Fishery Management Report No. 94-2

1993 Area Management Report for the Recreational Fisheries of the Upper Copper/Upper Susitna Rivers Management Area

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Nicole Szarzi
and
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Alaska Department of Fish and Game

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The Fishery Management Reports series was established in 1989 for the publication of an overview of Division of Sport Fish management activities or management goals in a specific geographic area. Fishery Management Reports are intended for fishery and other technical professionals, as well as lay persons. Distribution is to state and local publication distribution centers, libraries and individuals and, on request, to other libraries, agencies, and individuals. This publication has undergone editorial and peer review within Region II, Division of Sport Fish.

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SECTION I: MANAGEMENT AREA OVERVIEW

Management Area Description

The Upper Copper River-Upper Susitna River sport fish management area (UCUSMA) consists of all waters and drainages of the Copper River upstream from a line crossing the Copper River between the south bank of the mouth of Haley Creek and the south bank of the mouth of Canyon Creek in Wood's Canyon, and all waters and drainages of the Upper Susitna River upstream from the confluence of the Oshetna River (Map 1). Located within the UCUSMA are the communities of Glennallen, Gulkana, Gakona, Chitina, McCarthy, Kenny Lake, Copper Center, Paxson, Mentasta, and Slana/Nabesna. The state's major highways, together with numerous secondary roads and trails, provide relatively good access to most of the area's sport fisheries. Float equipped aircraft are commonly used to access the area's many remote lake and stream fisheries not accessible by road. Principal land managers in the UCUSMA are the National Park Service, Bureau of Land Management, Ahtna Native Corporation, and the Alaska Department of Natural Resources.

Regulations governing the sport fisheries in the UCUSMA are found in Chapter 52 of Title 5 of the Alaska Administrative Code. For the purposes of effort and harvest reporting in the statewide harvest survey (SWHS) by Mills (1992), UCUSMA fisheries are reported in the Glennallen Area (Area I).

Management and research functions for UCUSMA recreational and personal use fisheries are the responsibility of the Anchorage and Glennallen area offices. The Area Management Biologist (Kelly Hepler) is stationed in Anchorage. An assistant area management biologist (Nicole Szarzi) is stationed in Glennallen. A permanent full-time field office assistant is also stationed in Glennallen. This assistant is shared with the Division of Wildlife Conservation. The professional staff is assisted by numerous seasonal technicians and biologists whose employment ranges from 2 to 11 months. Significant support is also provided to the area staff by the Division of Sport Fish's Research and Technical Services section stationed in Anchorage.

Fisheries Resources

The UCUSMA offers a unique blend of freshwater fishing opportunities to recreational and personal use anglers. Three species of North Pacific salmon (chinook *Oncorhynchus tshawytscha*, coho *O. kisutch*, and sockeye *O. nerka*) are available to anglers fishing upper Copper River drainage waters. The upper Susitna River drainage has no anadromous salmon. A velocity barrier in Devil's Canyon prevents upstream migration in the Susitna River. Anglers can also target salmon stocked into various landlocked lakes of the UCUSMA.

Popular fisheries also occur on the area's resident stocks of Arctic grayling (*Thymallus arcticus*), burbot (*Lota lota*), Dolly Varden (*Salvelinus malma*), rainbow and steelhead trout (*O. mykiss*), and lake trout (*Salvelinus namaycush*). Smaller fisheries occur on the area's resident stocks of whitefish (*Coregonus* and *Prosopium*).

Regulatory Process

The process of developing fishing regulations appropriate for fisheries in the UCUSMA occurs within the established Alaska Board of Fisheries (BOF) process. Public input concerning regulation changes and allocation issues is provided for in this process through various means including direct testimony to the BOF and through participation in local fish and game advisory committees. Advisory committees have been established throughout Alaska to assist the BOF in assessing fisheries issues and proposed regulation changes in areas that might be affected. Most active committees meet at least once each year, usually in the fall prior to scheduled BOF meetings. Staff from the Division of Sport Fish and other divisions are often invited to attend the committee meetings. In this way, advisory committee meetings allow for direct public interaction with staff involved with resource issues of local concern. Within the UCUSMA there are three advisory committees that serve resource users of the area: the Tok Cutoff/Nabesna Road, Copper Basin, and Paxson advisory committees.

Under the current operating schedule, the BOF meets on a 3-year cycle. Proposals regarding UCUSMA fisheries were last heard during the February 1990 BOF meeting. The next BOF meeting to address proposals regarding UCUSMA sport and personal use fisheries is scheduled for February 1994.

To address conservation concerns and to implement BOF adopted management plans, the department has emergency order authority (5 AAC 75.003) to modify time, area, and bag/possession limits regulations. Emergency orders issued under this authority during 1987 through 1993 are summarized in Table 1.

Established Management Plans and Policies

Some UCUSMA fisheries have been the focus of allocative conflicts. These conflicts have lead the BOF to establish several management plans and policies to guide the area's fisheries. These plans attempt to assure the sustained yield of the area's fish stocks as well as establish allocation and management actions/guidelines for department fisheries managers. Specific to the UCUSMA, the BOF has adopted the following management plans and policies:

Copper River Personal Use Salmon Management Plan (5 AAC 77.590). This management plan establishes seasons, open areas, legal gears, permit requirements, and bag limits for a personal use salmon fishery in the Copper River. The plan also stipulates a harvest quota for this fishery.

Copper River Subsistence Salmon Management Plan (5 AAC 01.647). This management plan establishes seasons, open areas, legal gears, permit requirements, and bag limits for a subsistence salmon fishery in the Copper River.

Lake Burbot Management Plan (5 AAC 52.045). This management plan stipulates that the lake burbot fisheries of the UCUSMA be managed to ensure maximum sustainable harvests and provides the department the authority, through emergency order, to establish periods to reduce time/area and/or prohibit set lines to accomplish this management objective.

Cook Inlet & Copper River Basin Rainbow/Steelhead Trout Management Policy. This management policy was adopted by the BOF to provide future Boards, fisheries managers, and the sport fishing public with: (1) management policies and implementation directives for area rainbow and steelhead trout fisheries, (2) a systematic approach to developing sport fishing regulations that includes a process for rational selection of waters for special management, and (3) recommended research objectives. This management policy was never adopted as regulation.

Copper River District Salmon Management Plan (5 AAC 24.360). This management plan stipulates that during years when Copper River District sockeye salmon returns are forecasted to be weak or are demonstrated to be weak by inseason stock assessment monitoring tools and a *strong* harvestable surplus of chinook salmon can be demonstrated, the department may, by emergency order, authorize the use of large mesh gear in the Copper River District.

Recreational Angler Effort

Recreational angler effort in the UCUSMA has been estimated since 1977 using a mail survey (Mills 1979-1993). This survey estimates the number of angler-days of sport fishing effort expended by recreational anglers fishing Alaskan waters as well as the harvest of important sport species. The survey is designed to provide estimates of effort and harvest on a site-by-site basis and, unfortunately, is not designed to provide estimates of effort directed towards a single species. Beginning in 1990, the survey was modified to include estimation of catch (release plus harvest) on a site-by-site basis. Additionally, creel surveys have been selectively used to ground truth the mail survey for choice fisheries of interest or for fisheries that require more detailed information or inseason management. The following summary of recreational angler effort in the UCUSMA is based on mail survey data.

From 1977 through 1992, recreational anglers have expended 853,537 angler-days fishing UCUSMA waters, accounting for an average of 2.9% of the annual statewide recreational angling effort and about 3.3% of the annual southcentral recreational angling effort over this period (Table 2). Recreational angler effort has remained relatively stable over the past 16 years (Figure 1).

The upper Copper River drainage has supported over 75% of the recreational effort expended from 1977 through 1992 (Table 3). In this drainage, the Gulkana River drainage has supported a vast majority of the recreational angling effort (Table 3). Other upper Copper River drainage systems supporting popular recreational fisheries include the Klutina and Tazlina River drainages and the mainstem Copper River (Table 4). Popular sport fisheries in the upper Susitna River drainage include the Tyone River drainage (including Lake Louise and Susitna and Tyone lakes) and tributaries to the Susitna River.

During 1992, just over 72,000 angler-days were expended by recreational anglers fishing UCUSMA waters (Table 2). This was 35% above the historic average effort for this management area and was the highest on record for the

second year in a row. The 1992 effort represented 2.8% of the total statewide angling effort (Table 2).

Other User Groups

Returns of salmon to the Copper River support commercial fisheries in the Copper River District. From 1977 through 1993, mean harvests have been 768,222 sockeye salmon and 32,084 chinook salmon (Donaldson et al. 1993, Table 5).

A personal use and a subsistence salmon fishery have been established by the BOF in the upper Copper River. The Division of Commercial Fisheries has lead management authority for the subsistence fishery while the Division of Sport Fish has the lead management responsibility for the personal use fishery.

From 1977 through 1993, over 1 million salmon have been harvested in these fisheries (Table 6). Sockeye salmon have comprised the largest portion of this catch, accounting for about 95% of the total catch. These fisheries are described in detail in a separate chapter of Section II of this report, and thus will not be described in further detail here.

Economic Value of Recreational Fisheries

The Jones and Stokes (1987) survey of southcentral Alaska sport fisheries only estimated the value of the Gulkana River fisheries and the winter fisheries of the Lake Louise complex (Lake Louise and Susitna and Tyone lakes). Based on this survey, anglers expended $450,000 to fish for grayling in the Gulkana River during 1986 and expressed a net willingness to pay (net WTP) an additional $350,000 to assure for the continuation of this fishery (Table 7). Most of the expenditures in this fishery were by resident anglers. Anglers participating in the winter fisheries of the Lake Louise complex for lake trout and burbot expended $66,000 and expressed a net WTP of an additional $186,000 to assure for the continuation of these fisheries (Table 7). The Jones and Stokes survey did not provide an estimate of the overall economic value of UCUSMA sport fisheries.

A rough approximation of the total economic value of the recreational fisheries of the UCUSMA can be made by applying the direct expenditures per angler-day values estimated for southcentral Alaska resident and nonresident sport anglers through the Jones and Stokes survey to the estimated sport effort expended in the UCUSMA (Table 8). Based on this approach, the economic value of all UCUSMA sport fisheries during 1986 was approximately $5 million. This compares to an estimated value of $127 million for all southcentral Alaska sport fisheries during 1986 (Jones and Stokes 1987).

Major Issues

The major issues associated with UCUSMA recreational and personal use fisheries are summarized below:

Burbot: The lakes of the UCUSMA have historically supported some of the largest sport fisheries for burbot in Alaska. Stock assessment work indicated that many of the larger lake burbot stocks were overfished in the early 1980s and as a result became depressed. Based on these

findings, the BOF adopted a management plan for burbot stocks in UCUSMA lakes. Under this management plan, the Board has adopted a more conservative management regime for UCUSMA burbot fisheries that allows previously overfished stocks to recover, and permits sustainable fisheries for healthy stocks. Part of the current regulatory regime is the elimination of unattended set lines from the fishery. Many local anglers are not supportive of this action and wish to have unattended set lines reintroduced to the fishery and have submitted proposals to the Board to accomplish this. Staff do not currently support reintroduction of unattended setlines at this time. This gear issue will likely continue to remain an issue into the future. Lake Louise remains closed to burbot fishing due to depressed burbot stocks. Lake Louise will be reopened to burbot fishing when stock assessment work shows that the burbot stocks have recovered enough to permit a sustainable fishery. Local advisory committees are supportive of this closure.

Lake Trout: Lakes in the UCUSMA have historically supported some of the largest recreational fisheries for lake trout in Alaska, with lakes of the Tyone River drainage (Lake Louise and Susitna and Tyone lakes) and Gulkana River drainage (Summit and Paxson lakes) having supported the largest fisheries. Concern was raised in the late 1980s that sport harvests in some of these lakes may have been exceeding sustainable levels. As a result, an 18 inch minimum size limit was enacted for the above stated lakes to assure that fish could spawn at least once prior to being subject to harvest. Subsequent stock assessment work suggests that an 18 inch size limit does not protect first-time spawners from harvest in these lakes. Staff have therefore proposed a 24 inch minimum size limit for these lakes in the form of a BOF proposal to be considered at the February 1994 BOF meeting. This action is supported by the local advisory committees.

Copper River Chinook Salmon: Under the *Copper River Personal Use Salmon Fishery Management Plan* (5 AAC 77.590), the department is directed to manage the Copper River District commercial salmon fishery to attain a spawning escapement of 15,000 chinook salmon, 60,000 salmon (species not defined) for the personal use fishery, and 35,000 salmon (species not defined) for the subsistence fishery. Unfortunately, there is a lack of spawner-recruit data to assess the long-term productivity of the Copper River chinook salmon return or the validity of the established 15,000 fish spawning escapement goal. Most managers agree that current harvest levels are sustainable; however, concern has been raised that the Copper River chinook salmon return is nearing full utilization and recommend that total harvests on this stock not be expanded in the future. Commercial harvests, the largest component of the annual harvest, are projected to remain relatively stable into the future. However, increased participation in the area's subsistence, personal use, and sport fisheries is likely to result in increased harvests by these users. To assure that harvest of Copper River chinook salmon does not exceed sustainable levels, it may be necessary for the department to seek BOF direction in the allocation of this return. The BOF will consider several proposals that address this issue during the February 1994 meeting.

Copper River Personal Use & Subsistence Salmon Fisheries: Since 1985, harvests in the Copper River subsistence and personal use salmon fisheries have increased, with most of the growth having occurred in the personal use fishery. Both fisheries are managed under BOF adopted management plans. Under these management plans, the subsistence fishery is not managed under a harvest cap while the personal use fishery is managed under a harvest cap which varies depending upon inriver run strength. In recent years, harvest in the personal use fishery has exceeded the harvest cap mandated by run strength. Unless Board action is taken to raise the harvest cap, the department will need to reduce the harvest potential of the current fishery to assure that the harvest cap is not exceeded. The department will seek the Board's guidance in this matter during the Board's next scheduled meeting on this area in February of 1994.

SECTION II: FISHERIES

The following text discusses, by species, the major sport fisheries in the UCUSMA. For each major fishery, a discussion is presented with respect to: (1) a historical perspective of the fishery, (2) fishery objectives, (3) inseason management approaches, (4) actions taken by the BOF during their last meeting dealing with the fishery, (5) the recent performance and status of the fishery, (6) any current biological and social issues related to the management of the fishery, and (7) recommended research and management activities. Discussion of recent performance of the fishery will center around the 1992 season, as the major source of data for most sport fisheries in the area is the Statewide Harvest Survey (SWHS) (Mills 1993). However, observations or data regarding the 1993 fishery will also be presented when available. A summary of the historical harvest of fish in the UCUSMA by species is presented in Figure 2 and Table 9.

ARCTIC GRAYLING FISHERIES

More grayling have been harvested by recreational anglers fishing UCUSMA waters since 1977 than any other fish (Figure 2). From 1977 through 1992, about 43% of the fish harvested by anglers from these waters was grayling. Harvests remained relatively stable from 1977 through 1987 (Figure 3), averaging about 28,982 grayling. Since 1987, however, harvests have declined annually (Figure 3), with the 1992 harvest of 11,125 grayling being the lowest on record (Table 10). This has been primarily the result of more restrictive regulations adopted to assure for the sustained yield of the area's grayling stocks. The 1992 harvest accounted for about 43% and 25% of the Southcentral and statewide harvest of grayling, respectively.

