel B). Coho salmon annual harvests in the 1980s averaged about 40,000 fish (Figure 204, Panel C). Harvests increased somewhat to an average annual level of about 55,000 fish in the 1990s but have decreased to about half that level since 2000. Pink salmon are abundant in Norton Sound, particularly in even-numbered years. Commercial harvests of pink salmon have been sporadic; in some years, recently no pink salmon have been commercially harvested, while in 1994, almost one million pink salmon were commercially harvested (Figure 204, Panel D). Commercial harvest of chum salmon in Norton Sound annually averaged about 150,000 fish in the 1970s and 1980s (Figure 204, Panel E). Management for fixed escapement goals in the 1990s resulted in reduced harvests in the 1990s, averaging only about one-third of the prior sustained level of about 40,000 fish. Average harvest levels since 2000 dropped to about 5,000 chum salmon. The overall pattern of commercial salmon harvests in the Norton Sound area is one of fishery development in the 1960s, increasing salmon harvests each decade through the 1990s, and a sharp reduction in harvests in the last few years (Figure 204, Panel F). Commercial salmon harvests in the 1980s and 1990s averaged a little over 300,000 fish annually.

Other Salmon Harvests

Annual subsistence harvests in Norton Sound and Port Clarence have averaged about 100,000 fish since 1994 with a low of about 65,000 fish in 1999 to a high of about 145,000 fish in 1996 (Figure 205). Pink salmon have represented about 46% of the subsistence harvest followed by chum salmon (25%), coho salmon (19%), Chinook salmon (6%), and sockeye salmon (4%). Subsistence use has declined over the last 10 years, although the decline in commercial harvests is more stark (Figure 206).

Sport fishermen also harvest salmon in Norton Sound (Table 34). Sport fishing harvests are stable, with reduction in the pink and chum salmon harvests compensated by increases in the harvest of Chinook, sockeye and coho salmon.

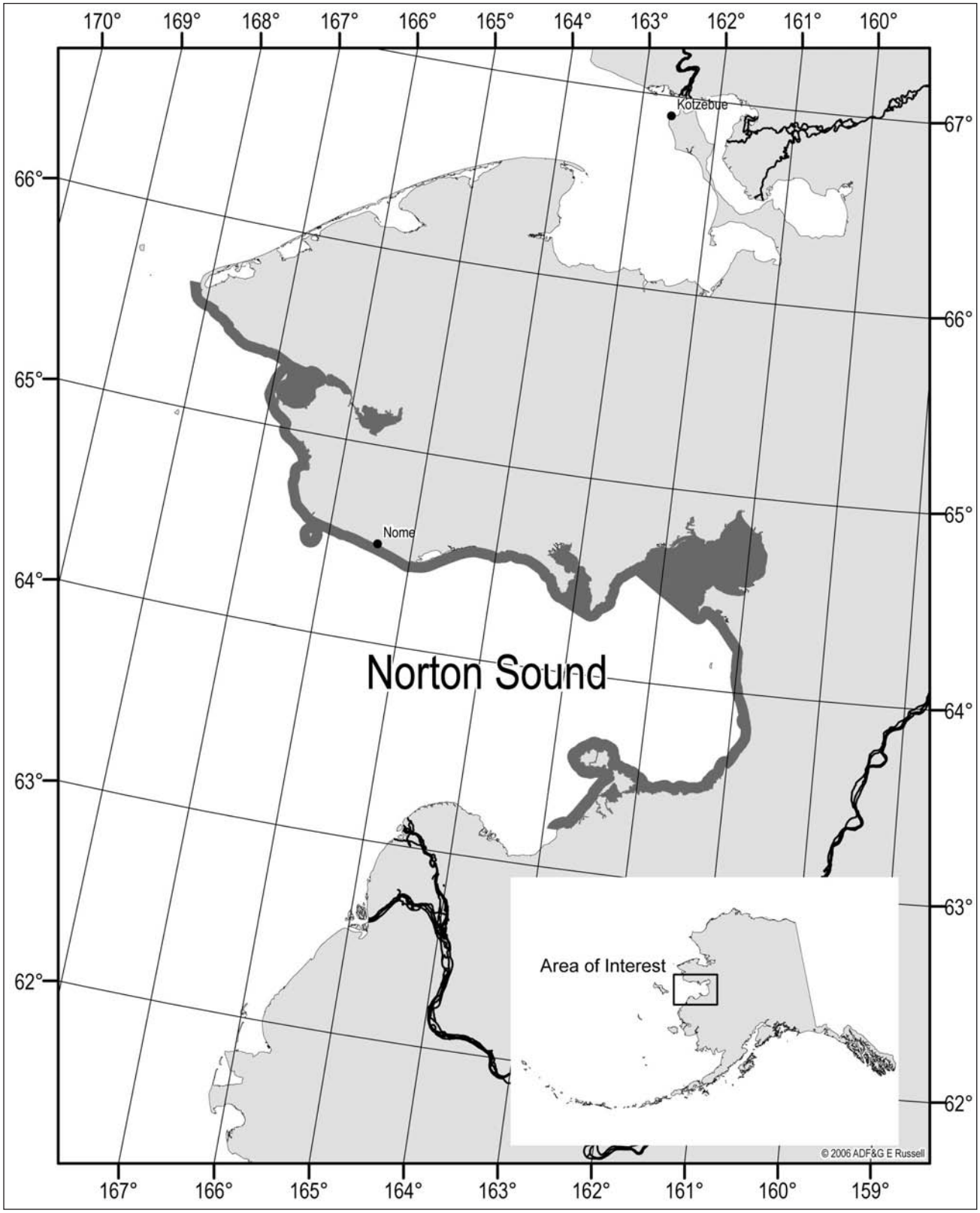

Figure 203. Norton Sound area commercial salmon fishery.

Commercial Salmon Fishery Users

As of August 2005, a total of 154 limited entry permits were valid for commercial fishing with gillnets in Norton Sound. Participation in the Norton Sound commercial salmon fishery has drastically declined since the mid-1980s (Figure 207). In 2002 only 12 fishermen participated in the fishery, in 2003 only 30 participated, and in 2004 only 36 participated—a fraction of the permits available, and only a small fraction of the number of permits fished in the mid-1980s.

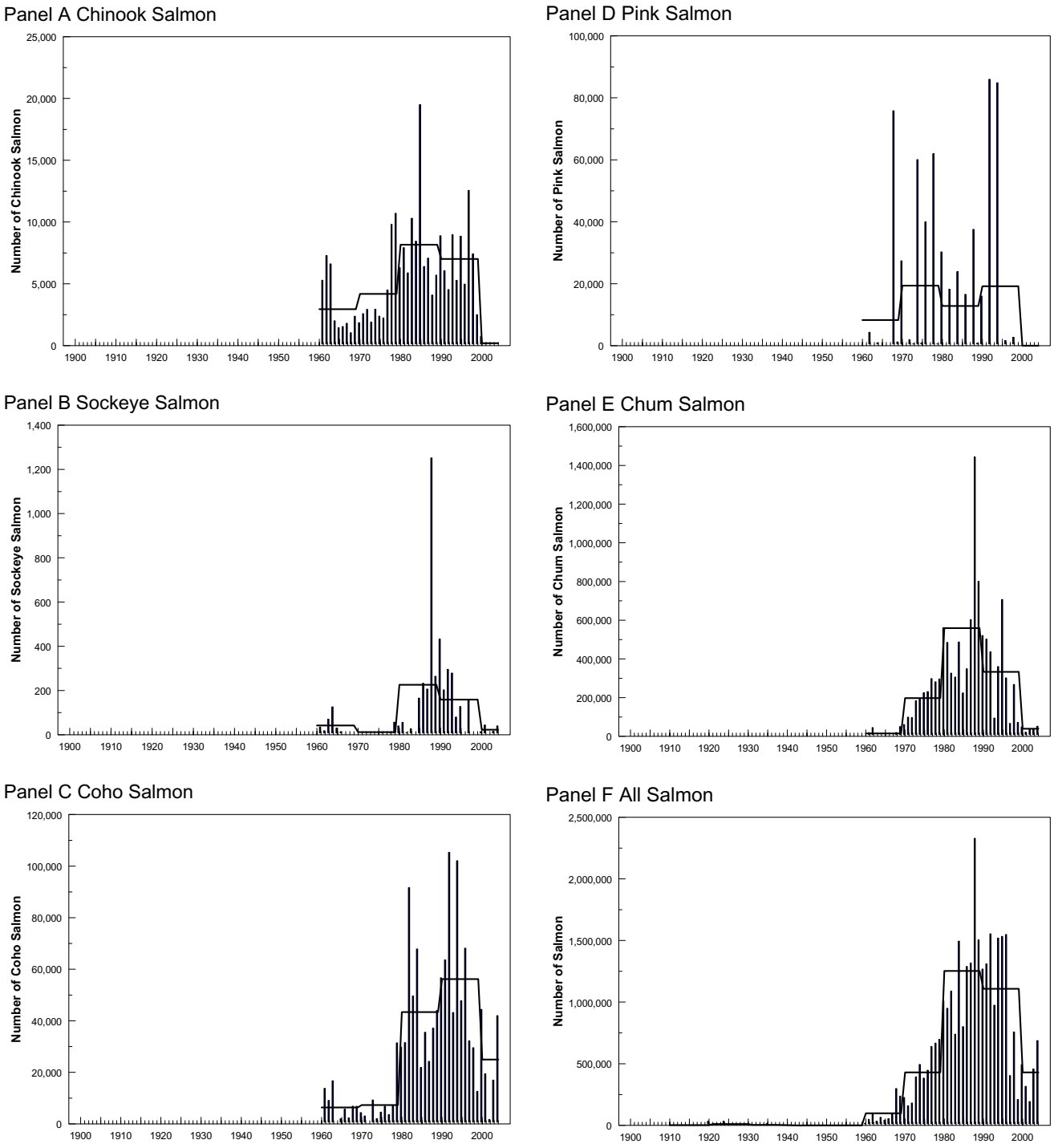

Figure 204. Commercial salmon harvests in Norton Sound from 1900–2004; bars provide annual catches and lines provide decade averages.

Exvessel Value

As the salmon fishery in Norton Sound developed after statehood, the commercial fishery provided a valuable source of income in a rural part of Alaska, where it was an important portion of the local economy. In 1985 for instance, the inflation-adjusted exvessel value of the commercial salmon fishery was about $1.9 million. Sporadic market demand for salmon from rural areas of Alaska, low prices paid for those salmon harvested, and weak chum salmon runs in Norton Sound over the past 10 years, have combined to result in the present-day fishery that contributes little to the local economy (Figure 208). In 2004 for instance, the exvessel value of the fishery totaled only about $125,000 (only about 6% of the 1985 exvessel value). In 1964, commercial fishermen in Norton Sound were paid almost $5.00 per pound for Chinook salmon; 40 years later in 2003, fishermen were only paid $0.64 per pound. Meanwhile, due to 40 years of inflation, operational costs to fishermen have increased substantially. In 1988, commercial fishermen in Norton Sound were paid $1.13 per pound for coho salmon whereas in 2004, they were only paid $0.39 per pound. In 1988, commercial fishermen in Norton Sound were paid $0.39 per pound for chum salmon whereas in 2004, they were only paid $0.14 per pound, about 35% of the price paid 16 years earlier when operating expenses were much less.

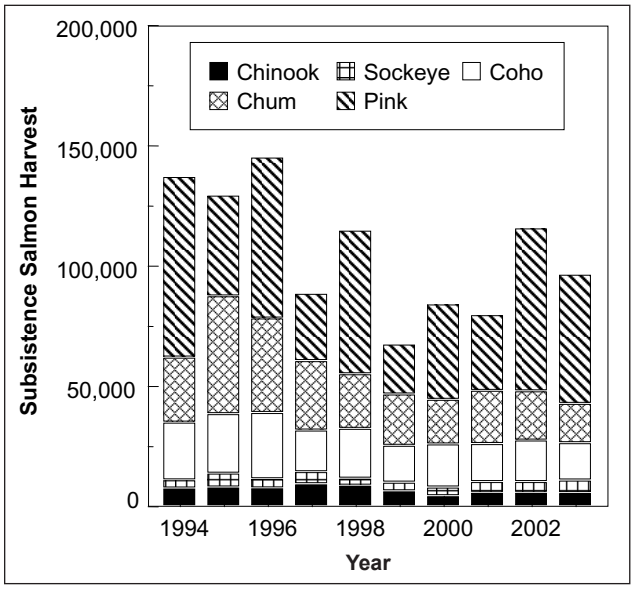

Figure 205. Subsistence salmon harvests in Norton Sound and Port Clarence from 1994–2003.

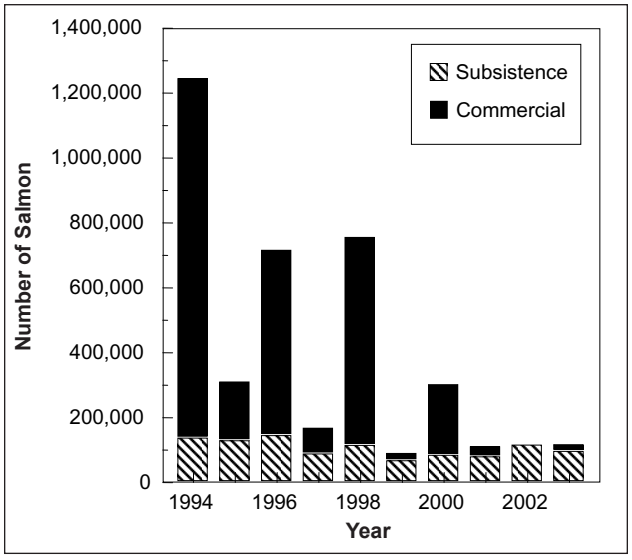

Figure 206. Subsistence and commercial harvests of salmon in the Norton Sound area from 1994–2003.

Management

A large tagging study of salmon in Norton Sound conducted in 1978 and 1979 found that salmon entered

Table 34. Average annual harvest of salmon in the Norton Sound sport fishery.

Species	1980–1989	1990–1999	2000–2004
Chinook	400	559	558
Sockeye	226	84	212
Coho	3,397	4,852	5,043
Pink	4,957	4,490	3,617
Chum	1,628	632	881
Total	10,608	10,617	10,311

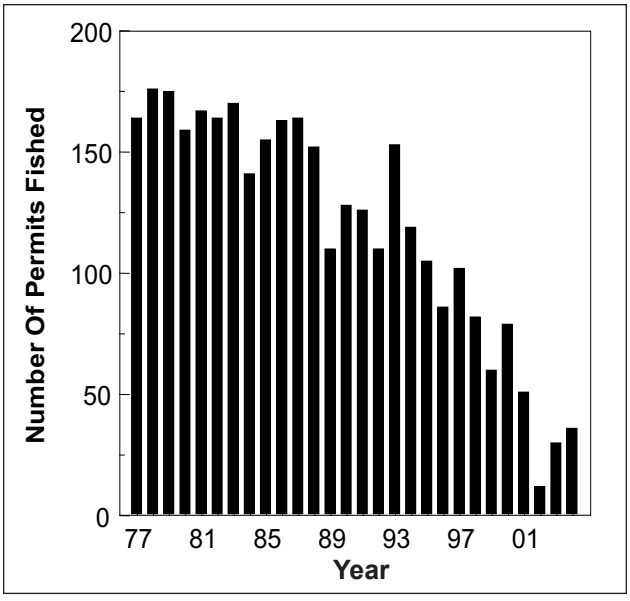

Figure 207. Number of commercial permits fished in Norton Sound, 1977–2004.

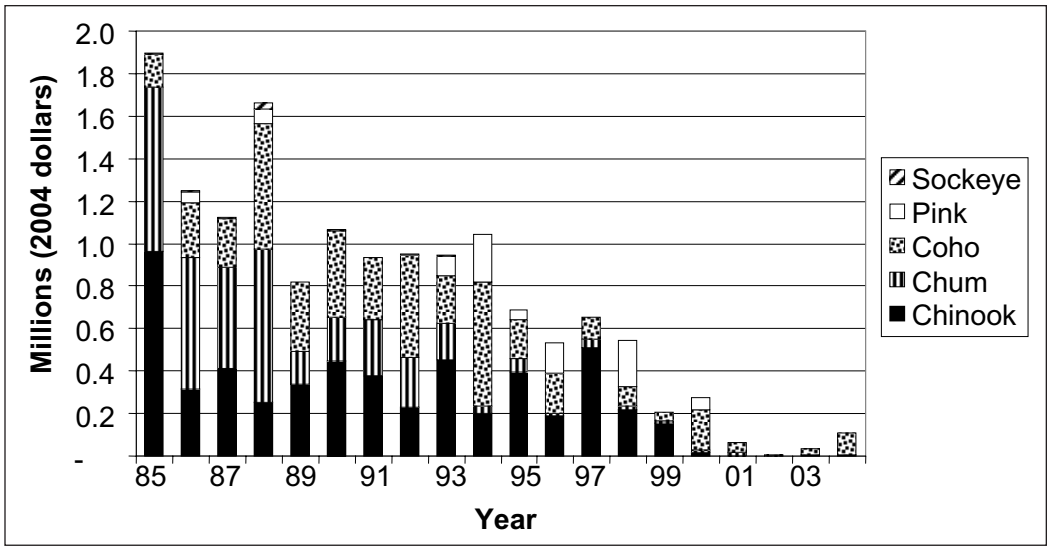

Figure 208. Exvessel value of the Norton Sound commercial salmon fishery, 1985–2004, adjusted for inflation into 2004 dollars.