The largest grayling fishery in the UCUSMA has historically occurred in the Gulkana River drainage (Table 10). From 1987 through 1992, this drainage has accounted for about 45% of the grayling harvest from UCUSMA waters. A discussion of the Arctic grayling fishery in the Gulkana River drainage follows this areawide assessment. Other UCUSMA drainages that have supported significant grayling fisheries include the Klutina and Tazlina drainages and various upper Susitna River drainage lakes and streams. Various lakes stocked with grayling fry also provide fishing opportunity for this species.

To assure the sustained yield of UCUSMA grayling, daily bag and possession limits for grayling in all flowing waters in the UCUSMA were reduced from 10 to 5 fish in 1988. For the Gulkana River, the fishery was further restricted in that anglers were permitted only 1 grayling per day over 14 inches. This action was taken to maintain historic size compositions in this drainage. The bag and possession limits in stocked lakes and those lakes without management concern remained at 10 per day and in possession. Under these regulations, most grayling stocks in the UCUSMA are currently considered healthy.

Gulkana River Arctic Grayling Fishery

Background and Historical Perspective

The Gulkana River drainage (Map 2) supports the largest grayling population in the UCUSMA. This clearwater drainage originates in the Alaska Range and flows south to join the Copper River near the community of Glennallen. Access to the river is available from various secondary roads and trails off the Richardson Highway which parallels much of the river. Anglers utilize rafts and power boats to gain access to the more remote sections of the river. Raft anglers frequent the various sections of the river from Paxson Lake downstream to the Richardson Highway bridge. Power boat operators generally launch at Sourdough and utilize that section of the river from approximately 2 miles below Sourdough upstream to the confluence of the West Fork. The section of the Gulkana River upstream from Sourdough has been designated by Congress as a Wild and Scenic River. The Gulkana River from the Richardson Highway bridge downstream to a department marker 500 yards downstream of its confluence with the Copper River is an area in which only single hook, artificial flies may be used. This area has low use and is utilized primarily by walk-in anglers across Ahtna Native Corporation lands; however, power boat operators occasionally access the confluence of the Gulkana River with the Copper River using power boats launched from Copper Center or from the Richardson Highway Bridge.

The Gulkana River drainage has historically supported the largest sport fishery for grayling in the UCUSMA (Table 10). From 1977 through 1985, harvests of grayling from the Gulkana River drainage generally increased (Table 11, Figure 4). A peak harvest of 19,888 fish occurred in 1985 and accounted for 60% and 35% of the total harvest in the UCUSMA management area and Southcentral region, respectively (Mills 1986).

The peak harvest experienced in 1985 raised concern that the grayling stocks in the drainage were in danger of overharvest, given that grayling stocks in several interior Alaska streams near Fairbanks became severely depressed when subjected to similar harvest rates. Regulations were therefore adopted in 1988 that reduced the bag and possession limit to five fish per day. Also, past research data indicated that the maximum size of grayling observed in the Gulkana River drainage was decreasing as the result of anglers targeting larger fish. In an attempt to maintain historic size compositions, regulations were also adopted in 1988 that restricted anglers to only one grayling over 14 inches.

A research program was initiated in 1986 to assess the status of grayling stocks of the Gulkana River drainage. Beginning in 1988, the study has been conducted in conjunction with the University of Alaska and is forming the basis of a M.S. thesis for a graduate student (Dan Bosch). Objectives of the research program are to determine stock structure; growth; annual abundance, survival, and recruitment; sustainable yields under a variety of management scenarios; and future monitoring strategies. This project is scheduled to be completed in June 1993, with the final report/thesis completed in January of 1994.

Fishery Objectives

Grayling fisheries in the Gulkana River drainage are managed to assure maintenance of historic age and size compositions and stock abundances.

Recent Board of Fisheries Actions

The BOF took no action regarding this fishery at its 1990 meeting. Issues regarding this fishery could be heard at the February 1994 meeting although no specific proposals for regulation changes have been turned in to date.

Recent Fishery Performance

The restrictions placed on the fishery during 1988 have significantly reduced the total harvest of grayling in the Gulkana River drainage (Figure 4). Preliminary estimates of abundance indicate that current exploitation rates on the major stock units of grayling in the Gulkana River drainage appear sustainable given current harvest levels. Preliminary data from the research program also indicate that the restriction limiting anglers to only one grayling over 14 inches is allowing the population to reach and maintain historic levels.

Current Issues

Overall, Gulkana River drainage grayling stocks appear healthy. With the completion of the research project, a management plan for grayling in the Gulkana River drainage will be developed. The plan will strive to provide a diversity of fishing opportunities for grayling in the Gulkana River drainage under sustained yield management. This plan will be distributed for public comment and after completion will be forwarded to the BOF at the next scheduled meeting dealing with UCUSMA issues, likely winter of 1997. Until completion of this management plan, staff will maintain the current management strategy and regulatory regime.

Data, collected through the statewide mail survey, suggest that many anglers fishing grayling in the Gulkana River drainage are practicing catch and release. Anglers released an estimated 88% in 1990, 80% in 1991 and 87% in 1992 of the grayling they caught (Table 11). Assuming a 5% release mortality rate, this appears acceptable given current harvest and abundance levels.

The upper reaches of the Gulkana River drainage above Paxson Lake, notably the Gunn and Fish Creek drainages, contain small populations of large-sized grayling. Currently, these populations are not targeted by a large number of anglers and current exploitation rates appear sustainable given current harvest and abundance levels. However, if exploitation rates increase it may be necessary to reduce harvest to assure for sustained yield and maintenance of historic size compositions.

Recommended Research and Management

An objective of the current research program is to develop a monitoring program for assessing the status of grayling stocks in the Gulkana River drainage. We urge that the recommended monitoring program be conducted to assure for the sustained yield of this fishery.

LAKE TROUT FISHERIES

Background and Historical Perspective

Lake trout stocks of the UCUSMA provide significant fishing opportunities and economic benefit to the people of Alaska. Nowhere else in Alaska can lake trout be taken in such quantities and range of sizes along the road system. From 1977 through 1991, about 105,000 lake trout have been harvested from UCUSMA lakes and streams (Map 3, Table 9), accounting for about 12% of the total fish harvest from UCUSMA waters over this period (Figure 2). Since 1977, lakes and streams of the UCUSMA have accounted for over 40% of the annual statewide harvest of lake trout.

Most of the lake trout harvest in the UCUSMA has come from lakes of the Tyone River (Lake Louise and Susitna and Tyone lakes) and Gulkana River (Paxson, Susitna, and Crosswind lakes) drainages (Table 12). Since 1977, these two drainages have accounted for just over 80% of the UCUSMA lake trout harvest and an average of 33% of the statewide lake trout harvest. Paxson Lake and Lake Louise have supported the largest fisheries for lake trout in the UCUSMA and Alaska. Together, these two lakes have accounted for about half of the UCUSMA lake trout harvest and an average of 20% of the annual statewide harvest of lake trout since 1984. Other major sport fisheries for lake trout in the UCUSMA occur in Summit and Crosswind lakes (in the Gulkana River drainage) and in Susitna Lake (in the Tyone River drainage). These lakes contribute between 3% and 5% of the statewide harvest of lake trout.

Prior to 1987, anglers fishing UCUSMA waters were allowed a daily take of 2 lake trout over 20 inches and 10 lake trout under 20 inches. Under these regulations, lake trout harvests from UCUSMA waters were relatively stable, averaging about 7,500 trout (Table 12, Figure 5). A study conducted in 1986, however, suggested that eight of nine study lakes in the upper Copper and Delta drainages were being harvested as much as seven times the level estimated to be sustainable, based on lake trout populations in Canada and the Great Lakes. As a result of these research findings, the daily bag limit for UCUSMA waters was reduced to 2 fish and a minimum size limit of 18 inches was adopted for Summit and Paxson lakes, Lake Louise, and the remainder of the Tyone River drainage in 1987. The minimum size limit was imposed to allow female lake trout to spawn once before reaching harvestable size.

A research program was initiated in 1990 to evaluate the status of lake trout fisheries in the UCUSMA. The goal of the research program has been to determine appropriate management strategies that assure sustained yield of lake trout in UCUSMA lakes. The study is currently conducted in Paxson and Susitna lakes and Lake Louise. The objective of the current program in Paxson Lake is to determine stock status of lake trout through annual assessment of abundance, survival, and recruitment. Work in Lake Louise and Susitna Lake is currently limited to determination of spawning areas and age/size compositions of spawning population and sport harvest. It is hoped to eventually determine stock status of lake trout in Lake Louise and Susitna Lake through annual assessment of abundance, survival, and recruitment and the estimation of the sustainable yield of this resource as more is learned about this resource. It is also hoped that information gained from the study of these lakes can be applied to better manage other lake trout fisheries in the UCUSMA.

Fishery Objectives

Fishery objectives have yet to be defined for specific UCUSMA lake trout fisheries. To date, regulations have been written to assure that maximum sustained yield of the UCUSMA lake trout resource is not exceeded. It is likely that as fishery objectives are defined for specific lake trout fisheries, they will center around assuring for optimal, rather than maximal, sustained yield. For some lakes, optimal sustained yield will equal maximum sustained yield; for other lakes, however, optimal sustained yield will be lower than maximum sustained yield to accommodate angler's wishes for trophy or other type of special fisheries.

Recent Board of Fisheries Action

The Board of Fisheries has not made any changes to UCUSMA lake trout regulations since 1987.

Recent Fishery Performance

Since adoption of the new regulations in 1987, lake trout harvests from UCUSMA lakes and streams have fallen (Figure 5). The 1992 harvest of 4,251 lake trout was the lowest on record since 1977 (Table 12). In general, harvests from the Tyone River drainage have fallen while harvests in the Gulkana River drainage have remained relatively stable (Figure 6). Declining harvests from the Tyone River drainage are at least partially due to reduced effort linked to restrictions and closures placed on the burbot fishery in this drainage since 1987.

Two methods are currently used to estimate sustained yield for lake trout stocks in the UCUSMA. The first method involves estimating the level of sustainable harvests for lakes based on an observed lake trout production-lake surface area relationship for northern latitude lakes (Healy 1978). Healy found that northern latitude lakes could sustain harvests at a rate of approximately 0.5 kg ha^{-1} y^{-1}. Because estimates of the average weight of lake trout from most lakes in the UCUSMA are unavailable, the sustainable harvest of lake trout has been estimated based on the probable range of lake trout weights: 1.0 and 3.5 kg. Based on Healy's approach and these weights, lakes in the UCUSMA which are less than 500 ha appear capable of sustaining harvests of 70 to 250 lake trout annually, depending in part upon their elevation, depth, acreage, and available spawning habitat. Based on these estimates, the harvest of lake trout from lakes smaller than 500 ha appears to be slightly below estimates of sustainable yield. For lakes larger than 500 ha which are not road accessible (e.g., Crosswind, Tanada, and Copper lakes), harvests also appear below estimates of sustainable yield. These larger lakes appear capable of sustaining annual harvests from about 250 to 700 lake trout.

For lakes larger than 500 ha which are road accessible (e.g., Paxson, Summit, Susitna lakes and Lake Louise), Healy's methods plus an alternate approach based on the volume of water in the preferred temperature range for lake trout (8° to 12° C), termed the thermal habitat volume (THV), are used to estimate the current status of lake trout stocks in these lakes. Based on the THV approach, the sustainable yield for Paxson Lake is 1.01 kg ha^{-1} y^{-1}, for Lake

Louise 0.93 kg ha^{-1} y^{-1}, and for Susitna Lake 0.5 kg ha^{-1} y^{-1}. Thermal habitat volume information is not available for Summit Lake. Using the average weight of lake trout harvested in each lake to convert yields to numbers of fish, the sustainable harvest from Paxson Lake is 884 trout, Lake Louise 2,095 trout, and Susitna Lake 600 trout. These yields compare to yields based on Healy's approach of 500 trout from Paxson Lake, 1,000 trout from Lake Louise, 600 trout from Susitna Lake, and 500 trout from Summit Lake. Based on these estimates, harvests of lake trout from Lake Louise and Susitna Lake appear to be below estimates of sustainable yield (Figure 7) while harvests from Paxson and Summit lakes appear to be exceeding sustainable levels (Figure 8).

Findings from the research program indicate that the abundance of mature lake trout in Paxson Lake has declined annually from 1988 through 1990 (Figure 9). Maturity in this study was defined as the age at which 99% are capable of spawning, which is 7 years for females and 6 years for males. Abundance during 1991 increased from past years, largely the result of a large number of new recruits to the spawning population. This suggests that recruitment into the lake trout population in this lake varies annually. Although 5-year-old males are not fully recruited into the harvest, a relative lack of them in harvest samples in 1992 compared to 1991 may indicate that recruitment was again low in 1992 (Szarzi 1992). The possibility of low recruitment in 1992 and harvests which continue to exceed sustainable levels strongly suggest that the overall decline in abundance observed from 1988 through 1990 will continue unless measures are taken to reduce harvest. Trends in the abundance of the lake trout population in Paxson Lake were modeled in order to predict the reduction in harvest necessary to arrest declining abundance and allow the population to rebuild. The carrying capacity of the lake was estimated at 17,675 trout; an abundance of half this would produce a maximum sustainable harvest of 884 trout. Based on this, removals from Paxson Lake must be reduced by approximately 60% to arrest the decline in the abundance of the modeled population.

Unfortunately, similar information on population trends is unavailable for Lake Louise, Susitna Lake, or Summit Lake. For Lake Louise, recruitment is evident in length and age samples; however, anecdotal information from lake residents indicates that catch rates are less and lake trout size is smaller than in the past.

Data from the research effort also indicate that the minimum size limit of 460 mm (18 in) total length (TL) is not protecting first time spawners as was intended. No spawning female lake trout captured during fall sampling in 1992 at Paxson Lake or Lake Louise were less than 460 mm (18 in) TL and only 1% were less than this length in samples from Susitna Lake. Sublegal fish which reached legal size following the imposition of the minimum length limit did not contribute significantly to the harvest after 1988. Whether the length limit protected enough spawners to increase the number of recruits into the fishery will not be known until 1993 when those recruits reach maturity. However, the relatively small number of 5 year olds in the harvest from Paxson Lake in 1992 indicates that the length limit did not add a significant number of recruits to that fishery. Also, research indicates that the present bag limit is not limiting the harvest of lake trout. Anglers caught less than one lake trout each from Paxson Lake and fewer than two each from Lake Louise and Susitna Lake.

Current Issues

The current regulatory regime is not adequately protecting all UCUSMA lake trout stocks from overharvest under the current fishery objective. For this reason, the department has submitted a proposal for consideration by the BOF at the February 1994 meeting that would better protect area lake trout stocks from overharvest.