Norton Sound and generally migrated in a clockwise fashion with various stocks of salmon entering spawning streams while other stocks, including Yukon origin salmon, attempted to pass through the various fishing districts (Gaudet and Schaefer 1982). Subdistrict commercial harvests of salmon in Norton Sound represent mixed stock harvests, and further, most subdistricts have multiple streams that support spawning salmon populations. The Division of Commercial Fisheries has managed the Norton Sound commercial fisheries since the late 1980s to achieve spawning targets in numerous Norton Sound streams. As this escapement-based management regime was implemented, commercial fisheries were increasingly restricted. Norton Sound salmon runs decreased in the 1990s, especially chum salmon. Less than average productivity, coupled with the escapement-based management regime implemented, has resulted in very low commercial harvests over the last several years.

The Board of Fisheries determined that the Nome, Golovin, and Moses Point subdistrict runs of chum salmon were stocks of concern in 2000. The Board of Fisheries determined the Shaktoolik and Unalakleet stocks of Chinook salmon were stocks of concern in 2004. Over the last 10 years, the fishery management program in Norton Sound has become more complex with the addition of several management plans, improved inseason and postseason stock status information, and more intensive inseason management of both the commercial and subsistence fisheries. In each of the last 5 years, Division of Commercial Fisheries managers have issued about 30 emergency orders per year to regulate these salmon harvests with the recent trend being more and more intensive management of subsistence fisheries (Figure 209).

Over the last several years, as increasing concern for stock status of salmon in Norton Sound developed, large-scale federal funding has been obtained to improve the salmon monitoring program. The historic run monitoring program in Norton Sound consisted of documenting commercial harvests, monitoring

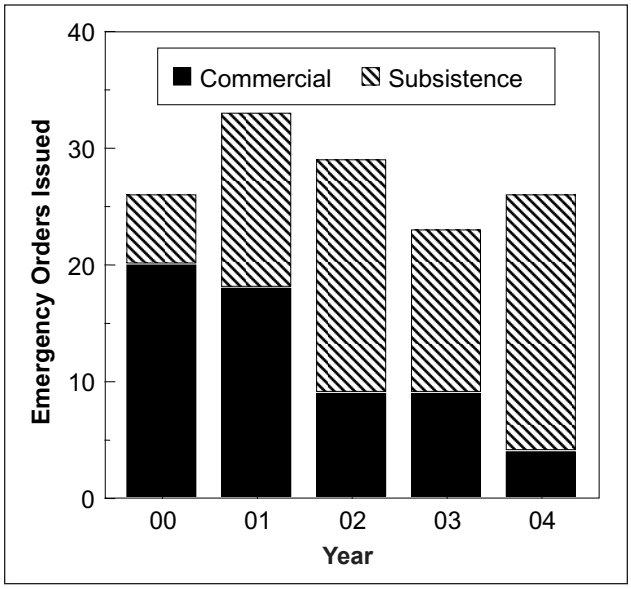

Figure 209. Number of emergency orders issued for management of Norton Sound commercial and subsistence fisheries, 2000–2004.

subsistence harvests, and tracking trends in salmon escapement largely through aerial surveys. The only long-term, on-the-grounds, escapement monitoring project in Norton Sound was the Kwiniuk River tower project that has been used since 1962. Various efforts have been made to reconstruct stock status using the aerial survey database to provide an improved understanding of salmon dynamics in Norton Sound. However, as is obvious, these efforts are based on a variety of assumptions. New funding sources have focused recent efforts on using weirs and towers to obtain good counts of salmon going into spawning streams. Information from these efforts has greatly improved the information base for salmon resources in Norton Sound.

Escapement goals currently in effect for management of salmon fisheries in Norton Sound are listed in ADF&G (2004). There are 3 escapement goals in effect for Chinook salmon, 2 for sockeye salmon, 3 for coho salmon, 5 for pink salmon, and 11 for chum salmon. With the exception of 3 biological escapement goals for chum salmon, the goals currently in effect are sustainable escapement goals, meaning they are expected to provide for sustained harvest but not necessarily provide for maximum sustained production. A few of the better data sets available for tracking Norton Sound salmon escapement trends are provided.

The Kwiniuk River is located in the Moses Point subdistrict and a tower has been used to count salmon escapements annually since the early 1960s. Counts of Chinook salmon were not made in 1964 and 1970 and the tower program may have not been in place early enough in the year during the 1960s and 1970s to obtain accurate escapement counts. The current sustainable escapement goal for Kwiniuk River Chinook salmon is a range of 300 to 550 fish. Chinook salmon escapements in excess of the lower end of the current goal range have been documented in 17 of the 22 years (77%) since 1984 (Figure 210). Weak escapements occurred from 1998 through 2001 while more recent Chinook salmon escapements have been substantially stronger.

Salmon Lake is in the Port Clarence district and escapement strength of sockeye salmon has been monitored with an aerial survey program since 1963. Successful surveys were not implemented in 1970, 1981, and 1982. Over the past 40 years, sockeye salmon escapements have increased dramatically in this river system (Figure 211). The current sustainable escapement goal for this stock is 4,000 to 8,000 fish observed during an aerial survey. Since 1995, only in 2002 was the peak survey less than the lower end of the escapement goal range; thus 91% of the escapements documented since 1995 (last 11 years) have been at or above the lower goal range.

The Niukluk River is in the Golovin subdistrict of Norton Sound and coho salmon escapements have been documented with aerial surveys since 1984 (Figure 212). Successful surveys were not completed in 1986, 1994, 1997, 2003, and 2004. The current sustainable escapement goal for this stock is 950 to 1,900 fish observed during an aerial survey. Escapements in excess of the lower end of the goal range have occurred in 9 of the 16 years (56%) since 1984 when successful surveys adequately documented escapement strength. These data indicate substantial variation in annual escapement strength of coho salmon in the Niukluk River, but a trend pattern is not obvious.

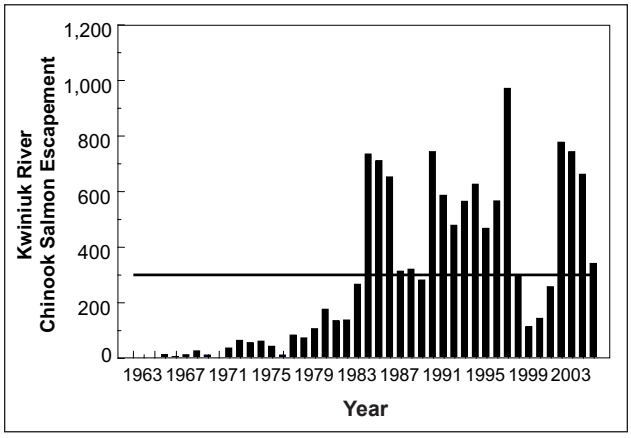

Figure 210. Annual tower counts of escapements of Chinook salmon in the Kwiniuk River from 1963–2005 (bars) and the lower end of the current ADF&G sustained escapement goal range of 300–550 (line).

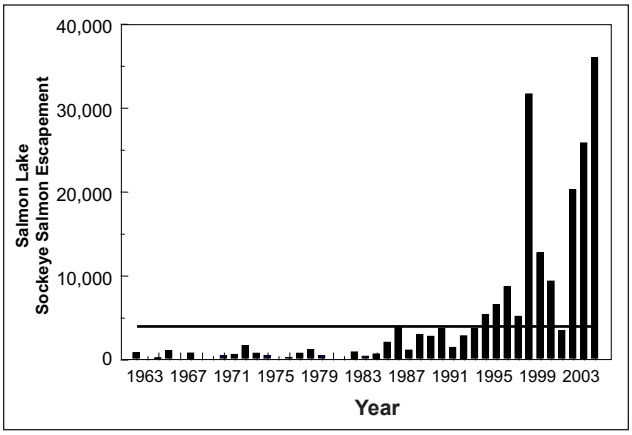

Figure 211. Annual peak survey counts of escapements of sockeye salmon in the Salmon Lake and Grand Central River from 1963–2005 (bars) and the lower end of the current ADF&G sustainable escapement goal range of 4,000–8,000 (line).

The current sustainable escapement goal for the Kwiniuk River pink salmon stock is a threshold value of 8,400 fish. The stock shows a marked even-year dominance, particularly since the mid-1980s (Figure 213). The 2004 escapement was over 3 million fish and the 2005 escapement was almost 350,000 fish. Since 1968, only the 1987 and 1999 escapements were less than the current escapement goal, thus 95% of the last 37 annual escapements exceeded the threshold value of 8,400 fish, and in most of those years, the annual escapements were many times larger. The Kwiniuk River pink salmon stock, like most Norton Sound pink salmon populations, has virtually exploded in abundance over the last 40 years.

The Nome River is in the Nome subdistrict of Norton Sound and a weir has been used to count salmon escapements since 1993 (Figure 214). Like other Norton Sound pink salmon stocks, the run is even-year dominant and increasing. The current sustainable escapement goals for this stock are a threshold value of 3,200 fish during odd years and a threshold value of 13,000 fish during even years. The threshold escapement goals have been exceeded each year since 1993 except for the odd-year runs in 1999 and 2001. Although the 2001 escapement goal was not achieved, in 2003 the escapement was about 11,000 fish, exceeding the goal. The escapement in 2004 was over one million fish and the escapement in 2005 was over 275,000 fish; thus, recent escapements for both odd- and even-year runs of pink salmon were at record levels.

Run reconstructions using fishery data and aerial surveys for the composite stocks of chum salmon in the Nome subdistrict were used in 2000 to develop a biological escapement goal of 23,000 to 35,000 fish (Figure 215). This modeling effort provided a set of long-term data to evaluate overall stock status of chum

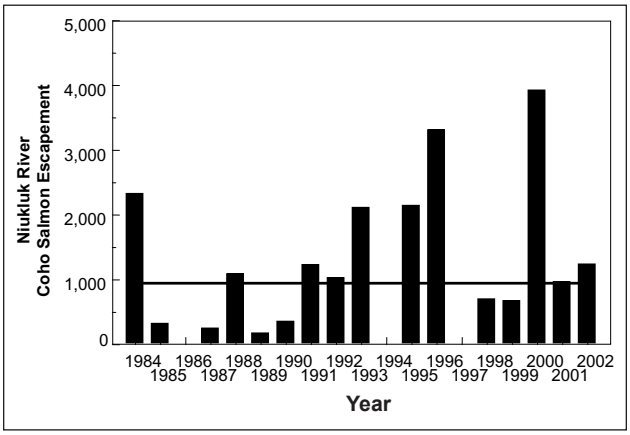

Figure 212. Annual peak survey counts of escapements of coho salmon in the Niukluk and Ophir Rivers from 1984–2002 (bars) and the lower end of the current ADF&G sustainable escapement goal range of 950–1,900 (line).

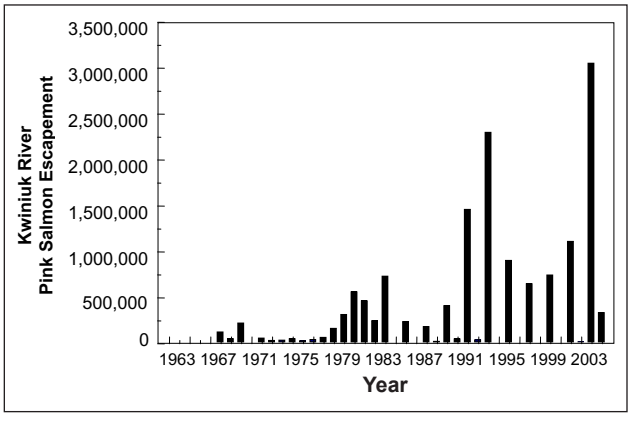

Figure 213. Annual tower counts of escapements of pink salmon in the Kwiniuk River from 1963–2005.

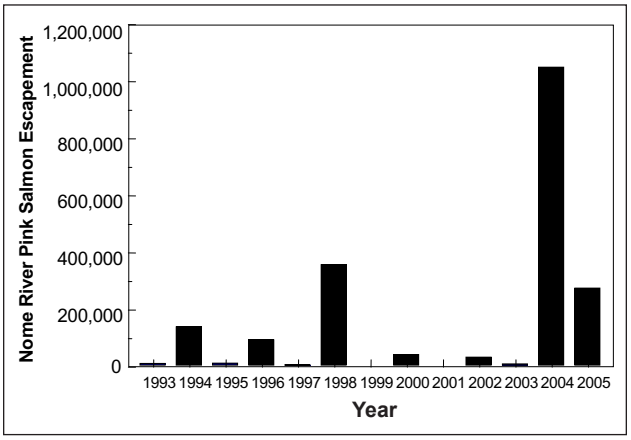

Figure 214. Annual weir counts of escapements of pink salmon in the Nome River from 1993–2005.

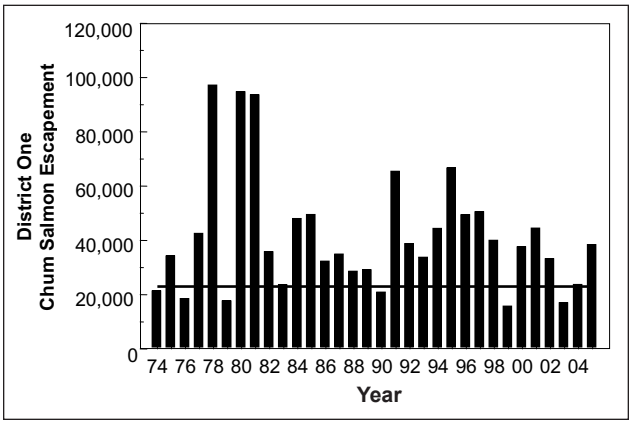

Figure 215. Estimated aggregate annual escapements of chum salmon in District One of Norton Sound from 1974–2005 (bars) and the lower end of the current ADF&G biological escapement goal range of 23,000–35,000 (line).

salmon in the Nome subdistrict of Norton Sound. While annual runs and escapements varied over the 30-year period, the level of variation was similar to what has been observed in other parts of Alaska. Since 1974, 26 of the 32 (82%) annual escapements have exceeded the lower escapement goal range. The time series of estimated escapements shows less variation through time, a result of management for escapement. However, early in the time series the Nome subdistrict supported a commercial chum salmon fishery, but commercial harvests in the subdistrict were absent during the latter part of the series.

Aerial surveys of chum salmon escapements in the Nome River represent a small component of Figure 215. Since 1993, a weir on the Nome River has provided more accurate information on escapement trends for these fish over the last 10 years (Figure 216). Escapements of chum salmon in the Nome River were low in 1998, 1999, 2002 and 2003. The current sustainable escapement goal for the Nome River is from 2,900 to 4,300 fish counted through the weir. Only in about half of the years that the weir has operated have Nome River chum salmon escapements been above the lower end of the escapement goal range.

Aerial surveys of chum salmon escapements in the Snake River represent another small component of Figure 215. Since 1995, a total escapement enumeration program using weirs or towers on the Snake River provided more accurate information on escapement trends for these fish (Figure 217). Chum salmon escapement in the Snake River was very low in 1999. The current sustainable escapement goal for the Snake River is 1,600 to 2,500 fish. Escapements from 1995 to 1998 were well above the lower end of the escapement goal range. Escapement in 1999 was substantially below the goal, and escapements from 2000 to 2005 were just barely above the lower end of the escapement goal range.

Since 1995, a tower has been used to count chum salmon escapements in the Niukluk River (Figure 218). The current escapement goal for this stock is a threshold value of 30,000 fish. Chum salmon escapements in the Niukluk River have decreased over the last 10 years, and from 2003 to 2005 were below the threshold.

Since 1963, the primary purpose of the Kwiniuk River tower project has been to count chum salmon escapements, resulting in a 40-year time series of information available (Figure 219). The data set shows years of relatively high escapement strength followed

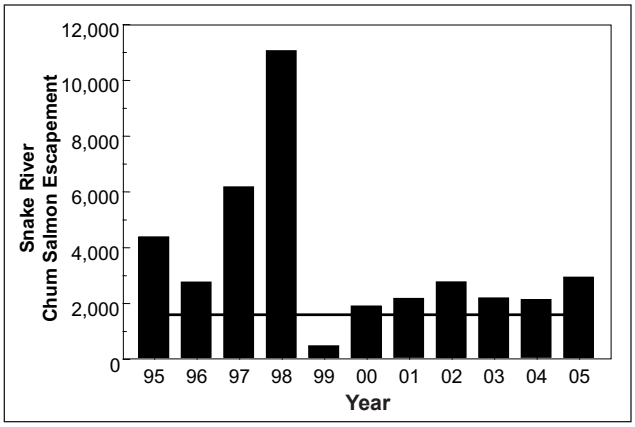

Figure 217. Annual weir counts of escapements of chum salmon in the Snake River from 1995–2005 (bars) and the lower end of the current ADF&G sustainable escapement goal range of 1,600–2,500 (line).