Recommended Research and Management

The current research program which focuses work on Paxson and Susitna lakes and Lake Louise should be continued. In addition, more information is needed regarding the characteristics of the life history and harvest of other lake trout stocks which have the potential to be overexploited including: size and age structure, maturity schedules, abundance and yield, and the contribution of the winter fishery to the lake trout harvests.

Current regulations are not protecting all UCUSMA lakes from overharvest, in particular the large road accessible lakes (e.g., Paxson and Susitna lakes and Lake Louise). Thus, a new regulatory scheme needs to be adopted for these lakes. Towards developing this scheme, managers are considering the previously discussed regulatory options to reduce harvest. On a lake-by-lake basis for the large road accessible lakes, these regulatory options would have the following impacts:

Paxson Lake:

A change in the length limit would be an effective tool to reduce the harvest of lake trout from Paxson Lake while protecting more spawners. Burr (1991) states that a minimum length limit of 560 mm (22 in) TL (510 mm fork length [FL]) would protect females in Paxson Lake through two spawning seasons and would be more effective than the present size limit at reducing harvest of these fish. In 1992, 42% of spawning females in seine samples were under 511 mm FL while 39% of harvested females were less than 511 mm FL. The modal length of the harvest samples from Paxson Lake for 1991 and 1992 was 560 mm TL (508 mm FL). An increase in the minimum size limit to 560 mm (22 in) TL would not, however, produce an adequate reduction in the harvest to allow the stock to rebuild to permit a sustainable harvest. Given this, managers are considering either a larger minimum size limit of 610 mm (24 in) or a 560 mm (22 in) size limit in concert with some other regulation change aimed towards reducing harvest (e.g., a reduced bag limit).

Increasing the minimum length limit would disenfranchise anglers who like to keep small lake trout to eat. Protected slot limits would serve these anglers but yet reduce harvest. Burr (1991) states that Paxson Lake is a likely candidate for a protected slot limit due to its high productivity and high density of lake trout. He suggests a slot range where lake trout between 405 mm (16 in) and 760 mm (30 in) TL are protected. The proportion of the lake trout harvest less than 405 mm TL in 1986 (36%) and over 760 mm TL (1%) indicated that this would be a viable alternative for reducing harvest. Slot limits are supported by anglers who fish at Lake Louise and Susitna Lake; however, managers feel that a slot limit is not appropriate for Paxson Lake at this time as the abundance of immature lake trout has not been estimated. Increasing effort on this element of the population might reduce abundance by

removing too much of the potential spawning stock needed to rebuild or sustain the population.

The elimination of bait could offset some of the increase in lake trout killed due to hooking, however its affect on harvest levels would be minimal. Anglers used bait or bait in combination with lures on only 9% of angler-trips on Paxson Lake. Since so little benefit to the lake trout would be derived from the elimination of bait while an unknown number of anglers that fish through the ice would be inconvenienced, this is currently not considered an option.

A reduction in the bag limit to one fish would do little to reduce harvest as anglers kept 2 lake trout on only 5% of their angler-trips to Paxson Lake during 1992. However, a bag limit reduction could reduce the additional pressure which might be directed towards bigger lake trout if their abundance increases in the future. A seasonal bag limit might also be useful towards reducing harvest.

An unknown but perhaps significant reduction in the harvest might be achieved by closure of the fishery in the spring until the lake stratifies. The largest portion of the fishery at Paxson Lake occurs as the ice melts away from the shoreline in the spring until the lake stratifies in early July. This alternative would accommodate anglers who like to eat small fish but would place a hardship on local businesses who benefit from the large influx of anglers during ice out through the Fourth of July holiday.

Lake Louise:

Increasing the minimum size limit of harvestable lake trout at Lake Louise is recommended to assure that harvests remain at sustainable levels in the face of our lack of understanding of the dynamics of Lake Louise lake trout stocks. A minimum size limit of 560 mm (22 in) TL would not be as effective in Lake Louise compared to Paxson Lake because size at entry into the harvest is larger for lake trout from Lake Louise than from Paxson Lake and the average size of Lake Louise fish is greater. A 610 mm (24 in) TL minimum size limit would fall in the range of the modal length of the harvest (610 mm or 24 in TL in 1991 and 585 mm or 23 in TL in 1992) and would result in a significant reduction in the harvest; in 1992, 53% of harvested females were under 560 mm (24 in) FL. At least half of spawning females would also be protected under a 640 mm (24 in) TL minimum size limit. However, the average size of the harvest is significantly higher than the average size of spawning fish. This may indicate that anglers are able to target larger fish and might reduce the effectiveness of the minimum length limit by focusing more effort on larger fish. Therefore, a reduction in the bag limit may also be necessary to counter increased pressure on larger fish.

A seasonal closure during ice out until July would be effective at limiting the harvest from Lake Louise. A closure of this type, however, would have a negative impact on businesses located on the lake and is not currently considered an option.

A reduction in the bag limit alone would not be effective in reducing harvest from Lake Louise because of a small contribution of second fish to the harvest. The elimination of bait would likewise be ineffective towards

reducing harvest since its use is minimal and anglers would likely switch to lures rather than quit fishing. The elimination of bait in conjunction with a more restrictive length limit could reduce hooking mortality. At present, however, managers do not consider the elimination of bait as a viable option towards reducing harvest.

Susitna Lake:

A restriction in the harvest at Lake Louise would likely focus more effort on Susitna Lake. Although stocks in Susitna Lake appear to be healthy, lake trout here are virtually unprotected from overharvest by current length limits: fish from the harvest in 1992 were larger on average than those from Paxson Lake and spawners were larger than spawning fish in Lake Louise. To avoid the impact of focusing effort on Susitna Lake, restrictions similar to those adopted for Lake Louise are advisable. A minimum length limit of 610 mm (24 in) would likely be effective at protecting a significant proportion of the spawning population and falls in the range of the modal length of the harvest (584 mm FL or 25 inches TL).

A minimum size limit would offset increased pressure but, as in Lake Louise, needs to be accompanied by a bag limit of one to counter a shift in pressure to larger fish. The overlap in the average size of harvested lake trout and spawning fish may reflect a preference by anglers to keep small fish to eat; Susitna Lake is a remote lake and more anglers are local cabin owners than visitors seeking fish. The harvest might easily shift to larger lake trout as only 31% of the harvest is under 610 mm (24 in) TL.

A seasonal closure would be effective in Susitna Lake. The impact would be greatest on anglers targeting lake trout. Local cabin owners and area businesses would be minimally affected.

Based on this, the following regulation changes will be proposed to the Board of Fisheries during their 1994 meeting:

1. Increase the minimum size limit of lake trout to 610 mm (24 in) TL in the Tyone drainage, Paxson Lake, and Summit Lake.
2. Reduce the bag limit to one lake trout in the Tyone River drainage.

BURBOT FISHERIES

Background and Historical Perspective

The many lakes and rivers of the UCUSMA (Map 4) support some of the largest populations of burbot in Alaska and have supported up to 70% of the statewide sport harvest of this species (Table 13). The largest fishery has historically occurred in the Lake Louise complex (consisting of Lake Louise, Susitna and Tyone lakes); this complex has historically supported just over half of the area's burbot harvest (Table 14). Other significant fisheries occur in the various lakes of the Gulkana River drainage (e.g., Paxson, Summit, and Crosswind lakes), Tolsona and Moose lakes, and various smaller remote lakes scattered throughout the UCUSMA. The fishery occurs primarily during the winter months from November to April using closely attended set or hand jig lines.

Prior to 1979, there were no daily bag or possession limits or gear restrictions governing the harvest of burbot in the UCUSMA. In recognition of burbot as an important sport species to be managed for sustained yield, a daily bag and possession limit of 15 burbot was enacted prior to the 1979 winter fishery. Anglers were allowed to harvest burbot by fishing multiple hand lines and unattended set lines with no more than a total of 15 hooks plus two hand-held jig hooks. Under these regulations, the sport harvest of burbot from UCUSMA waters increased dramatically, peaking in 1985 when a record harvest of 19,355 burbot were taken (Table 13, Figure 10).

The rapid growth in the fishery raised concern that several UCUSMA burbot stocks were either being, or in imminent danger of becoming, overexploited. In response, in 1987 daily bag limits and the number of hooks an angler could fish in area lakes were reduced to 5, whether fished on unattended set lines or hand-held jig lines. In several road accessible lakes (Lake Louise, Tyone, Susitna, Tolsona, Moose, and Summit lakes), the daily bag and possession limits were further reduced to 2 fish and anglers were restricted to using only two hooks. Also, the sport fishery for burbot in Hudson Lake was closed by emergency order based on findings that this burbot stock had been severely overexploited and was depressed.

During their 1988 meeting, the Board of Fisheries adopted a management plan for the lake burbot fisheries of the UCUSMA. The plan was adopted as regulation (5 AAC 52.045) to insure that the department had the necessary tools through which to manage the area's lake burbot fishery for *maximum sustained yield and opportunity to participate*. In order to achieve this management objective, the plan gave the department the authority to use time and area closures *and* method and means restrictions to manage the area's lake burbot sport fisheries. In adopting the plan, the BOF stated their desire to not have the bag limits for burbot reduced to less than 2 for road accessible lakes and 5 for remote lakes, as it was considered unreasonable by Board members to participate in these fisheries at lower bag limits.

Further actions were implemented during 1989 under the newly adopted management plan. An emergency order was issued that closed the burbot fishery in Lake Louise based on research findings that showed the lake's burbot stocks had become severely depressed due to overfishing. In addition, an emergency order was issued to keep the burbot fishery in Hudson Lake closed, as research

showed that burbot in this lake remained depressed. Emergency regulations were also enacted that eliminated set lines from the sport fishery in all remaining lakes of the Tyone River drainage given that anglers had begun to seek out previously unexploited lakes in the Tyone River drainage in response to restrictions and closures placed on other area lakes.

A research program was initiated in 1986 to evaluate the life history of interior Alaska burbot and to determine stock status and sustained yields of burbot fisheries in the UCUSMA. The goal of the research program has been to determine appropriate management strategies that assure for the maximum sustained yield of burbot from UCUSMA lakes. The study has been conducted in a variety of lakes. Results to date have provided managers with the tools to determine stock status using a variety of assessment methods and an estimate of the productivity of the area's burbot fisheries. Annual results of the research project are summarized in Lafferty et al. (1990, 1991, 1992) and Lafferty and Bernard (1993).

Fishery Objectives

Based on the lake burbot management plan (5 AAC 52.045), the lake burbot fisheries of the UCUSMA are to be managed for *maximum sustained yield and opportunity to participate*. In order to achieve this fishery objective, the plan gives the department the authority to use time and area closures *and* method and means restrictions to manage the area's burbot sport fisheries. Healthy stocks are managed to permit maximum sustained yield while depressed stocks are managed to allow the stocks to rebuild. Fishing is permitted on some depressed stocks, however exploitation levels allow the stocks to rebuild to permit a fishery capable of maximum sustained yield.

The management goal is to develop an orderly fishery. As these fisheries rebuild, it is hoped to provide between 10,000 to 15,000 angler days of ice fishing opportunity with a harvest of about 5,000 burbot on an annual basis in the UCUSMA.

Recent Board of Fisheries Actions

Although the more restrictive regulations greatly reduced harvest in the burbot fisheries of the UCUSMA, managers remained faced with a number of biological and social concerns regarding the management of the area's burbot fisheries. For example, in response to closures and restrictions placed on many popular fisheries (e.g., those in the Tyone River drainage), anglers began to target unexploited burbot populations in many of the smaller lakes of the UCUSMA. Many of these smaller burbot populations are capable of providing only limited sustainable yields. There was concern that some of these lakes could become overfished, requiring the department to take, on a lake-by-lake basis, emergency action to protect the stocks. This would be costly and result in a multitude of regulations throughout the management area.

For this reason, managers supported a new approach to the management of the UCUSMA lake burbot fisheries. Various options were considered; however, managers submitted a proposal to the Board at their 1991 meeting calling for the elimination of *unattended* set lines from all burbot fisheries in the UCUSMA. This proposal was intended to reduce angler efficiency thereby providing protection from overexploitation to small burbot stocks in the area.

After lengthy discussion and consideration, the Board adopted this proposal. Other management options, such as spawning season closures, were considered, but due to insufficient data were not selected as viable options towards assuring against overharvest. Managers believe this action should assure for the long-term opportunity to fish for and harvest burbot in the UCUSMA.

Lake Louise and Hudson Lake were also closed to burbot fishing at the 1991 Board meeting. Both lakes had been closed through emergency orders for the past several years and were expected to be closed through additional emergency orders through at least the next scheduled Board meeting in 1994. A decision was therefore made to close these fisheries through regulation.

Recent Fishery Performance

With the adoption of the more conservative regulations, harvests of burbot from UCUSMA waters have generally declined annually since 1985 (Table 13, Figure 10). The reduction in harvest has allowed some of the previously overexploited burbot stocks in smaller lakes (e.g., Tolsona and Moose lakes) and moderately sized lakes (e.g., Susitna and Paxson lakes) to recover to permit sustainable fisheries. For some lakes, however, these sustainable yields are substantially lower than maximum sustained yields the fisheries are capable of supporting. Larger lakes which were severely overexploited (e.g., Lake Louise) in the early to mid 1980s remain depressed. These larger lakes take longer to recover from overexploitation than do smaller and moderately sized lakes. In Lake Louise, historically the largest burbot fishery in Alaska, the burbot stock remains in a depressed condition. The decline in the numbers of mature burbot in this lake, however, has leveled off at 4,000 mature burbot in recent years. The current level of burbot abundance in this lake, although stable, remains less than the minimal abundance level of 7,000 established by managers to open the fishery. Once opened, only limited fishing will be allowed such that the stock can rebuild to permit a fishery capable of maximum sustained yield. Unfortunately, a lack of recruitment into the Lake Louise burbot population continues to slow the recovery process.

Hudson Lake has been closed for fishing for burbot since 1988. The stock of burbot in Hudson Lake was overfished in the late 1980s and the population could not continue to sustain a fishery. The intent of the department was to leave Hudson Lake closed until the burbot population could rebuild to a level that could support a sustainable fishery. Using catch-per-unit-effort (CPUE) as a population index, the department set a management objective for a CPUE estimate of greater than 2.5 burbot per trap to reopen the fishery. Sampling conducted during the summer of 1993 indicates that the burbot population has recovered sufficiently to reopen the fishery. Catch-per-unit effort estimates for 1993 were 2.64 burbot per trap. Length frequency distributions from 1993 also indicate a large number of fish entering the population through growth recruitment. These indices indicate that burbot in Hudson Lake have attained healthy abundance levels and can sustain a modest fishery. Emergency order (E.O. No. 2-BB-3-38-93) opened Hudson Lake to sport fishing and set a two fish bag and possession limit.

Current Issues

Many anglers have been adverse to what they perceive as rapid and drastic changes made to the burbot fisheries of the UCUSMA and some remain convinced

today that the actions were unduly restrictive and unfair. This is particularly true with the action taken to eliminate *unattended* set lines from the burbot fisheries of the UCUSMA. Many anglers do not support this action and are choosing to not participate in this fishery because they cannot use this gear type. This reduces participation in fisheries capable of supporting effort and harvest. To promote participation, staff have encouraged anglers to shift to alternative gear types that are legal (attended set lines or tip ups); however, anglers continue to be reluctant. The Copper Basin Advisory Committee submitted a proposal to re-allow the use of unattended set lines in rivers and glacial lakes of the UCUSMA. At this time, staff remain opposed to the reintroduction of unattended set lines in lakes of the UCUSMA. Historically, a few anglers using unattended set lines overharvested several UCUSMA burbot populations within a short period of time. Once overexploited, these fisheries needed to be restricted or closed. Given life history characteristics of burbot, recovery of a depressed stock is slow, often taking many years to rebuild to a condition capable of sustaining a fishery. Creation of the lake burbot management plan gave managers the necessary tools to arrest a fishery that had overexploited a burbot stock. However, actions taken under this management plan promote reactive management where the department bears the burden of detecting overexploited stocks with costly assessment programs. This fragments the burbot fisheries of the UCUSMA and leads to regulations which can be confusing due to superseding emergency orders.

Whereas the department has opposed the use of unattended set lines in flowing waters in the past, the department will now support a modified version of the proposal submitted by the Copper Basin Advisory Committee. The department has completed a series of unique studies of burbot in the Tanana River which indicate (1) all burbot in that river comprise a single, extremely large population, (2) burbot migrate throughout the river, and (3) burbot are less susceptible to fishing during the spawning season in the river than the surrounding lakes. For these reasons, the population of burbot in the Tanana River has been very resilient to overharvest, much more so than populations in lakes. While there is no similar information on populations of burbot in the flowing waters of the UCUSMA, the department feels that conditions in the Copper River are similar to those of the Tanana River. Therefore, the department recommends establishing a personal use fishery for burbot that provides for the use of unattended set lines in the mainstem of the Copper River. Daily bag limits would be 5 burbot. Fishing with unattended set lines would be restricted to the mainstem of the Copper River and prohibited in its tributaries. Participants in this fishery would be required to (1) obtain a permit, (2) report the number and location of burbot that were harvested, and (3) deliver carcasses from the burbot they catch to the department. Age of harvested burbot will be determined through inspection of the bones in the delivered heads. In the years ahead, knowledge of the age composition of the harvest will be used to estimate abundance of burbot in the Copper River.

Recommended Research and Management

The research program is currently limited to stock assessment of burbot populations in Lake Louise and Tolsona Lake. Both lakes will be sampled during the spring of 1994. The department is committed to continued monitoring of the burbot stocks in Lake Louise until the fishery has recovered and can be reopened. Staff will continue to try to educate the angling public and seek their input to managing these important ice fisheries.

CHINOOK SALMON FISHERIES

In the UCUSMA, only the Copper River drainage supports anadromous runs of chinook salmon. No anadromous runs of chinook salmon return to the upper Susitna River drainage. Devil's Canyon is a hydraulic barrier which prevents upstream salmon migration in this drainage.

Chinook salmon returning to the Copper River drainage begin passing through the Copper River delta and entering the Copper River during early May. The peak migration into the river is generally from mid-May to mid-June, with the return essentially complete by July 1. However, small numbers of chinook salmon continue to enter the Copper River through August. Chinook salmon make their way to spawning areas in Copper River tributaries primarily through June and July with spawning beginning in mid-July and continuing through August.

Chinook salmon are broadly distributed throughout the Copper River basin, having been observed in approximately 40 tributaries. Aerial surveys have been conducted in 35 of these systems; however, only nine of these systems have been surveyed consistently since 1966 (Roberson and Whitmore 1991). In general, chinook salmon returns to the these nine Copper River tributaries were above historical averages from 1982 through 1991 (Table 15, Figure 11). The 1992 escapement to these nine streams, however, was the lowest observed since 1969 (Table 15); the reasons for which are unknown. All nine streams were not surveyed in 1993 so comparison to historical means for the Copper River is not possible. However, the 1993 escapement count of 1,156 chinook salmon in the Gulkana River is above the historical mean for that system and nearly twice the 1992 count. Assessment of chinook salmon spawning escapements through aerial surveys is considered index of escapement and not an estimate of the total spawning return. This is because not all spawning areas are surveyed and not all spawners are counted in surveyed areas.

Copper River chinook salmon stocks are harvested in a variety of fisheries including: (1) a commercial gill net fishery on the Copper River delta, (2) a personal use dip net fishery in the Copper River near Chitina, (3) a subsistence dip net and fishwheel fishery in the Copper River between Chitina and the Slana River confluence, and (4) sport fisheries which occur in various tributaries. The total harvest of chinook salmon in these fisheries has been estimated since 1966 (Donaldson et al. 1993, Roberson and Whitmore 1991). Since 1982, the total harvest of chinook salmon in these fisheries has ranged from 27,000 to 59,000 (Table 16, Figure 12). Unfortunately, the contribution to the catch of fish from each spawning stock for the various mixed stock fisheries cannot be quantified at present (Brady et al. 1991, Roberson and Whitmore 1991). Thus, it is not currently possible to assess the productivity of this stock using spawner-recruit databases.

The Copper River Delta District commercial fishery management strategy provides for two, 24-hour periods per week commencing during the second or third week of May with adjustments in the fishing schedule being made through emergency order. Early season management, when chinook salmon are of consequence in the fishery, is based on actual catches as compared to anticipated catches. Under the *Copper River District Salmon Management Plan*, the department may, through emergency order, authorize the use of large mesh gear in the Copper River Delta District if Copper River District sockeye salmon returns are forecasted or observed to be weak and a strong harvestable

surplus of chinook salmon is demonstrated. Since 1982, chinook salmon harvest in the Copper River Delta District commercial fishery has averaged approximately 38,000 fish (Table 16), with harvests having remained relatively stable (Figure 13).

Subsistence and personal use harvest of Copper River chinook salmon has averaged approximately 3,600 fish since 1982 (Table 16), with harvests having generally increased in recent years (Figure 14). The subsistence fishery occurs from June 1 through September 30 in the mainstem Copper River from the upstream edge of the Chitina-McCarthy Highway bridge upstream to Slana. Fishwheels and dip nets are legal gear. Permits are a requirement of this fishery. The maximum harvest limit for a household of one person is 200 fish and for a household of two or more is 500 fish. There is no limit as to the number of chinook salmon within the annual permit limit for people using fishwheels, while a five chinook salmon limit is imposed on subsistence fishermen using dip nets. Chinook salmon are present in the fishery when the fishery is opened and, on average, 80% of the chinook salmon harvest is achieved by July 12 (Roberson and Whitmore 1991).

The personal use fishery is restricted to mainstem waters of the Copper River from the downstream edge of the Chitina-McCarthy Highway bridge downstream to a department marker located approximately 200 yards upstream of Haley Creek. The season is from June 1 through September 30. Fishing periods are established by emergency order. The schedule is designed to allow a total harvest of 60,000 sockeye salmon given a Miles Lake sonar count of less than 516,000 sockeye salmon over the course of the season. Specific weekly harvest limits for each of the first 5 weeks of the fishery are incorporated into the schedule. Total harvest of less than 45,000 sockeye salmon by the end of the fifth week of the fishery allows for an increase in the possession limit for sockeye salmon, but not for chinook salmon. Participants in this fishery must be residents of the state and have a current sport fishing license. Permits are a requirement of this fishery. Permits limit households of one individual to 15 salmon of which no more than 5 can be chinook salmon and households of more than one person to 30 salmon of which no more than 5 can be chinook salmon. Chinook salmon are present in the catch when the fishery is opened. On average, 80% and 95% of the chinook salmon harvest is complete by July 1 and July 17, respectively (Roberson and Whitmore 1991).

The sport harvest of chinook salmon from Copper River tributaries has increased substantially since 1982 (Figure 15), with the 1991 harvest of 4,884 being the highest on record (Table 16). Since 1982, the average harvest of chinook salmon by recreational anglers fishing UCUSMA waters has been about 3,200 fish. The fishery primarily occurs in various tributaries to the Copper River with the largest fisheries occurring in the Gulkana and Klutina rivers (Table 17). Approximately 94% of the estimated sport harvest of chinook salmon taken from the Copper River drainage since 1983 have been taken from these two drainages. Since 1970, the recreational harvest of chinook salmon over 20 inches in length in the recreational sport fishery of the Copper River Basin has been limited by a bag and possession limit of 1 per day and 1 in possession. Further protection was afforded area chinook salmon stocks through spawning season closures beginning in 1989. In 1989, it was established that a chinook salmon removed from UCUSMA waters becomes part of the daily bag and possession limit of the person who hooked the fish. During 1991, recreational chinook salmon fishing was closed in Indian, Bernard,

Ahtel, Natat, and Smith Creeks. This action was taken in effort to bolster escapements to these small clearwater tributaries which have showed decline in chinook salmon returns in recent years.

Overall, Copper River chinook salmon stocks are considered healthy (Roberson and Whitmore 1991). Although harvests have increased over the past decade, observed spawning escapements have remained relatively stable (Figure 16). However, the 1992 observed spawning escapement of only 1,057 was the lowest on record since 1969 (Table 16). Future escapements will need to be monitored closely to determine if this relates to a long-term trend.

Gulkana River Chinook Salmon Fishery

Background and Historical Perspective

The Gulkana River drainage has historically supported the largest sport fishery for chinook salmon in the UCUSMA. This drainage originates in the Alaska Range and flows south to join the Copper River near the community of Glennallen (Map 2). The section of the Gulkana River upstream from Sourdough has been designated by Congress as a Wild and Scenic River. Access to the river is available from various secondary roads and trails off the Richardson Highway which parallels much of the river. Anglers utilize rafts and power boats to gain access to the more remote sections of the river. Raft anglers frequent the various sections of the river from Paxson Lake downstream to the Richardson Highway bridge. Power boat operators generally launch at Sourdough and utilize that section of the river from approximately 2 miles below Sourdough upstream to the confluence of the West Fork. More recently, power boat operators have begun launching from the Richardson Highway bridge and utilizing the 5 mile reach of the river above the bridge. Power boat operators occasionally access the confluence of the Gulkana River with the Copper River using power boats launched from Copper Center.

Chinook salmon typically begin entering the Gulkana River in early to mid-June. The sport fishery typically peaks during late June or July; however, limited fishing for chinook salmon continues until the season closes. Spawning begins in mid-July and continues through late August. Most spawning occurs upstream of the confluence of the West Fork.

Under current regulations, anglers fishing the Gulkana River are allowed 1 chinook salmon over 20 inches daily and in possession. All waters above the Middle Fork confluence with the mainstem Gulkana River are closed to fishing year round to protect spawning fish. Waters below the Middle Fork confluence but above the Alyeska Pipeline crossing are open to chinook salmon fishing from January 1 through July 19. All waters below the Alyeska Pipeline crossing are open to chinook salmon fishing from January 1 through July 31. The early closure above the Alyeska Pipeline is intended to offer spawning fish protection. The Gulkana River from the Richardson Highway bridge downstream to a department marker 500 yards downstream of its confluence with the Copper River is an area where only single-hook, artificial flies may be used from June 1 through July 31. In all waters of the Gulkana River drainage upstream of a marker 7.5 miles upstream of the West Fork confluence with the mainstem, only unbaited, artificial lures may be used. This regulation is intended to protect rainbow trout stocks that inhabit this area.

The primary source of information regarding the sport fishery is the statewide mail survey (Mills 1979-1993). Based on this survey, the sport harvest of chinook salmon in the Gulkana River has averaged about 1,700 fish annually since 1977 (Table 18), with harvests having remained relatively stable since 1979 (Figure 17). The 1992 harvest of 3,071 chinook salmon was the second largest on record and accounted for nearly 70% of the sport harvest of chinook salmon in the UCUSMA. Sport fishing effort on the Gulkana River has averaged about 23,800 angler-days annually since 1982 (Table 3). Due to the nature of the mail survey, it is unknown how much of this effort was directed toward chinook salmon. Observations, however, suggest that a majority of the recent years' effort is directed toward chinook salmon.

A creel survey was conducted in 1989 to estimate the catch and harvest of and effort directed toward chinook salmon. Results of this survey (Potterville and Webster 1990) indicated that sport anglers expended 29,103 angler-hours to catch 2,398 chinook salmon. Sixty-one percent (1,461 fish) of the catch was estimated to be harvested. This estimate of harvest is close to that estimated from the mail survey (1,530 fish), indicating that the mail survey appears to accurately estimate the harvest of chinook salmon in this fishery. Approximately 50% of the harvest was estimated to have occurred on weekends. The majority of the sport harvest occurred in the 5 mile reach directly upstream of the Richardson Highway bridge and the 10 mile reach near the Bureau of Land Management campground and boat launch at Sourdough. Few anglers fished the single-hook, artificial fly-fishing-only area and, although many anglers floated the upper river, the harvest of chinook salmon was minimal in this reach due to the July 20 spawning season closure.

The spawning escapement of chinook salmon in the Gulkana River upstream of the West Fork has been documented since 1966 by aerial surveys of index sites in the drainage since 1966 (Brady et al. 1991, Roberson and Whitmore 1991). Through 1990, escapement indices averaged 1,035, ranging from a high of 3,182 fish in 1986 to a low of 147 fish in 1969 (Table 15). With the exceptions of a low escapement during 1985 and high escapement during 1986, escapements have remained relatively stable since 1977 (Figure 17).

Overall, Gulkana River chinook salmon stocks are considered healthy (Roberson and Whitmore 1991). Both inriver harvests and spawning escapement index counts have remained relatively stable since 1980 (Figure 17).

Fishery Objectives

No specific fishery objectives have been established for this fishery, although a preliminary biological escapement goal of 2,800 chinook salmon has been established for the Copper River. The escapement objective is based on enumeration of spawning fish by aerial surveys. During years in which water clarity has been good enough to conduct area surveys, no action has been taken to restrict the fishery if spawning escapements of 800 fish are achieved in the area between the outlet of the Gulkana River to the Copper River to the confluence of the Gulkana River with the West Fork during the week following the Fourth of July weekend. Unfortunately, water clarity often prohibits conducting aerial surveys during this period.

Inseason Management Approach

Chinook salmon sport fisheries in the Copper River will be managed to meet the biological escapement goal (BEG) of 2,800 chinook salmon. Changes in the management of the fishery will based on the results of the escapement surveys conducted after the fishery closes each year. Recommendations to change management practices would normally be made after there appears to be a declining trend in escapements. It is possible that some inseason management actions may be taken if harvest of chinook salmon in the downriver fisheries (commercial and personal use) were significantly lower than anticipated and there were low and clear water conditions in the Gulkana River.

Recent Board of Fisheries Actions

During the February 1991 meeting, that portion of the river 7.5 miles upstream of the confluence of the West Fork was designated as an area where only unbaited, single-hook artificial lures may be used. This action was taken as a conservation measure for rainbow trout and has had little or no affect on the chinook salmon fishery.

Recent Fishery Performance

During 1992, 3,071 chinook salmon were harvested by sport anglers fishing the Gulkana River drainage (Table 18). Observed chinook salmon spawning escapement during 1993 (1,156) was near average (1,282) (Table 18). Harvest information is not yet available for the 1993 season.