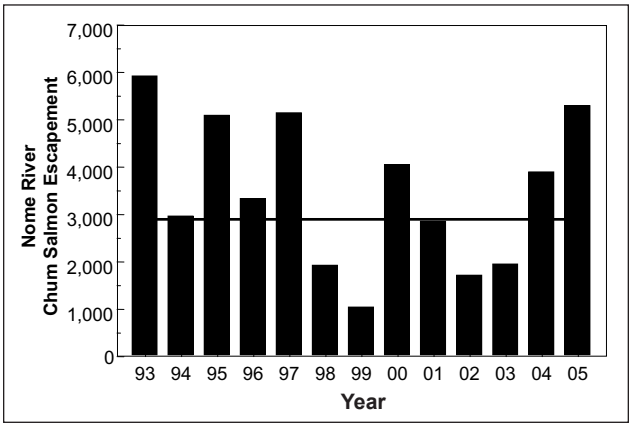

Figure 216. Annual weir counts of escapements of chum salmon in the Nome River from 1993–2005 (bars) and the lower end of the current ADF&G sustainable escapement goal range of 2,900–4,300 (line).

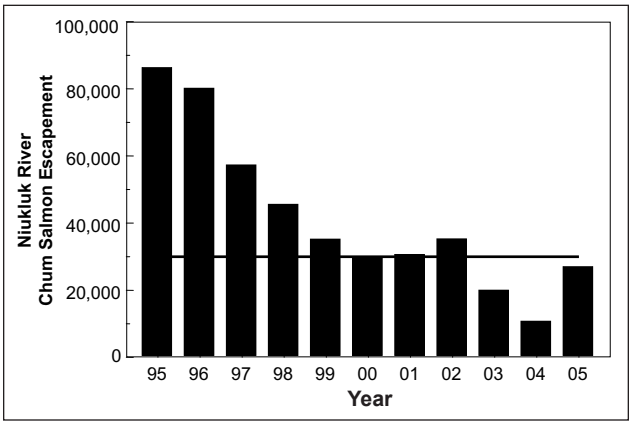

Figure 218. Annual tower counts of escapements of chum salmon in the Niukluk River from 1995–2005 (bars) and the current ADF&G sustainable threshold escapement goal range of 30,000 (line).

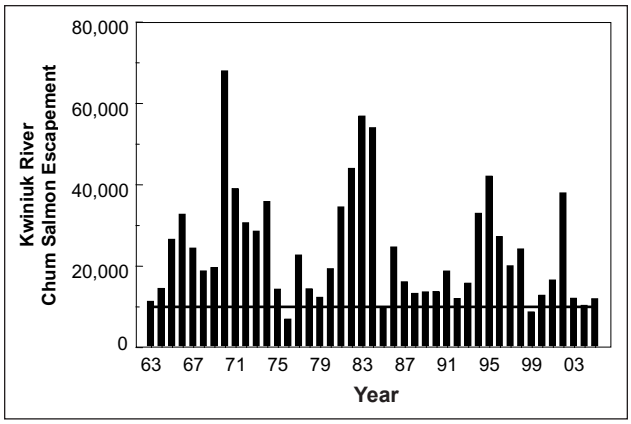

Figure 219. Annual tower counts of escapements of chum salmon in the Kwiniuk River from 1963–2005 (bars) and the lower end of the current ADF&G biological escapement goal range of 10,000–20,000 (line).

by years of relatively low escapement strength. Due to fishery management actions, through time the highs got lower and the lows got higher. The biological escapement goal for the Kwiniuk River chum salmon stock is 10,000 to 20,000 fish. Since 1963, only 3 of the annual escapements were less than the lower end of the current escapement goal range.

Trends in escapement for salmon stocks in Norton Sound are mixed. Escapements of sockeye salmon and pink salmon are substantially higher than the levels observed in the 1960s when the commercial fishery of Norton Sound was first developed. Pink salmon stocks have greatly increased in the last 20 years, with current escapements being several-fold higher than the levels observed in the 1960s and 1970s. Pink salmon are now commonly observed in abundance in streams where only few pink salmon were observed 40 years ago. While sockeye salmon are not widely distributed in Norton Sound, the stocks present increased substantially in the 1980s over levels observed in the 1960s and 1970s, and then greatly increased again several-fold since the 1980s. Long-term data is lacking for most Chinook and coho salmon stocks in Norton Sound; the available escapement data show variable escapement patterns but increasing or decreasing trends are not evident. Chum salmon escapement trends in Norton Sound demonstrate variable abundance over the last 40 years, with a level of variation not atypical of Alaska salmon stocks. Abundance of chum salmon in Norton Sound was noticeably lower in the 1990s than in the 1960s, 1970s and 1980s; the reason for lower productivity is unknown. However, the exploding abundance of pink salmon in these same streams leads to speculation concerning competition between the 2 species for spawning habitat and for early marine rearing. While abundance of chum salmon has decreased, escapements have been adequate to sustain the runs but often inadequate to provide enough surplus for continued commercial harvests.

Budget History and Fiscal Support

General funds allocated and used by the Division of Commercial Fisheries to manage salmon in Norton Sound totaled $800,800 in FY 03, $780,600 in FY 04, and $731,600 in FY 05. These levels of funding represent substantial increases over funding provided for management of these fisheries as they were being developed after statehood. Federal grants of $12,900 in FY 03, $19,100 in FY 04, and $6,600 in FY 05 were obtained and used for salmon stock assessment in Glacier and Salmon Lakes. The Division of Commercial Fisheries has worked with other resource agencies and with nongovernmental organizations with interests in Norton Sound to plan and implement a variety of salmon stock assessment activities that have been funded since 2000. The $5 million multiyear Norton Sound fishery disaster federal grant has helped improve understanding of salmon in the area. The Arctic–Yukon–Kuskokwim Sustainable Salmon Initiative federal grant program has also been used in the last 3 years to fund important stock assessment efforts in the Norton Sound area. Over the last decade ADF&G has worked with staff from federal agencies and nongovernmental organizations to implement an expanded monitoring program for salmon in Norton Sound. Often, specific salmon stock assessment activities are carried out by mixed crews from these agencies and organizations. A major challenge in the future will be funding these activities to continue the development of long-term data sets.

The Division of Commercial Fisheries and the salmon fishermen in Norton Sound face several challenges. The Division of Commercial Fisheries is committed to managing fisheries on a sustainable yield basis, but the subsistence fishery has priority over the commercial fishery. The salmon stocks of Norton Sound have been sustained, and the subsistence fishery has been sustained, although not without recent substantial inseason management. On the other hand, the commercial fishery of Norton Sound has been greatly reduced. The cost of the fishery management program in Norton Sound is high relative to exvessel value of the commercial fishery and the current stock assessment program could not be implemented without major federal funding. If productivity of chum salmon in Norton Sound improves or if significant market in-

terest in pink salmon develops, significant commercial fishing in Norton Sound could occur. But without the extensive stock assessment program now in place, management would be more conservative than it was 20 or 30 years ago. On the other hand, if commercial markets for Norton Sound salmon do not improve, even with improved productivity of chum salmon stocks, a revised commercial fishery would not generate much improvement in the local rural economy. The challenge to fishermen in Norton Sound is 2-fold: (1) developing niche markets to substantially increase the value of commercial salmon landings, allowing fishermen to increase earnings from commercial salmon fishing; and (2) supporting a comprehensive stock assessment program implemented by agencies and nongovernmental organizations to ensure opportunity for continued commercial fishing that will not negatively affect salmon stock status nor subsistence utilization of salmon stocks in Norton Sound.

KOTZEBUE COMMERCIAL SALMON FISHERY

Area Description and Gear Types

Kotzebue Sound supports the northernmost commercial salmon fishery in Alaska (Figure 220). Although a few Chinook, sockeye, and pink salmon have been caught in the fishery, over 99% of the salmon harvest has been comprised of chum salmon (Table 35). These harvests are believed to be supported almost entirely by runs of chum salmon that return each year to spawn in the Kobuk and Noatak Rivers.

Only set gillnet gear is used for commercial salmon fishing in the Kotzebue area; nets are limited to 150 fathoms.

History of the Commercial Salmon Fishery

The first commercial fishery in the Kotzebue area occurred in 1909 when native fishermen sold salmon to gold miners. A commercial fishery occurred from 1914 to 1918; salmon were canned and most of the product sold to miners working in the upper Kobuk drainage. Commercial salmon fishing did not occur during the next 40 years.

The inception of modern-day commercial fishery occurred in 1962. The commercial fishery became fully developed in the 1970s and the peak annual catch occurred in 1981 when about 680,000 chum salmon were commercially harvested. The fishery displayed a gradually declining pattern of overall run strength with multiyear cycles of stronger returns followed by weaker returns (Figure 221). Harvests were proportional to total runs prior to 1987. Management actions emphasized attaining escapement goals and harvests starting in 1987 and harvests thereafter are less indicative of run strength. Since 1995, poor market conditions caused harvests to fall far short of their potential. Harvest trends in the last 10 years or so have no relation to potential harvests but instead reflect processor interest and capacity. Annual management reports for the Kotzebue area, written by ADF&G staff since the 1960s provide detailed fishery data and insight into the management program and fishery. See Kohler et al. (2005).