Since 1991 there has been a significant increase in use of power boats from the Richardson Highway bridge upstream for about 5 miles. Also, a notable increase in the number of guides specializing in guiding anglers targeting chinook salmon has occurred on the lower river (below the West Fork confluence) over the past several years. Prior to the 1986 season, only one individual specialized in guiding anglers targeting chinook salmon on this section of the river. During the 1987 and 1988 seasons, a minimum of eight guides operated on the lower portions of the river, while the number increased to at least ten guides during 1989 and 1990. Available data indicate that the guided anglers are more successful than unguided anglers. During 1990, back-trolling techniques similar to those used in the Kenai River were introduced on the Gulkana River. It is generally believed this technique has further increased catch rates for chinook salmon.

Current Issues

Increased participation by float and power boat operators on the Gulkana River is leading to increased conflict between the users. Float-boat operators fish primarily from the bank and do not like power boats back trolling through holes they are fishing. Additionally, reports have been made by float-boat operators that power boats have bumped into them. In response to these growing conflicts, the Copper Basin Advisory Committee has submitted a proposal that would eliminate fishing from power boats in the Gulkana River from the Richardson Highway to the department marker placed at the confluence of Poplar Grove Creek.

The majority of the land adjacent to the Gulkana River downstream of Sourdough is owned by the Ahtna and Chitina Native Corporations. Beginning during the 1991 season, these corporations prohibited trespass across their lands for the purpose of hunting or fishing. The reason the corporations have not allowed access for hunting or fishing purposes is that they feel their customary and traditional lifestyle has been jeopardized by elimination of the rural preference in the subsistence law. They may, if requested, allow access for camping, hiking, or other nonconsumptive resource uses.

The allocation of chinook salmon between recreational, commercial, and personal use fishermen remains a controversial issue. A significant portion of the total chinook salmon commercial harvest is taken by June 1 incidental to a significantly larger sockeye catch. Many recreational anglers think this fishery should begin at least a week later than historically conducted. Since stock status is considered healthy, this is an allocative rather than biological issue.

Additionally, the local advisory committee has submitted two proposals that address the need to reduce the harvest potential of the chinook salmon fishery. These proposals call for establishing a 5 fish seasonal bag limit and closing the season in the lower Gulkana River approximately 12 days earlier.

Recommended Research and Management

It has been determined that the mail survey accurately estimates the harvest of chinook salmon in this drainage; therefore, it is not recommended that creel surveys be conducted on an annual basis. It is, however, recommended that aerial surveys be continued to index numbers of spawning salmon.

Recreational harvests are documented through the mail survey, the personal use and subsistence harvests are recorded through permits, and the commercial harvest is enumerated through fish tickets. At the present time the commercial fishermen do not have to report their home pack of chinook salmon. Anecdotal information suggests that approximately 2,000 to 5,000 chinook salmon are harvested annually for home pack. To determine the total harvest of Copper River bound chinook salmon, a method of recording the home pack by commercial fishermen needs to be established. The Board has asked the department to work with the local advisory committees to establish a process to record home pack and a list of the specific species of concern for each local area around the state. The department has submitted a proposal that asks the Board to have the home pack of chinook salmon and steelhead trout harvested from the Copper River delta be recorded on fish tickets.

Klutina River Chinook Salmon Fishery

Background and Historical Perspective

The Klutina River supports the second largest sport fishery for chinook salmon in the UCUSMA. This semiglacial river drops rapidly out of Klutina Lake to enter the Copper River at the community of Copper Center. Access to the river is available along the Richardson Highway and from the Klutina Lake Road (also called the Brenwick-Craig Road) which parallels the lower portion of the

river. Shore anglers participate in the fishery adjacent to the highway and the Klutina River Road. The distance between the Klutina River Road and the river varies along the course of the road, with the road running along the ridge above the river. Much of the land between the road and the river belongs to the Ahtna Native Corporation and permission to cross their land is required. Jet river boats are used by experienced operators to access the upstream portions of the river. Jet boats are launched from private land adjacent to the highway or from several sites along the Copper River. The river has considerable stretches of white water and is considered to be very challenging to jet river boat operators. The fast water of the Klutina River limits the number of resting pools for chinook salmon; therefore, there are less than two dozen good fishing sites in the lower portion of the river accessible to most anglers.

Chinook salmon typically begin entering the Klutina River in late June, with the run continuing well into August. The sport fishery typically peaks during the second week of July; however, fishing for chinook salmon continues until the season closes on August 10. Peak spawning occurs from late July through August. Most spawning occurs upstream of a point adjacent to Mile 19.2 on the Klutina Lake Road.

Chinook salmon spawning season closures were established in the UCUSMA during the 1989 Board meeting to allow chinook salmon to spawn unmolested. On the Klutina River upstream of a department marker located adjacent to Mile 19.2 of the Klutina Lake Road, chinook salmon may be taken only from January 1 through July 19. Downstream of this marker, the chinook salmon season is from January 1 through August 10. Current bag and possession limits governing the sport fishery for chinook salmon over 20 inches are 1 and 1, respectively.

Sport harvest of chinook salmon from the Klutina River drainage has been estimated using the mail survey since 1983 (Mills 1984-1993). Based on this survey, the sport harvest of chinook salmon from the Klutina River drainage has averaged 665 fish from 1983 through 1992, ranging from a low of 189 fish in 1983 to a high of 1,588 fish in 1991 (Table 19). With the exception of the record harvest during 1991, harvests have remained relatively stable since 1983 (Figure 18). Over this same period, sport effort on the Klutina River has averaged approximately 4,600 angler-days, ranging from 1,568 in 1983 to 12,145 in 1991 (Table 4). Due to the nature of the mail survey, it is unknown how much of this effort was directed toward chinook salmon versus other species. Observations in recent years, however, suggest that a majority of the recent years' effort is directed toward chinook salmon.

During 1988 and 1989, creel surveys of the sport fishery targeting chinook salmon in the Klutina River drainage were conducted. High water reduced effort and catch during a significant portion of the 1988 season whereby river conditions remained favorable throughout the 1989 season. Results of the 1988 survey (Roth and Delaney 1989) indicated that sport anglers caught a total of 1,048 chinook salmon of which 43% were retained. The estimated harvest (450) was close to that reported in the mail survey for 1988 (483), indicating that the mail survey fairly accurately estimates sport harvest in this fishery. During the 1989 survey, it was estimated that anglers caught 1,587 chinook salmon of which 65% were retained (Potterville and Webster 1990). The estimated harvest (1,031 fish) was again reasonably close to that reported in the mail survey for 1989 (652 fish). The 1988 survey showed that guided boat

anglers accounted for nearly 90% of the catch and 80% of the harvest of chinook salmon. During the 1989 survey boat anglers accounted for 88% of the estimated total catch and exhibited significantly higher catch (3.3 fish per hour) and harvest (2.1 fish per hour) rates than did shore anglers (0.5 and 0.4 fish per hour, respectively). The vast majority of boat anglers that participated in the fishery were guided and therefore insufficient data were available to determine if guided boat anglers had different catch or harvest rates than unguided boat anglers. Daily estimates of CPUE from the 1988 survey were used to estimate the timing of chinook salmon into the fishery. These data indicate that CPUE peaks during mid-July, with 50% of the run having entered the river by late July. Approximately 12 guides operated on the Klutina River during 1989 and 1990, all of which conducted boat trips. The vast majority of shore anglers fished that portion of the river downstream from the Richardson Highway bridge.

The spawning escapement of chinook salmon to the Klutina River has been documented by aerial surveys of St. Anne and Manker creeks since 1966 (Table 15). Spawning escapement has averaged 102 fish during 1966-1992, ranging from a high of 433 in 1986 to a low of 21 in 1976. Since 1986, observed escapements to this drainage have declined (Table 19, Figure 18). No escapements surveys were flown on the Klutina River index areas in 1993. The 2-mile stretch of the river just below the lake is known to support chinook salmon spawning; however, due to the turbid water conditions in this area, it is not possible to assess abundance of spawning fish.

Fishery Objectives

No specific fishery objectives have been established for this stock. An underlying assumption of past and current management, however, has been to assure sustained yield. Aerial survey index evaluation does not appear to evaluate the majority of spawning fish in this system and has not been used to manage this fishery.

Inseason Management Approach

The comments written for the Gulkana River chinook salmon fishery also apply to the Klutina River.

Recent Board of Fisheries Actions

No action was taken at the November 1991 meeting which directly affected the Klutina River chinook salmon fishery.

Recent Fishery Performance

The 1991 sport harvest of 1,588 chinook salmon was the largest on record and accounted for about 35% of the estimated total sport harvest of chinook salmon in the UCUSMA. The 1992 harvest of 1,075 was only two-thirds of the 1991 harvest but still nearly twice the historical harvest. This record harvest was the result of nearly double the effort from any previous year (Table 4) in conjunction with a strong return of chinook salmon. Escapement of chinook salmon to the Klutina River drainage spawning grounds, as documented by aerial surveys of index sites during 1991 was estimated at 216 fish (Table 19).

Current Issues

The sport fishery for chinook salmon in the Klutina River has, in recent years, taken a higher proportion of returning fish (Figure 18). This has resulted from an increase in the number of guides operating in the fishery, increased angler access to salmon holding areas, and a general increase in angler proficiency. Greater exploitation rates increase the risk of over-harvest during years of low production and high angler effort. Further harvest increases may make further restrictions to the fishery necessary.

The majority of the land adjacent to the Klutina River upstream of the Richardson Highway is owned by Ahtna Native Corporation. Beginning during the 1990 season, this corporation prohibited trespass across its lands for the purpose of hunting or fishing. The reason the Corporation was not allowing access for hunting or fishing purposes is it felt customary and traditional lifestyle had been jeopardized by elimination of the rural preference in the subsistence law. The Corporation may, if asked, allow access for camping, hiking, or other nonconsumptive resource uses.

The swift, rapid nature of the Klutina River in conjunction with increasing use by power boats and limited use by rafts creates a hazard to users. Many sections of the river are not wide enough to allow boats to pass.

Recommended Research and Management

Aerial survey index evaluation does not appear to evaluate the majority of spawning fish in this system. Given the increased use of this system by guided and unguided anglers, a research program may need to be initiated to assess the spawning ground escapement. Overlapping run timing of chinook and sockeye salmon make the use of sonar impractical. A mark-recapture program may be the best way to address this issue.

A portion of the chinook salmon hooked in the Klutina River are lost in the fast water before they can be landed. It is suspected that many of these fish play out and may not survive to spawn. The hooking mortality of these fish needs to be evaluated. Evaluation of hooking mortality could be addressed during the mark-recapture study.

Other Copper Basin Chinook Salmon Fisheries

Less than 10% of the harvest of chinook salmon in the UCUSMA occurs in systems other than the Gulkana and Klutina rivers. The majority of this harvest occurs in the Tonsina River. The glacial Tonsina River flows from Tonsina Lake into the Copper River downstream of the Klutina River confluence. The Tonsina River crosses under the Richardson Highway at Mile 79 and the Edgerton Highway at Mile 19. Shore anglers participate in the fishery adjacent to the Edgerton Highway, some angling is conducted by raft between the Richardson and Edgerton Highways and some angling is conducted by fly-in anglers fishing the outlet of the Tonsina River at Tonsina Lake and Grayling Creek, a tributary which flows into Tonsina Lake. Chinook salmon run timing to the Tonsina River drainage is similar to that of the Klutina River; late June through August.

The Tonsina River chinook salmon sport fishery supports a harvest, as estimated by the mail survey, of less than 50 fish annually. Creel surveys or fishery monitoring of catch or catch rates have not been conducted on the Tonsina River due to low fishing effort and low chinook salmon catches within this drainage. Fish and Wildlife Protection and department personnel do, however, conduct enforcement monitoring of this fishery on a sporadic basis.

The spawning escapement of chinook salmon to the Tonsina River has been documented by aerial surveys of the Little Tonsina River and Grayling Creek since 1966 (Table 15). The spawning escapement to these index sites has averaged 265 fish through 1992, ranging from a high of 847 in 1984 to a low of 23 fish in 1968.

Current regulations allow sport fishing for chinook salmon in the Tonsina River from January 1 through July 19. The July 19 closure date was established in 1989 to allow chinook salmon to spawn unmolested. Current daily bag and possession limits for chinook salmon over 20 inches in this drainage river are 1 and 1, respectively.

The Little Tonsina River and Bernard Creek and all flowing waters within a 1/4 mile radius of their confluence with the Tonsina River are closed to chinook salmon fishing. A staff proposal was submitted during the 1989 Board meeting to open the Little Tonsina River, which had been closed to fishing since 1967, to a 2 day per week fishery. This proposal was for a 3 week long season and required closing all areas to fishing except when open to chinook salmon fishing. This area has a history of illegal fishing activity. The Copper Basin Advisory Committee recommended that additional emphasis be placed on enforcement of current regulations and until the illegal harvest could be curtailed, no changes should be made. They were also opposed to the restriction of the sport fishery which targets Dolly Varden. At this time, staff see no need to create a chinook salmon sport fishery given the lack of local support.

The primary biological concern regarding the Tonsina River drainage chinook salmon in recent years is the extremely low chinook salmon escapements. There has been no apparent trend of increasing angler participation or harvest within this drainage. The problem, therefore, is reduced production, over-harvest within one of several other exploiting mixed-stock fisheries, or the result of illegal fishing activities within the Tonsina River drainage.

It is thought that the Tonsina drainage chinook salmon have similar run timing to Klutina drainage chinook salmon. Based on this, a public proposal was submitted that recommended the Tonsina River drainage fishery be allowed to continue through August 10 rather than July 20 to give anglers a better opportunity to harvest fish.

There is also a limited fishery that occurs on Kiana Creek in the Tazlina River drainage. The average escapement since 1966 has been 190 chinook salmon. The last 2 years the escapement in Kiana Creek has significantly declined. In 1992 and 1993 the escapement was 79 and 65 fish, respectively. The department has concerns for the conservation of the chinook return in light of the recent decline in Kiana Creek. In response, the department may issue a preseason emergency order that restricts the fishing on Kiana Creek to weekend only during the chinook salmon season.

WILD RAINBOW TROUT/STEELHEAD TROUT FISHERIES

The UCUSMA is the northern most extent of the natural range of rainbow and steelhead trout in North America. Given this, the area's widely distributed stocks of wild rainbow and steelhead trout stocks display generally low and variable production. To assure that these stocks are not overexploited, a conservative regulation package has been developed to manage the fisheries targeting these stocks. This package has been guided by the *Upper Cook Inlet and Copper River Basin Rainbow/Steelhead Trout Management Policy*. This policy was adopted by the Board of Fisheries during 1986 and provides the Department with:

1. management policies and implementation directives for Copper River basin rainbow and steelhead trout fisheries;
2. a systematic approach to developing sport fishing regulations that includes a process for rational selection of waters for special management such as catch and release, trophy areas, or high yield fisheries; and
3. recommended research activities needed to meet these goals.

Under this policy, the entire Gulkana River drainage has been managed as a catch-and-release fishery for rainbow and steelhead trout since 1990. Managers believe that the abundance of trout in this drainage is low and that the stocks are incapable of supporting any level of long-term sustainable harvest. Additional protection was afforded this drainage's trout stocks through the establishment of an unbaited, artificial lures only area in all flowing waters of the Gulkana River drainage upstream from an unnamed creek flowing into the Gulkana River 7.5 miles upstream from the confluence of the West Fork. This action was taken in 1990.

The policy has also guided the development of regulations for the Tebay River drainage. In Summit Lake and Bridge Creek, rainbow/steelhead trout less than 32 inches in length may not be possessed or retained and the daily bag and possession limit for trout over 32 inches is one. This trophy fishery was established in 1988 to provide anglers the opportunity to harvest a "trophy trout" in the UCUSMA. Research has shown that these waters contain the largest nonanadromous rainbow trout in the Copper River drainage, with individual fish measuring over 32 inches in length and weighing up to 20 pounds. Also, the waters of Lower Hanagita Lake and the Hanagita River from Lower Hanagita Lake to the Tebay River has been managed as a catch-and-release fishery for trout since 1988. In all these waters, only unbaited, artificial lures may be used. This special regulation was adopted in 1988 to afford additional protection to these trout stocks.

All other waters supporting wild rainbow/steelhead trout stocks are managed under a 2 fish daily and 2 fish possession limit of which only 1 trout may be over 20 inches. The season is year round with the exception of Our Creek (a tributary to Moose Lake) which is closed from May 5 through June 15 to protect spawning trout.

Under this regulation package, the harvest of wild rainbow and steelhead trout has decreased (Tables 20 and 21, Figure 19). Managers currently believe that the area's stocks of rainbow and steelhead trout are healthy and adequately protected against overharvest. The commercial fishery on the Copper River

flats also harvests steelhead for home pack and is in all likelihood the largest harvester of steelhead. The proposal submitted by the department would require the commercial fishermen to report their home pack on fish tickets.

COPPER RIVER PERSONAL USE & SUBSISTENCE SALMON FISHERIES

Background and Historical Perspective

There is a long history of salmon harvest for consumption as food or use as bait in the Copper River drainage. Prior to white settlement, Ahtna natives took salmon, mostly chinook and sockeye, with funnel traps and spears in clearwater tributaries. Weirs, gillnets, and dip nets were used in the turbid mainstem Copper River and at its delta. Haley Creek was one of the many traditional fishing camps along the Copper River. With white settlement, fishwheels were introduced to the Copper River. By 1920, fishwheels and dip nets took over as the traditional means of capturing salmon for personal needs in this river. Also, the popularity of the fishery increased substantially with the introduction of this gear.

Historically, the taking of salmon for consumption as food or use as bait in the Copper River drainage was governed under subsistence regulations. In 1978, Alaska passed its first subsistence law. This legislation guaranteed the "customary and traditional use" of fish and game in Alaska and gave subsistence harvest allocative priority. Under this law, the Board of Fisheries adopted the *Copper River Subsistence Salmon Management Plan* (5 AAC 01.647). This management plan established seasons, open areas, legal gears, permit requirements, and bag limits for a subsistence salmon fishery in the Copper River. The plan also directed the department to manage the Copper River commercial salmon fishery to assure that an adequate escapement reaches the spawning areas and to provide for subsistence harvest.

In 1980, with the passage of the Alaska National Interest Lands Conservation Act (ANILCA), the federal government mandated a subsistence hunting and fishing preference for "rural" residents on federal lands. Subsequent rulings by the federal government stated that if the state failed to meet this requirement, the federal government would take over management of fish and game on all federal lands. To comply with this requirement and prevent federal takeover, the joint Boards of Fish and Game adopted a regulation in 1982 stating that only "rural" residents had "customary and traditional use" of fish and game and established eight criteria for identifying "customary and traditional uses." Under this plan, subsistence fishers were given one of four classes of permits-depending upon their locality to the fishery, income, age, and past use. At times of low escapement, Copper River basin residents received priority over nonbasin residents. Due to growth in the fishery, the Board eliminated nonbasin residents from the Copper River subsistence fishery based on an analyses of the eight point criteria in 1984.

This decision precluded many individuals from participating in the Copper River subsistence fisheries, thereby efficiently precluding them from harvesting fish for their personal use. This led the Board of Fisheries to establish a new category of fisheries, personal use fisheries (5 AAC 77.001), in 1982. These fisheries were created to provide Alaskans who became ineligible to harvest fish under new subsistence regulations the opportunity to harvest fish for consumption as food or use as bait. Personal use fisheries, like commercial and sport fisheries, were not given a "priority" in terms of allocation as were subsistence fisheries. In 1984 the Board of Fisheries created a personal use salmon fishery in the Copper River drainage

under the *Copper River Personal Use Salmon Fishery Management Plan* (5 AAC 77.590).

Personal use fisheries differ from sport fisheries in both their objective and management. Both fisheries provide Alaskans the opportunity to harvest fish for personal consumption (in either fishery, fish cannot be sold or bartered); however, personal use fisheries are managed to maximize harvest potential whereby sport fisheries are managed to provide diversity of opportunity and to maximize economic benefit to Alaska. Also, whereas anyone can participate in Alaska's sport fisheries (provided they have a license), only Alaska *residents* may participate in personal use fisheries. The personal use fishery is managed by the Division of Sport Fish whereby the subsistence fishery is managed by the Division of Commercial Fisheries.

Both the subsistence and personal use salmon fisheries in the Copper River drainage have undergone changes since their establishment. Currently, all Alaskans are eligible to participate in the subsistence fishery based on the McDowell decision in 1989. The subsistence fishery occurs upstream of the Chitina-McCarthy bridge to Slana and can be prosecuted with fishwheels and dip nets. The season is from June 1 through September 30, unless closed by emergency order. Fishing periods are established by emergency order and are 2 days per week during June and 3.5 days per week for the remainder of the season. Only Alaska residents can participate in this subsistence fishery. A special permit, which is free, is required to participate in the fishery. The permit can only be obtained at the Fish and Game office in Glennallen. Anglers must record their harvest on their permit and return the permit upon completing fishing. The limits are 30 salmon for a household of one, 60 salmon for a household of two, and 10 salmon for each additional person in a household of more than two people. For people using dip nets, only 5 of the salmon may be chinook salmon. There is also a requirement that all anglers, upon landing a salmon while subsistence fishing, must immediately remove its dorsal fin. A subsistence fishery is also allowed in a portion of Tanada Creek with spears and dip nets.

As is the case for the subsistence fishery, only Alaska residents can currently participate in the Copper River personal use salmon fishery. This fishery is opened by emergency order. Both a valid Alaska sport fishing license and a special permit are required to participate in the personal use fishery. The permit costs $10 and can only be obtained at the department trailer at Chitina. Anglers must record their harvest on their permit and return the permit upon completing fishing. The limits are 15 salmon for a single person and 30 salmon for a household of two or more, only 5 of which may be chinook salmon. Only dip nets may be used to harvest salmon. The entire mainstem Copper River between the downstream edge of the Chitina-McCarthy bridge and a department marker located about 200 yards upstream of Haley Creek (in Wood Canyon) is open to personal use fishing. The Board has mandated that Alaskans can participate in either the subsistence or personal use fishery in the Copper River drainage, but not both.

For a total return of 516,000 salmon (escapement of 410,000 past the Miles Lake sonar counter), the Board of Fisheries has mandated the following allocations (in 5 AAC 77.590):

spawning escapement (sockeye)	300,000
spawning escapement (chinook)	15,000
subsistence harvest	35,000
personal use harvest guideline	60,000
sport fishery (sockeye)	3,500
sport fishery (chinook)	2,500
hatchery brood stock	20,000
hatchery surplus	80,000

Thus, the maximum harvest for the personal use and subsistence fisheries are 60,000 and 35,000 salmon, respectively, given a total return of 516,000 salmon, not including any salmon harvested after August 31. When escapement of more than 516,000 salmon is projected to pass the sonar counter, the Board has mandated that 25% of the excess be allocated to the personal use fishery with the remainder being added to the spawning escapement, other user groups, and hatchery brood stock.

To spread effort and harvest over the return, the Board has also stipulated that the department shall manage the personal use fishery so as to apportion the harvest as follows:

Week	Percent of Total Harvest
1	10
2	20
3	25
4	20
5	15

The remaining 10% of the harvest may be taken during the rest of the season. When establishing these harvest quotas, the Board tried to reduce the harvest of wild stocks during the early portion of the run and increase harvest of hatchery-supported returns during the later part of the run.

Harvests in the subsistence fisheries have been estimated since 1965 (Table 22). From 1965 through 1979, harvests in the subsistence fisheries remained relatively stable, averaging about 28,000 salmon (Figure 20). The fishery experienced rapid growth from 1980 through 1983, when a peak harvest of 119,000 salmon was taken (Table 22, Figure 20). Under the subsistence fishery management plan, harvests decreased substantially in 1984 to about 23,000 salmon. Since 1984, subsistence harvests have gradually increased (Figure 20). Concern has been expressed regarding significant under-reporting of salmon harvest in this fishery, especially over the past decade. Trends in the number of permits issued to participate in this fishery closely resembles harvest trends (Table 22, Figure 20).

Harvests in the personal use fisheries have been estimated since their establishment in 1984 (Table 23). From 1984 through 1988, harvests remained relatively stable, averaging about 47,000 salmon annually (Figure 21). Since 1988, harvests in the personal use fishery have increased annually (Figure 21). Trends in the number of permits issued to participate in this fishery closely resemble harvest trends (Table 23, Figure 21).

Harvests in both the subsistence and personal use fisheries are dominated by sockeye salmon (Table 26). Sockeye salmon comprise an average of 96.8% and 93.4% of the subsistence and personal use salmon harvests, respectively, since 1984. Chinook salmon comprise the second largest harvest, accounting for an average of 2.5% and 4.9% of the subsistence and personal use salmon harvests, respectively, over this period. The remaining harvest is made up of coho salmon.

Fishery Objectives

Both fisheries are managed under Board of Fisheries adopted management plans. The subsistence fishery is managed under the *Copper River Subsistence Salmon Management Plan* (5 AAC 01.647). The personal use fishery is managed under the *Copper River Personal Use Salmon Management Plan* (5 AAC 77.590). Both management plans stipulate management objectives and guidelines.

Inseason Management Approach

The inseason management of the personal use fishery follows the objectives and guidelines in the *Copper River Personal Use Salmon Management Plan* (5 AAC 77.590). The Board established weekly harvest quotas and also allocated 25% of any escapement in excess of the optimum escapement goal of 516,000. The weekly fishing periods and limits are established by emergency order based on the projected inriver returns. Inriver returns are estimated by the sonar unit located at Miles Lake.

Recent Board of Fisheries Actions

No action was taken by the Board of Fisheries during their 1990 meeting with respect to either the Copper River subsistence or personal use fisheries. The Board is next scheduled to hear proposals regarding these fisheries at their 1994 meetings.

Recent Fishery Performance

The number of permits issued to participate in and salmon harvests in both the subsistence and personal use fisheries have increased in recent years. The 1993 harvest of 56,656 salmon in the subsistence fishery was the highest on record since the fishery has been managed under the subsistence fishery management plan (Table 22, Figure 20). The 1993 harvest of 99,327 salmon in the personal use fishery was the highest on record since the establishment of this fishery (Table 23, Figure 21). This increase of over 20,000 fish is essentially the same amount by which the subsistence harvest dropped indicating a possible shift by users to participate in the personal use fishery rather than the subsistence fishery. There is no indication that would suggest that the popularity of either fishery will decrease in the near future; this participation and harvest are expected to increase.

Current Issues

Salmon harvests in the personal use fishery have exceeded Board-allowed allocations during both the 1991 and 1992 seasons (Figure 22). The 1991 harvest exceeded the allowable harvest by about 9,300 salmon whereas the 1992 harvest exceeded the allowable harvest by about 7,800 salmon (Table 24).

Expressed in terms of percent variation from the allowed harvest, this corresponds to an 11% and 9% overharvest during 1991 and 1992, respectively. Given there is no indication that the popularity of the personal use fishery will decrease in the near future, it can be expected that allowable harvests will continue to be exceeded into the future unless the allocation for this fishery is increased or actions are taken to curtail harvests. Over this same period, subsistence salmon harvests have also exceeded allowable harvests (Table 25, Figure 23).

It appears the reason for the overharvest in the personal use fishery during 1991 and 1992 is caused by overharvest during the later part of the season (Table 26). During both years, harvests during the early part of the run were lower than allowed whereby harvests during the later part of the run exceeded allowable harvests (Figure 24). This was especially evident during the period after the fifth week of the fishery. Under the *Copper River Personal Use Salmon Fishery Management Plan*, 10% of the harvest may be taken during this period. During both years, however, harvests well exceeded this quota; by 500% in 1991 and by 425% in 1992. It appears that increased fishing opportunity is being given to increase harvest during the later part of the season to replace that lost during the early portion of the run, when an approach of cautious incremental openings is used. During the early portion of the run, managers are reluctant to grant additional fishing opportunity, as their confidence in escapement projections regarding run strength are still weak.

Several public proposals have been submitted to the Board to increase the 60,000 allocation to the personal use fishery. If the Board decides to not increase the allocation to this fishery, the department will be faced with decreasing the harvest potential of this fishery. One way to accomplish this would be to reduce fishing effort during the later portion of the return (after the fifth week). This could be accomplished under current management plans and regulations using emergency order authority. To assure harvest quotas established in the management plan are achieved, managers should consider giving more fishing opportunity early in the season but significantly less opportunity later in the season.

Another issue regarding this fishery relates to access. Much of the land in the area open to subsistence and personal use fishing is privately owned. In 1985 and 1986, the Chitina Native Corporation blocked the road to O'Brien Creek and charged a fee for access. In 1987, the State of Alaska negotiated a $15,000 contract with the Chitina Native Corporation for access and to build and maintain outhouses and to collect and remove garbage. The contract was renewed in 1988. The legislature refused to appropriate funds for access in 1989 after road work done in the fall of 1988 eliminated areas where the road passed on private land. In response, the Chitina Native Corporation refused fishers access to O'Brien Creek during the 1989 season. The legislature again appropriated funds for access to O'Brien Creek in 1991. Also in 1991, at the urging of the Chitina Dipnetter's Association, the legislature instituted a $10 fee for the personal use fishery. The fee was to be used to develop a long-term lease. Currently, trespass remains an issue and the department urges fishers to respect the rights of landowners in the area.

Recommended Research and Management

At present, the Division of Sport Fish conducts a program to issue permits, monitor the fishery, and estimate harvests during the Copper River personal use salmon fishery. It is recommended that an operational plan be written for the portion of this project used to estimate harvest.

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TABLES

Table 1. Emergency orders issued for UCUSMA sport fisheries during 1987 through 1993.