Other Salmon Harvests

Subsistence use of salmon in the Kotzebue area centers on the harvest of chum salmon, which represent about 96% of the total salmon harvest (Table 36). Annual documented subsistence harvests in the area since 1962 have ranged from a high in excess of 600,000 fish in 1974 to low of about 17,000 fish in 2002. Subsistence harvests over the last decade averaged about 60,000 fish (Figure 222) or about 10% of the peak annual harvest in 1974, and show a continued trend of lesser use through time. Sport harvests of salmon in the Kotzebue area are minor, although increasing. The recent 5-year annual average was only about 700 chum salmon (Table 36).

In 1981, a chum salmon hatchery was built at Sikasuilaq Springs, a tributary of the Noatak River (Figure 2). The hatchery was closed in 1995. At peak production, the adult hatchery return was about 90,000 chum salmon and these fish contributed to commercial and subsistence fisheries in the Kotzebue area. Other than these hatchery produced chum salmon, the rest of the harvests are believed to be comprised of wild spawning fish that return to freshwaters in the Kotzebue area.

Commercial Salmon Fishery Users

Participation in the Kotzebue commercial salmon fishery has drastically declined over the past 30 years (Figure 223). Due to limited ability to sell salmon caught in the commercial fishery, very few of the 173 legal set gillnet permits in the Kotzebue commercial salmon fishery have been used in recent years. In 2002 only 3 permits were used, in 2003 only 4 permits were used, and 2004 only 43 fishermen participated in the fishery.

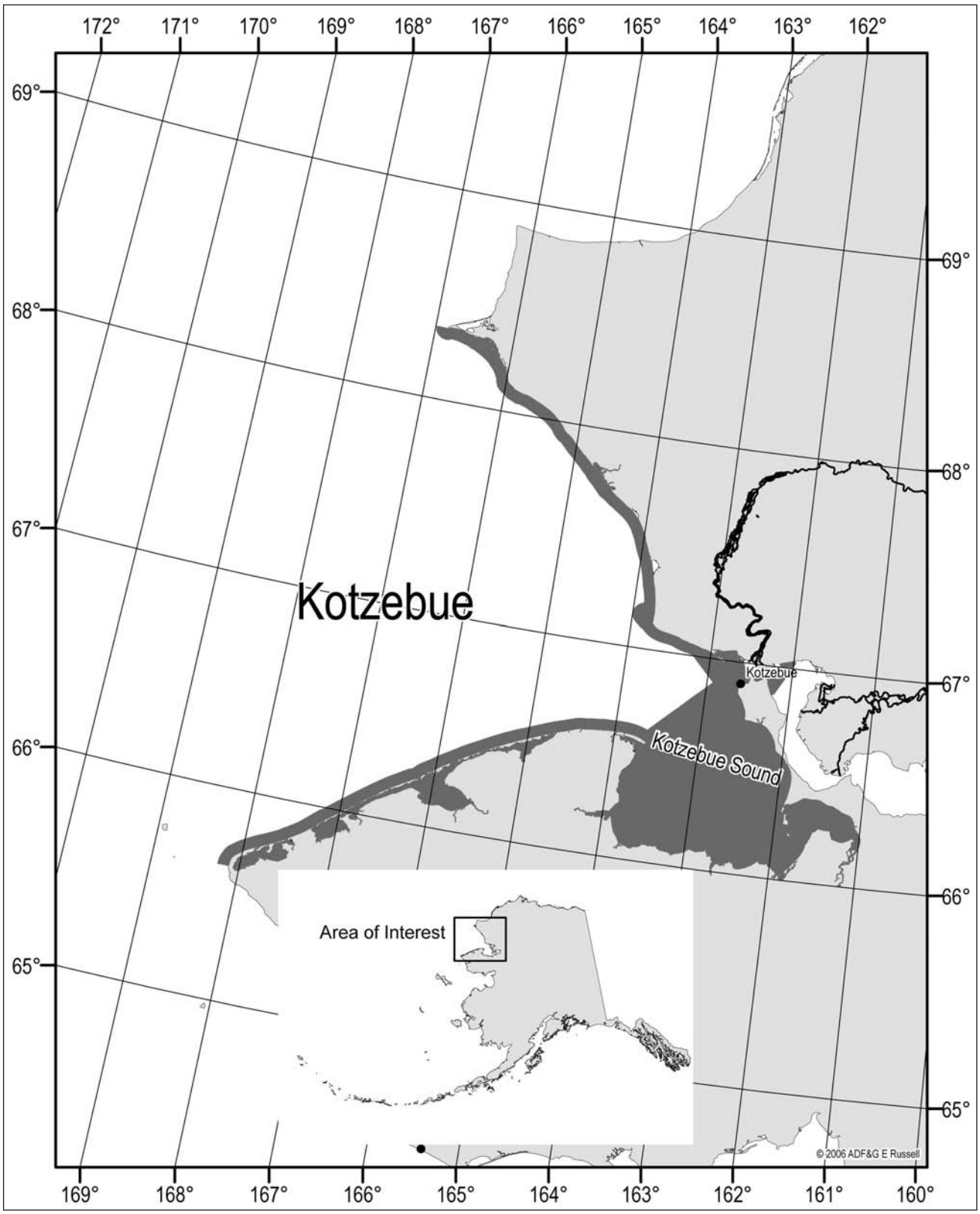

Figure 220. Kotzebue area commercial salmon fishery.

Exvessel Value

In the 1970s and 1980s the commercial salmon fishery in Kotzebue was important to the local economy and provided a valuable source of income in this rural part of Alaska. In 1985 for instance, the inflation-unadjusted exvessel value of the commercial salmon fishery was about $2.1 million. The loss of markets for chum salmon harvested in the Kotzebue area, coupled with low prices paid for those salmon harvested, have combined to result in a present day fishery that contributes little to the local economy (Figure 224).

Table 35. Species composition of the Kotzebue commercial and subsistence salmon harvests.

	Commercial Harvest (1900–2004)	Subsistence Harvest (1994–2003)
Chinook	0.017%	0.323%
Sockeye	0.001%	0.474%
Coho	0.000%	1.654%
Pink	0.115%	1.814%
Chum	99.867%	95.735%
Total	100.000%	100.000%

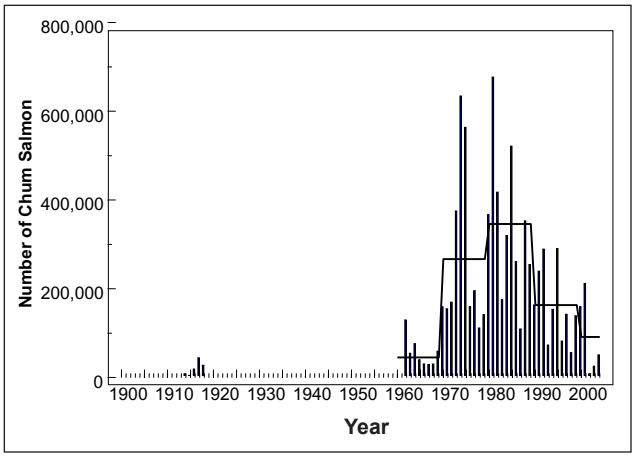

Figure 221. Commercial chum salmon harvests in the Kotzebue fishery from 1900–2004; bars provide annual catches and lines provide decade averages since the 1960s.

Table 36. Average annual harvest of salmon in the Kotzebue sport fishery.

Species	1980–1989	1990–1999	2000–2004
Chinook	14	3	9
Sockeye	2	0	0
Coho	6	5	37
Pink	18	51	13
Chum	298	271	739
Total	338	330	798

In 2004 for instance, the exvessel value of the fishery totaled only about $65,000 (less than 3% of the 1985 exvessel value). Fishermen in the Kotzebue area were paid $0.80 per pound for chum salmon in 1979, $0.10 per pound in 2002, $0.12 per pound in 2003, and $0.15 per pound in 2004 (Figure 225), only about 15% of the price per pound paid in 1979.

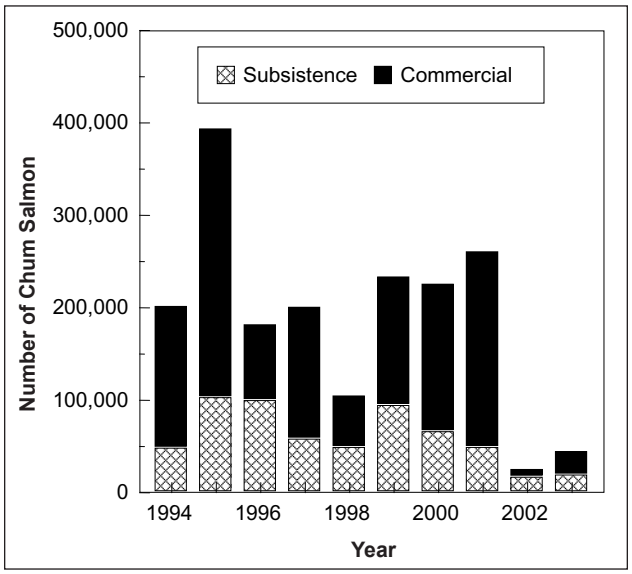

Figure 222. Subsistence and commercial harvests of chum salmon in the Kotzebue area from 1994–2003.

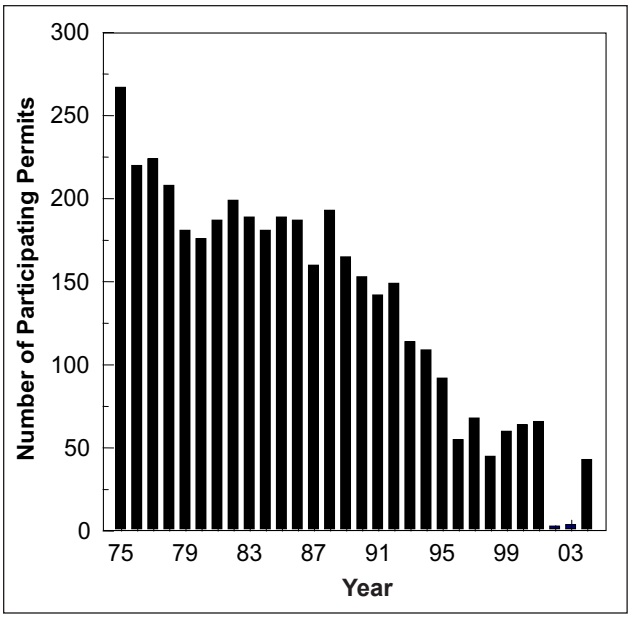

Figure 223. Participation in the Kotzebue commercial salmon fishery, 1975–2004.

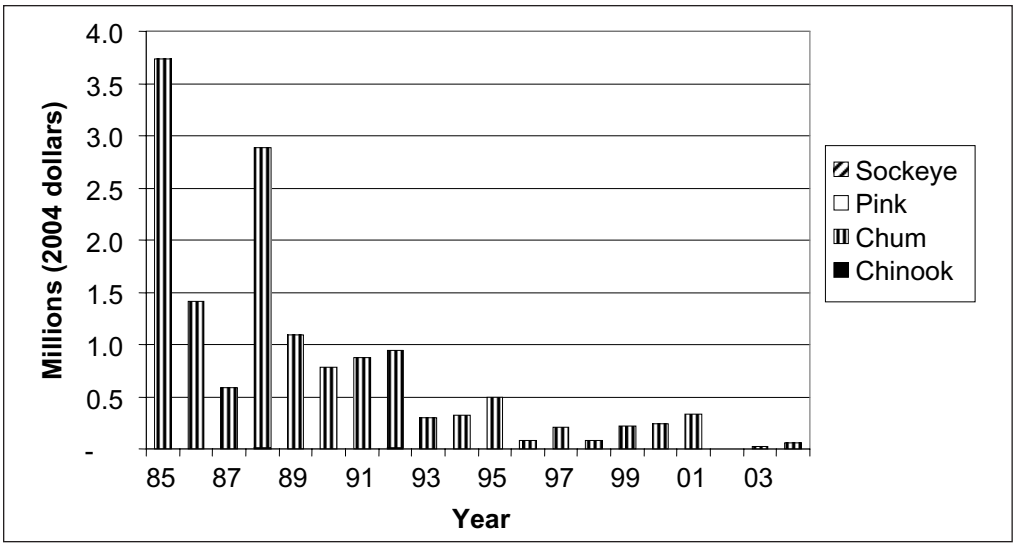

Figure 224. Exvessel value of the Kotzebue commercial salmon fishery, 1985–2004, adjusted for inflation into 2004 dollars.

Management

In recent years, very little inseason management of the Kotzebue commercial salmon fishery has been implemented by the Division of Commercial Fisheries due to the lack of processor interest in buying salmon. Since 2002, the Kotzebue area management biologist has issued one emergency order annually that has opened the commercial fishery on a continuous basis. The buyer has had limited capacity and has limited the harvest to low levels compatible with processor capacity. If and when the market for commercially harvested salmon in the Kotzebue area improves, the Division of Commercial Fisheries will need to implement an inseason management program aimed at ensuring spawning requirements are met, subsistence opportunity is provided, and that commercial fishing opportunity is provided to harvest surplus salmon in a sustainable manner.

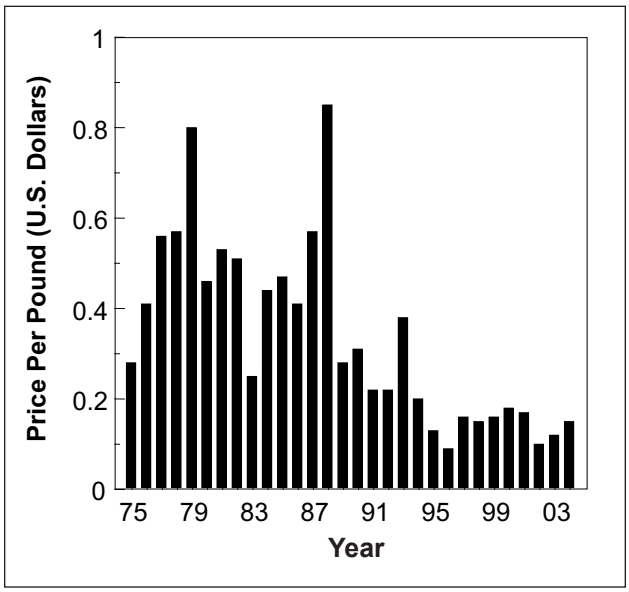

Figure 225. Average annual price paid per pound for chum salmon caught in the Kotzebue salmon fishery 1975–2004 (unadjusted for inflation).

Since 1963, the Division of Commercial Fisheries has attempted to document escapement strength and trends of chum salmon in the Kotzebue area with an aerial survey program. Three tributaries located in the lower portion of the Kobuk River drainage have been surveyed: (1) Salmon River, (2) Tutuksuk River, and (3) Squirrel River. Additionally a section of the upper Kobuk River has been surveyed (from Kobuk Village to Beaver Creek). A portion of the Noatak River has been surveyed to document escapement trends as well (Noatak River from mouth to Kelly Bar, including the Eli River). Sonar technology was used extensively to estimate chum salmon escapement in the Noatak River. However, various technical problems prevented successful implementation of an ongoing annual stock assessment program based on that technology. Although the Division of Commercial Fisheries has attempted to survey the Kobuk and Noatak spawning ground index areas several times each year since 1963, inclement weather and lack of aircraft have periodically prevented successful surveys, particularly in recent years. Successful surveys are those conducted from August 1 to August 31 for the lower Kobuk River tributaries, from August 20 to September 20 for the Upper Kobuk River, and from August 16 to September 16 for the

Noatak River. Further, successful or useable surveys are those that are not limited by poor weather or turbid water, both of which limit visibility. When multiple surveys of a given area during a given year have met those criteria, the peak or highest survey count has been used as the index value. Successful surveys as described have only been accomplished about 60% of the time in the Kotzebue area.

The Division of Commercial Fisheries has attempted to manage the salmon fisheries in the Kotzebue Area since 1987 with the dual goal of maintaining important fisheries and achieving desired escapement levels. Escapement objectives for the Kobuk and Noatak River chum salmon populations have been in effect over the past 20 years. However, the technical basis for these escapement goals has been simple escapement averaging methodology. For information concerning the 5 chum salmon sustainable escapement goals in use for management of the chum salmon fishery in Kotzebue, see ADF&G (2004). Escapement goals for chum salmon in the Kotzebue area will probably be revised by ADF&G before the 2007 salmon season (Eggers and Clark 2006).

The highest index escapement documented in the Noatak River was in 1996 when the index was about 5-fold the lower goal range (Figure 226). Escapement was not successfully indexed from 1997 to 2002; escapements were about 50% of the lower goal range in 2003 and 80% of the lower goal range in 2004. Escapement documentation since the mid-1980s has been sporadic, and as a result, trends in chum salmon escapement strength over the past 20 years are difficult to determine.