Year	E.O. Number	Explanation
1987	2-BB-3-xx-87	Closure of Hudson Lake to burbot fishing.
1988	2-BB-3-17-88	Closure of Hudson Lake to burbot fishing.
1988	2-RT-3-18-88	Closure of Summit Lake and Bridge Creek to all fishing by regulation from April 15 through July 10 to protect spawning rainbow trout.
1988	2-RS-3-08-88	Opening of portions of Paxson and Summit Lakes to the taking of sockeye salmon.
1989	2-BB-3-19-89	Closure of Hudson Lake and Lake Louise to burbot fishing and prohibition of set-lines in the Tyone River drainage.
1990	2-KS-3-10-90	Closure of Indian River, Ahtell Creek, and all waters within a one-quarter mile radius of their confluence with the Copper River, and Bernard Creek and all waters within a one-quarter mile radius of its confluence with the Tonsina River to fishing for chinook salmon.
1990	2-BB-3-34-90	Extends the closure of Hudson Lake and Lake Louise to burbot fishing and continues the prohibition of set-lines in the Tyone River drainage and Hudson Lake.
1991	No emergency orders issued	
1992	2-RS-3-09-92	Opened the personal use salmon fishery in the Chitina Subdistrict of the Upper Copper River Area from 12:00 noon Friday, June 5 through 6:00 p.m. Sunday, June 7 (a total of 54 hrs).
1992	2-RS-3-11-92	Established the season for the 1992 Copper River personal use salmon fishery.
1992	2-RS-3-20-92	Changed the open periods for the Copper River personal use salmon fishery to 12:00 noon Thursday and continuing through Sunday at midnight effective July 16. Thereafter, the fishery was opened 4 days a week, noon Thursdays until midnight Sundays, through August 6.
1993	2-BB-3-38-93	Opening of Hudson Lake to burbot fishing.
1993	2-RS-3-06-93	Opens Chitina Subdistrict to dip netting June 4 to June 6
1993	2-RS-3-12-93	Opens Chitina Subdistrict to dip netting June 10 to June 13
1993	2-RS-3-14-93	Opens Chitina Subdistrict to dip netting June 15 to June 20
1993	2-RS-3-15-93	Opens Chitina Subdistrict to dip netting June 20 to August 1
1993	2-RS-3-24-93	Opens Chitina Subdistrict to dip netting August 1 to August 15
1993	2-RS-3-31-93	Opens Chitina Subdistrict to dip netting August 16 to Sept. 30

Table 2. Number of angler-days of sport fishing effort expended by recreational anglers fishing UCUSMA waters, 1977-1992.

Year	UCUSMA Effort	Alaska Effort	% by UCUSMA	Region II Effort	% by UCUSMA
1977	51,485	1,198,486	4.3%	828,351	6.2%
1978	44,566	1,285,063	3.5%	913,417	4.9%
1979	57,266	1,364,739	4.2%	1,014,018	5.6%
1980	50,518	1,488,962	3.4%	1,072,384	4.7%
1981	53,499	1,420,172	3.8%	1,016,731	5.3%
1982	54,953	1,623,090	3.4%	1,131,358	4.9%
1983	51,512	1,732,528	3.0%	1,212,916	4.2%
1984	51,964	1,866,837	2.8%	1,341,658	3.9%
1985	48,707	1,943,069	2.5%	1,406,419	3.5%
1986	51,563	2,071,412	5.1%	1,518,712	3.4%
1987	52,324	2,152,886	2.4%	1,556,050	3.4%
1988	45,867	2,311,291	2.0%	1,679,939	2.7%
1989	52,262	2,264,079	2.3%	1,383,547	3.3%
1990	50,791	2,453,284	2.1%	1,745,110	2.9%
1991	64,207	1,782,055	2.6%	1,782,055	3.6%
1992	72,052	2,540,347	2.8%	1,889,930	3.8%
Average	53,346	1,843,644	2.9%	1,225,225	3.3%

Table 3. Number of angler-days of sport fishing effort expended by recreational anglers fishing upper Copper River and upper Susitna River drainage waters in the UCUSMA, 1977-1992.

Year	Upper Susitna River		Upper Copper River					
			Gulkana River		Other		Total	
	Number	Percent[a]	Number	Percent[a]	Number	Percent[a]	Number	Percent[a]
1977	14,899	28.9%	12,446	24.2%	24,140	46.9%	36,586	71.1%
1978	13,161	29.6%	15,487	34.7%	15,918	35.7%	31,405	70.4%
1979	12,199	21.3%	25,073	43.8%	19,994	34.9%	45,067	78.7%
1980	10,539	20.9%	21,477	42.5%	18,502	36.6%	39,979	79.1%
1981	14,397	26.9%	22,332	41.8%	16,770	31.3%	39,102	73.1%
1982	14,024	25.5%	23,834	43.4%	17,095	31.1%	40,929	74.5%
1983	13,573	26.5%	25,072	48.9%	12,631	24.6%	37,703	73.5%
1984	15,852	30.5%	19,753	38.0%	16,349	31.5%	36,102	69.5%
1985	12,017	24.7%	23,982	49.4%	12,570	25.9%	36,552	75.3%
1986	16,937	32.8%	18,889	36.7%	15,737	30.5%	34,626	67.2%
1987	9,542	18.2%	25,890	49.5%	16,892	32.3%	42,782	81.8%
1988	10,150	22.1%	19,078	41.6%	16,639	36.3%	35,717	77.9%
1989	9,696	18.6%	24,583	47.2%	17,817	34.2%	42,400	81.4%
1990	9,022	17.8%	26,683	52.7%	14,930	29.5%	41,613	82.2%
1991	9,706	15.1%	30,281	47.2%	24,220	37.7%	54,501	84.9%
1992	11,773	16.3%	34,791	48.3%	25,488	35.4%	60,279	83.7%
Average	12,343	23.2%	23,103	43.3%	17,856	33.5%	40,959	76.8%

[a] Percent of total effort expended in the UCUSMA during each year.

Table 4. Sport fishing effort (angler-days) in the UCUSMA averaged for the period from 1977-1986 and annually for the period 1987-1992.

Areas	1992	1991	1990	1989	1988	1987	1986-1977
Gulkana River Drainage							
Lakes	9,086	8,996	7,537	8,636	7,593	8,135	7,624
Upper River	6,768	5,854	4,079	4,082	3,624	4,000	15,735[a]
Lower River	19,271	15,431	15,067	11,865	7,861	13,755	
Total	35,125	30,281	26,683	24,583	19,078	25,890	21,051[a]
Upper Susitna/Tyone Drainage							
Lakes	10,627	8,427	8,272	9,412	9,732	9,379	
Streams	1,088	1,279	750	284	418	163	
Total	11,715	9,706	9,022	9,696	10,150	9,542	13,759[b]
Klutina River Drainage	6,398	12,145	5,556	6,053	6,192	6,394	3,358[c]
Tazlina Drainage	3,416	2,907	2,681	2,350	3,332	3,744	2,006[c]
Copper River Upstream of Gulkana	916	989	1,219	2,214	1,449	879	1,206[c]
Copper River Downstream of Klutina	3,618	2,441	1,008	2,183	931	710	1,401[c]
Stocked Lakes	7,537	4,287	2,102	2,752	2,357	3,733	2,158
Other Sites							
Lakes	1,553	486	3,554	4,070	4,153	4,462	
Streams	1,774	965	912	947	582	703	
Total	3,327	5,738	4,466	5,017	4,735	5,165	16,624[d]
AREA TOTAL	72,052	64,207	50,635	52,096	45,867	52,324	63,871[e]

[a] Includes all flowing waters, data not broken out by specific area prior to 1983.

[b] Includes all flowing waters, data not broken out by specific area prior to 1983.

[c] Average for the years 1983-1986 only because specific areas were not reported with effort for those areas included under Other Sites listing.

[d] For the years 1977-1982, other sites include effort for all areas except Gulkana and Upper Susitna drainages.

[e] Average of the total annual area harvest for the period from 1977-1986.

Table 5. Commercial harvests of chinook and sockeye salmon in the Copper River District, 1977-1993.

Year	Chinook Harvest	Sockeye Harvest
1977	22,089	619,140
1978	29,062	249,872
1979	17,678	80,528
1980	8,454	18,908
1981	20,178	477,662
1982	47,362	1,177,632
1983	50,022	633,010
1984	38,955	899,776
1985	42,333	931,132
1986	40,670	780,808
1987	41,001	1,180,782
1988	30,741	576,950
1989	30,863	1,025,923
1990	21,702	844,778
1991	34,787	1,206,811
1992	39,819	960,696
1993	29,716	1,395,371
Average	32,084	768,222

Table 6. Reported subsistence and personal use harvests of chinook, sockeye, and coho salmon in the Copper River, 1977-1993.

Year	Chinook	Sockeye	Coho	Total
1977	2,171	35,363	454	37,988
1978	2,050	19,207	633	21,890
1979	2,372	22,138	705	25,215
1980	2,256	21,437	639	24,332
1981	1,913	53,008	849	55,770
1982	2,532	96,799	1,246	100,577
1983	5,421	100,995	1,690	108,106
1984	2,007	65,078	789	67,874
1985	1,673	50,488	544	52,705
1986	2,916	64,684	785	68,385
1987	3,349	64,841	502	68,692
1988	3,395	58,294	695	62,384
1989	2,904	80,221	890	84,015
1990	3,198	93,740	1,533	98,471
1991	5,164	111,788	3,477	120,429
1992	4,705	127,670	1,817	134,192
1993	3,997	137,234	1,426	142,657
Average	3,060	70,764	1,098	74,922

Table 7. Estimated expenditures and net willingness-to-pay (net WTP), in thousands of dollars, for recreational anglers fishing the Gulkana River and Lake Louise complex during 1986 (data from Jones and Stokes 1987).

	Resident Anglers		Nonresident Anglers		All Anglers	
Fishery	Expenditures	Net WTP	Expenditures	Net WTP	Expenditures	Net WTP
	Thousands of dollars					
Gulkana River fisheries						
Grayling fishery	$ 370	$ 346	$ 81	$ 5	$ 451	$ 351
Other fisheries	$ 732	$1,488	$ 331	$ 102	$1,063	$1,590
All fisheries	$1,102	$1,834	$ 412	$ 107	$1,514	$1,941
Lake Louise winter fisheries	$ 66	$ 186	N/A	N/A	$ 66	$ 186

Table 8. Estimated economic value of UCUSMA sport fisheries during 1986 (data from Jones and Stokes 1987).

Angler Type	$/Ang-Day[a]	Southcentral Alaska		UCUS Management Area	
		Angler-Days[b]	Expenditures[c]	Angler-Days[b]	Expenditures
Resident	64.29	1,153,660	74,163,000	43,880	2,821,045
Non-resident	262.51	201,488	52,892,000	7,683	2,016,864
Both	---[d]	1,355,148	127,055,000	51,563	4,837,909

[a] Computed from Southcentral Alaska sport fisheries.

[b] Mills 1987.

[c] Jones and Stokes 1987.

[d] Not computed.

Table 9. Number of fish harvested, by species, by recreational anglers fishing UCUSMA waters, 1977-1992.

Year	Arctic Grayling	Lake Trout	Burbot	Rainbow Trout	Dolly Varden	Sockeye Salmon	White fish	Chinook Salmon	Landlocked Salmon	Coho Salmon	Steelhead Trout	Other Fish
1977	25,991	7,699	5,628	2,808	2,251	3,662	2,445	532	1,750	269	187	236
1978	26,488	5,433	7,223	4,366	904	1,606	3,634	641	2,819	126	45	27
1979	37,232	7,271	3,808	3,372	5,890	1,599	2,408	2,948	1,918	412	55	645
1980	32,106	8,067	10,159	3,255	835	2,109	2,507	2,101	1,919	164	34	973
1981	32,982	8,337	9,007	5,358	2,452	1,523	2,420	1,717	3,251	0	76	292
1982	33,586	8,699	8,006	3,060	2,148	3,343	1,824	1,802	4,726	398	73	126
1983	27,094	7,246	6,555	2,460	4,509	2,619	2,810	2,579	4,175	84	21	63
1984	19,272	6,311	10,329	8,926	5,200	3,267	3,010	2,787	992	496	137	256
1985	32,511	8,686	19,355	8,149	6,001	4,752	3,745	1,939	2,342	410	162	417
1986	24,185	6,779	10,030	8,510	5,205	4,137	3,915	3,663	89	202	58	178
1987	27,359	6,721	4,386	7,838	2,023	4,876	2,096	2,301	75	330	134	76
1988	21,937	6,277	3,747	6,695	5,185	3,038	2,474	1,562	746	291	91	0
1989	16,629	7,147	3,396	5,835	3,979	4,509	2,991	2,356	450	18	84	0
1990	13,775	5,503	1,836	3,924	3,159	3,569	1,784	2,302	170	0	34	0
1991	13,278	4,864	793	6,868	2,140	5,511	717	4,884	111	69	114	47
1992	11,125	4,251	1,495	9,373	1,997	4,560	1,150	4,412	433	113	8	11
Average	24,722	6,831	6,610	5,675	3,367	3,418	2,496	2,408	1,623	211	82	209

Table 10. Harvest of Arctic grayling by recreational anglers fishing UCUSMA averaged for the period from 1977-1986 and annually for the period 1987-1992.

Areas	1992	1991	1990	1989	1988	1987	1986-1977
Gulkana River Drainage							
Lakes	872	1,932	2,021	1,679	2,073	3,538	3,527
Upper River	2,901	2,968	1,969	2,636	3,984	3,553	8,832[a]
Lower River	188	1,558	1,970	2,570	2,310	7,138	
Total	3,961	6,458	5,960	6,885	8,367	14,229	12,359
Upper Susitna Drainage							
Lake Louise	481	875	1,613	1,526	1,855	1,086	3,496[b]
Susitna/Tyone Lake	639	330	68	169	91	1,041	
Other Lakes	218	125	289	394	364	357	287[c]
Streams	698	580	968	497	473	491	200[c]
Total	2,036	1,910	2,938	2,586	2,783	2,975	3,798[d]
Klutina River Drainage	346	1,092	544	1,041	1,673	729	1,110[c]
Tazlina Drainage	453	1,388	663	1,760	3,184	2,662	823[c]
Copper River Upstream of Gulkana							
Lakes	113	216	866	648	1,236	1,843	367[c]
Streams	391	579	272	656	820	1,264	642[c]
Total	504	795	1,138	1,304	2,056	3,107	1,009[c]

-continued-

Table 10. (Page 2 of 2).

Areas	1992	1991	1990	1989	1988	1987	1986-1977
Copper River Downstream of Klutina							
Lakes	330	0	136	365		595	97[c]
Streams	826	216	289	648	345	907	548[c]
Total	1,156	216	425	1,013	345	1,502	645[c]
Other Sites							
Stocked Lakes	1,714	760	884	356	382	89	261[c]
Other Lakes	421	68	951	823	1,346	341	
Other Streams	534	591	272	460	1,801	1,725	11,317[e]
Total	2,669	1,419	2,107	1,639	3,529	2,155	11,421
AREA TOTAL	11,125	13,278	13,775	16,228	21,937	27,359	29,117

[a] Includes lower river estimated harvest.