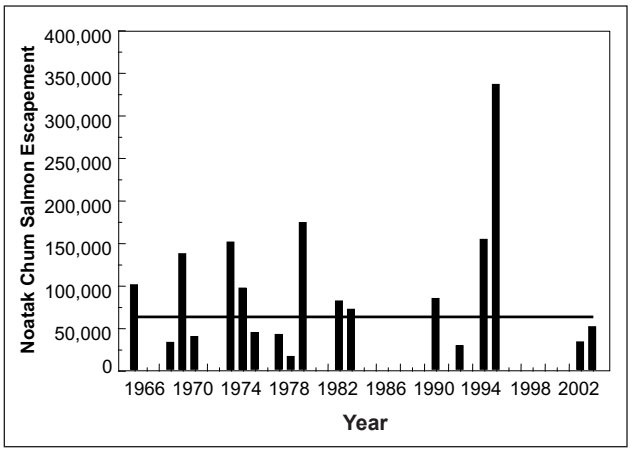

Figure 226. Annual aerial surveys of escapement of chum salmon in the Noatak and Eli Rivers from 1966–2004 (bars) and the lower end of the current ADF&G sustainable escapement goal range of 64,000–128,000 (line).

The highest index escapement documented in the Kobuk and Selby Rivers was in 1996 when the index was about 9-fold the lower goal range (Figure 227). The escapement index in 2003 was about 50% higher than the lower goal range. The escapement index in 2004 was about 3-fold the lower goal range. Recent stock strength of chum salmon escapements in this index area of the Kobuk River drainage appears somewhat higher than historic stock strength.

The Squirrel River is a tributary of the Kobuk River. The highest index escapements documented in the Squirrel River occurred in the early 1970s (Figure 228). The 3 most recent documented escapements all exceeded the lower goal range. Only sporadic success at indexing stock strength of the Squirrel River chum

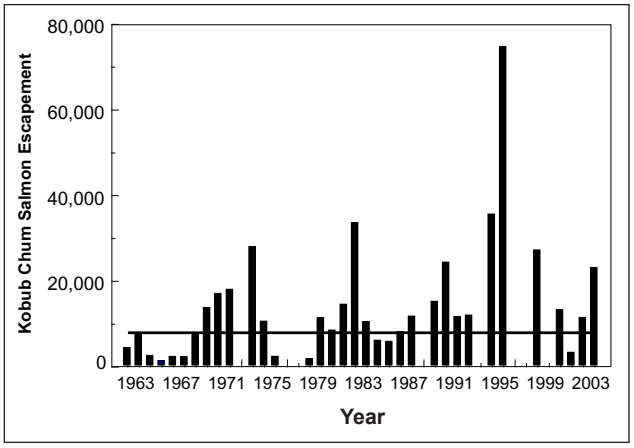

Figure 227. Annual aerial surveys of escapement of chum salmon in the Kobuk and Selby Rivers from 1963–2004 (bars) and the lower end of the current sustainable ADF&G escapement goal range of 8,000–16,000 (line).

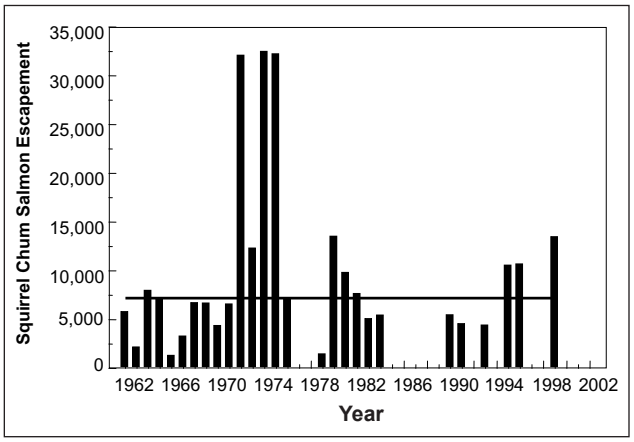

Figure 228. Annual aerial surveys of escapement of chum salmon in the Squirrel River from 1962–2004 (bars) and the lower end of the current ADF&G sustainable escapement goal range of 7,200–14,400 (line).

salmon escapement has occurred since the mid-1980s, and as a result, trends in chum salmon escapement strength over the past 20 years are not well documented.

The Salmon River is another tributary of the Kobuk River. The 2 highest index escapements documented in the Salmon River occurred in 1974 and 1996; the 1996 escapement was more than 7-fold the lower goal range (Figure 229). The 4 most recent documented escapements all exceeded the lower goal range. Only one successful survey of the Salmon River has occurred since 1996 and as a result recent trends in chum salmon escapement strength are not well documented.

The Tutuksuk River is a third tributary of the Kobuk River. The highest index escapement documented in the Tutuksuk River occurred in 1996 and exceeded the lower goal range by about 18-fold (Figure 230). The most recent documented escapement in 1999 exceeded the lower goal range by about 2.5-fold. Only one successful survey of the Tutuksuk River has occurred since 1996 and as a result recent trends in chum salmon escapement strength in this river are not well documented.

Budget History and Fiscal Support

The Division of Commercial Fisheries and the commercial fishermen in the Kotzebue area face several challenges with the Kotzebue commercial salmon fishery. While the Kotzebue fishery is the northernmost commercial salmon fishery in Alaska and the species is at the extremity of its range, the resource is relatively large and capable of supporting a substantial fishery that has the potential to add significantly to the local economy of the area. However, current world market conditions have resulted in low prices paid to fishermen; coupled with high operational costs for both the fishermen and the processors, the combination has resulted in a fishery that is legally opened by the ADF&G but has extremely low participation, minor harvests, and low exvessel value that adds little to the local economy. The challenge to fishermen and the commercial fishery industry is to identify marketing niches so that the fishery can rebound and the economy in the area can benefit. As this challenge is met, the challenge to the ADF&G will be: (1) to improve salmon stock assessments so that escapement documentation improves, (2) to improve the basis for escapement goals, and (3) to provide inseason stock assessments and fishery management to ensure sustainability of both the commercial and subsistence fisheries. On the part of the Division of Commercial Fisheries, these actions, if and when needed, will require a significant increase in the level of budget (Table 37) and program support for the Kotzebue area.

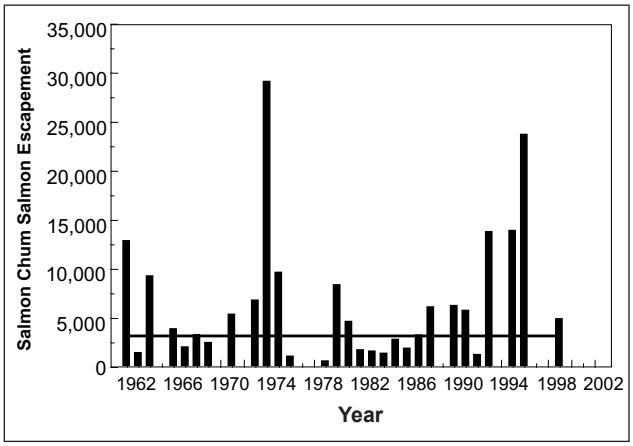

Figure 229. Annual aerial surveys of escapement of chum salmon in the Salmon River from 1962–2004 (bars) and the lower end of the current ADF&G sustainable escapement goal range of 3,200–6,400 (line).

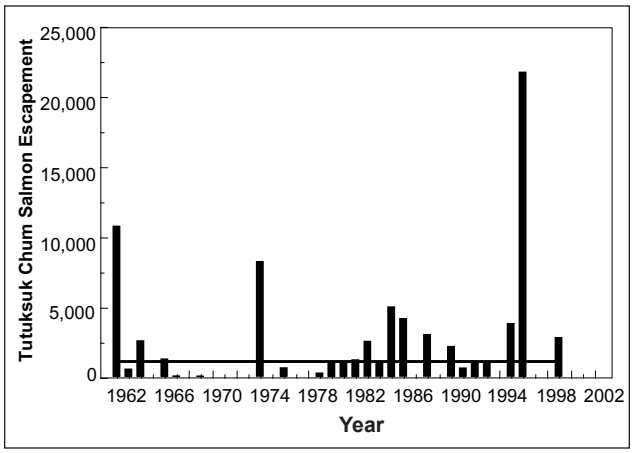

Figure 230. Annual aerial surveys of escapement of chum salmon in the Tutuksuk River from 1962–2004 (bars) and the lower end of the current ADF&G sustainable escapement goal range of 1,200–2,400 (line).

Table 37. Funding used by the Division of Commercial Fisheries for salmon in the Kotzebue area, FY 03–FY 05.

Funding Source	FY 03	FY 04	FY 05
State General Funds	$61,700	$62,600	$63,800
Other	none	none	none
Total	$61,700	$62,600	$63,800

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