[b] Includes Susitna and Tyone lakes estimated harvest.

[c] Includes 1983-1986 average only. Prior to 1983, harvest included in other sites.

[d] Harvest average prior to 1983 does not include other Upper Susitna lakes and streams.

[e] Harvest estimate includes other lakes.

Table 11. Harvest of Arctic grayling by recreational anglers fishing the Gulkana River drainage, 1977-1992.

	Harvest			Release	
Year	Rivers & Streams	Lakes	Total	Number	Percent
1977	3,355	2,574	5,929		
1978	7,494	2,125	9,619		
1979	8,726	5,063	13,789		
1980	6,776	3,754	10,530		
1981	9,158	2,775	11,933		
1982	9,149	5,124	14,273		
1983	10,827	2,990	13,817		
1984	6,362	3,659	10,021		
1985	16,126	3,762	19,888		
1986	10,710	2,493	13,203		
1987	10,542	3,479	14,021		
1988	6,294	2,382	8,676		
1989	5,506	1,520	7,026		
1990	3,820	1,461	5,281	39,783	88%
1991	5,004	1,932	6,936	27,805	80%
1992	3,089	872	3,961	25,462	87%
Mean	7,684	2,867	10,560	31,017	

Table 12. Harvest of lake trout by recreational anglers fishing UCUSMA waters averaged for the period from 1977-1986 and annually for the period 1987-1992.

Areas	1992	1991	1990	1989	1988	1987	1986-1977
Gulkana River Drainage							
Paxson Lake	1,118	1,248	2,139	1,557	1,310	1,457	
Summit Lake	524	981	968	863	528	1,368	
Crosswind Lake	378	463	306	272	382	401	529
Other Lakes	93	14	68	9	420	298	1,977[a]
Upper River	47	28	17	103	364	104	112[b]
Lower River	108	42	85	75	418	268	111
Total	2,268	2,762	3,583	2,879	3,422	3,896	2,618
Upper Susitna River Drainage							
Lake Louise	1,033	1,332	1,036	1,979	1,801	1,636	3,125[c]
Susitna Lake	324	308	204	826	473	446	
Other Lakes	363	226	0	291	0	208	239
Total	1,720	1,906	1,240	3,096	2,274	2,290	3,221
Klutina River Drainage	39	84	68	150	163	134	239[d]
Tazlina Drainage	62	42	51	0	0	0	334[d]
Copper River Upstream of Gulkana	23	42	170	496	400	104	189[d]
Copper River Downstream of Klutina	0	14	170	94	0	0	24[d]
Other Sites	139	0	221	150	18	297	1,296
AREA TOTAL	4,251	4,864	5,503	6,865	6,277	6,721	7,450[e]

[a] Includes Paxson and Summit lakes.

[b] Includes lower river harvest.

[c] Includes Susitna and Tyone Lake harvest estimate.

[d] Average harvest for years 1977-1982 includes harvest from all drainages except Gulkana and Upper Susitna.

[e] Average of the total annual area harvest for the period from 1977-1986.

Table 13. Harvest of burbot by recreational anglers fishing UCUSMA waters, 1977-1992.

Year	UCUSMA Harvest	Alaska Harvest	Percent	Southcentral Alaska Harvest	Percent
1977	5,628	8,425	66.8	6,652	84.6
1978	7,223	9,988	72.3	8,099	89.2
1979	3,808	7,304	52.1	5,207	73.1
1980	10,159	14,948	68.0	11,585	87.7
1981	9,007	14,342	62.8	9,536	94.5
1982	8,006	15,445	51.8	9,662	82.9
1983	6,556	14,465	45.3	8,870	73.9
1984	10,329	19,164	53.9	13,231	78.1
1985	19,355	27,230	71.1	22,015	87.9
1986	10,030	18,849	53.2	13,238	75.9
1987	4,386	13,543	32.4	9,526	46.0
1988	3,747	9,478	39.5	5,006	66.9
1989	3,396	9,268	36.6	4,374	77.6
1990	1,836	10,577	17.4	5,094	48.2
1991	793	4,882	16.2	1,827	37.4
1992	1,495	7,245	20.6	2,992	41.3
Mean	6,610	12,822	51.6	8,557	77.2

Table 14. Harvest of burbot by recreational anglers fishing in the UCUSMA averaged for the period from 1977-1986 and annually for the period 1987-1992.

Areas	1992	1991	1990	1989	1988	1987	1986-1977
Gulkana River Drainage							
Lakes	177	343	561	505	637	550	878
River	127	27	17	19	18	45	65
Total	304	370	578	524	655	595	943
Upper Susitna Drainage							
Lake Louise	0	0	255	976	655	507	5,040[a]
Susitna/Tyone Lakes	533	45	323	656	273	684	
Other Lakes	160	54	0	94	200	342	12
Total	693	99	578	1,726	1,128	1,532	5,052[b]
Klutina River Drainage	0	0	0	0	36	0	13[b]
Tazlina Drainage							
Moose/Tazlina	347	108	408	94	73	684	2,223
Hudson	0	0			327	446	746
Other	0	81		403	546	862	198
Total	347	189	408	497	946	1,992	3,167
Copper River							
Upstream of Gulkana	33	0	238	459	746	0	156[b]
Copper River							
Downstream of Klutina	8	0	0	113	0	0	12[b]
Other Sites	110	135	34	72	236	267	1,675[c]
AREA TOTAL	1,495	795	1,836	3,391	3,747	4,386	9,010[d]

[a] Includes Susitna and Tyone Lake catch estimates.
[b] Includes 1983-1986 average harvest estimate only. Prior to 1983 harvest included in other sites.
[c] Specific area not reported during 1977-1988 in other drainages included in this average estimate.
[d] Average of the total annual area harvest for the period from 1977-1986.

Table 15. Upper Copper River chinook salmon aerial escapement index counts, 1966-1993.

		Copper R. Upstream of Gulkana[a]		Tazlina Drainage[a]		Klutina Drainage[a]		Tonsina Drainage[a]		
Year	Gulkana R.	E. Fork Chistochina R.	Indian R.	Mendeltna Ck.	Kiana Ck.	St. Anne Ck.	Manker Ck.	Little Tonsina R.	Grayling Ck.	Total
1966	250	152	20[b]	12	272	48	64	42	22	982
1967	757[b]	291[b]	20[b]	6	123[b]	53	2	129[b]	48[b]	1,429
1968	757[b]	150	20[b]	100	100	26[b]	9	19	4	1,185
1969	147	200	20[b]	38[b]	34	26[b]	19[b]	129[b]	7	620
1970	364	368	20[b]	38[b]	162	35	17	129[b]	48[b]	1,181
1971	269	512	20[b]	56	81	4	30	200	45	1,217
1972	1,200	348	13	49	89	25	4	129[b]	47	1,904
1973	623	476	20[b]	15	172	26[b]	17	100	47	1,496
1974	1,317	137	4	15	55	32	29	65	49	1,654
1975	741	71	6	38[b]	123[b]	26[b]	19[b]	161	48[b]	1,233
1976	777	289	61	35	37	15	6	98	17	1,335
1977	1,090	132	20	73	91	10	15	35	48[b]	1,514
1978	921	137	9	52	125	24	20	285	92	1,665
1979	1,380	810	29	5	279	16	16	285	153	2,973
1980	718	575	24	3	247	8	35	70	66	1,746
1981	754[b]	120	20[b]	51	191	19	23	191	107	1,486
1982	1,656	1,260	179	70	200	35	49	440	127	4,016
1983	931	575	41	12	166	87	141	330	287	2,570
1984	2,189	577	17	26	382	89	264	568	279	4,391
1985	321	360	14	26	91	15	22	203	58	1,110
1986	3,182	618	29[b]	76	328	182	251	424	224	5,314
1987	1,228	764	33	10	80	192	141	247	112	2,807
1988	967	684	0	17	249	62	115	75	161	2,330
1989	1,993	740	3	185	344	90	165	65	72	3,657
1990	1,356	615	15	320	411	42	41	57	49	2,906
1991	1,303	865	18	305	520	115	101	54	151	3,432
1992	656	88	1	83	79	12	14	107	17	1,057
1993	1,156	--[c]	--[c]	126	65	--[c]	--[c]	--[c]	--[c]	--[c]
Mean	1,036	455[d]	26[d]	66	186	50[d]	62[d]	174[d]	91[d]	2,115[d]

[a] Some data published in Brady et al. 1991, remainder is unpublished.
[b] Estimated.
[c] No aerial surveys conducted in 1993.
[d] Average of 1966 through 1992 data.

Table 16. Copper River chinook salmon harvest and escapement index estimates, 1966-1993.

Year	Commercial Harvest[a]	Sport Harvest[b]	Subsistence/ Personal Use Harvest[c]	Total Harvest	Aerial Escapement Index
1966	11,422	500	727	12,649	882
1967	9,853	500	568	10,921	1,429
1968	9,743	500	923	11,166	1,185
1969	14,050	500	869	15,419	620
1970	19,375	600	551	20,526	1,181
1971	16,486	600	1,750	18,836	1,217
1972	22,349	750	1,797	24,896	1,904
1973	19,948	850	2,015	22,813	1,496
1974	18,980	900	1,297	21,177	1,654
1975	19,644	750	1,978	22,372	1,233
1976	31,483	400	2,335	34,218	1,335
1977	22,089	532	2,555	25,176	1,514
1978	29,062	641	2,239	31,942	1,665
1979	17,308	2,948	3,416	23,672	2,973
1980	8,449	2,101	3,035	13,585	1,746
1981	20,178	1,717	2,410	24,305	1,486
1982	47,362	1,802	2,764	51,928	4,016
1983	50,022	2,569	5,950	58,551	2,570
1984	38,955	2,787	2,269	44,011	4,391
1985	42,333	1,939	1,958	46,230	1,110
1986	40,670	3,663	3,052	47,385	5,314
1987	41,001	2,301	3,781	47,083	2,807
1988	31,741	1,562	3,982	37,285	2,330
1989	30,873	2,356	3,040	36,269	3,657
1990	21,702	2,302	3,325	27,329	2,906
1991	34,787	4,884	5,357	45,028	3,432
1992	39,819	4,412	5,013	49,224	1,057
1993	29,716	4,700[d]	4,362	38,778	NA
Mean	26,407	1,788	2,619	30,813	2,115

[a] Some data published in Donaldson et al. 1993, the rest is unpublished.

[b] Prior to 1977 harvests were estimated.

[c] These figures are expanded to reflect unreported permits. See Table 6 for actual reported harvests.

[d] Estimated.

Table 17. Harvest of chinook salmon by recreational anglers fishing in the UCUSMA averaged for the period from 1977-1986 and annually for the period 1987-1992.

Areas	1992	1991	1990	1989	1988	1987	1986-1977
Gulkana River Drainage							
Upper River	416	470	239	362	313	194	395[a]
Lower River	2,655	2,197	1,353	1,189	720	1,437	1,658[a]
Total	3,071	2,667	1,592	1,551	1,033	1,631	1,644
Klutina River Drainage	1,075	1,588	554	606	483	495	454[b]
Tazlina Drainage	8	32	17	34	9	49	31[b]
Copper River Upstream of Gulkana	18	0	17	0	9	0	46[b]
Copper River Downstream of Klutina	215	96	17	22	28	19	45[b]
Other Waters	0	51	35	6	0	107	197[c]
AREA TOTAL	4,387	4,434	2,232	2,219	1,562	2,301	2,071[d]

[a] Includes 1983-1986 average harvest only. Harvest prior to 1983 included in drainage total.

[b] Includes 1983-1986 average only. Prior to 1983 harvest included in other waters.

[c] Harvest for years 1977-1982 includes all drainages except Gulkana.

[d] Average of total annual harvest 1977-1986.

Table 18. Sport harvest and observed spawning escapements of chinook salmon in the Gulkana River drainage from 1977-1993.

Year	Sport Harvest	Observed Spawning Escapement
1977	421	1,090
1978	606	921
1979	2,440	1,380
1980	1,688	718
1981	1,469	754
1982	1,603	1,656
1983	2,224	931
1984	1,898	2,189
1985	1,256	321
1986	2,833	3,182
1987	1,631	1,228
1988	1,033	967
1989	1,551	1,993
1990	1,592	1,356
1991	2,667	1,303
1992	3,071	656
1993	NA[a]	1,156
Mean	1,746	1,282

[a] NA - Data are not available at time of publication.

Table 19. Sport harvest and observed spawning escapements of chinook salmon in the Klutina River drainage from 1983-1993.

Year	Sport Harvest	Observed Spawning Escapement
1983	189	228
1984	667	353
1985	249	37
1986	710	433
1987	495	333
1988	483	177
1989	606	255
1990	554	83
1991	1,588	216
1992	1,075	26
1993	NA[a]	[b]
Mean	665	214

[a] Data not available at time of publication.

[b] No aerial survey conducted in 1993.

Table 20. Harvest of wild rainbow trout by sport anglers fishing UCUSMA waters averaged for the period from 1977-1986 and annually for the period 1987-1992.

Areas	1992	1991	1990	1989	1988	1987	1986-1977
Gulkana River Drainage[a]							
Lakes	0	0	0	0	437	446	326
Upper River	0	0	221	375	600	283	
Lower River	0	0	204	281	272	1,011	1,085[b]
Total	0	0	425	656	1,309	1,740	1,411
Klutina River Drainage	63	96	17	56	18	208	143[c]
Tazlina Drainage	8	41	255	9	292	119	48[c]
Copper River Downstream of Klutina	278	68	17	761	236	1,145	131[c]
Other Sites	24	341	747	385	273	506	1,297[d]
AREA TOTAL	373	646	1,461	1,867	2,128	3,718	2,537[e]

[a] 1991 was the first year closed to harvest of rainbow trout.

[b] Includes average of upper and lower river.

[c] Includes 1983-1986 average harvest only. Prior to 1983 harvest included in other sites.

[d] Average harvest for years 1977-1982 includes harvest from all drainages except Gulkana and those from stocked lakes.

[e] Average of total annual harvest.

Table 21. Harvest of steelhead trout by sport anglers fishing UCUSMA waters averaged for the period from 1977-1986 and annually for the period 1987-1992.

Areas	1992	1991	1990	1989	1988	1987	1986-1977
Gulkana River Drainage	0[a]	0[a]	34	56	10	104	18
Tazlina Drainage	0	0	0	0	73	0	0[b]
Copper River Upstream of Gulkana	0	0	0	0	0	15	0[b]
Copper River Downstream of Klutina	0	0	0	0	0	15	0[b]
Other Sites	0	114	0	28	0	0	67[c]
AREA TOTAL	0	114	34	84	91	134	85[d]

[a] 1991 was the first year closed to the harvest of steelhead trout.

[b] Includes 1983-1986 average harvest only. Prior to 1983 harvest included in other sites.

[c] Harvest estimates for years 1977-1982 include harvest estimates from all drainages except Gulkana.

[d] Average of total annual harvest, 1977-1986.

Table 22. Number of permits issued and salmon harvests during the subsistence salmon fishery in the Copper River, 1965-1993.

Year	Number Permits Issued	Estimated Salmon Harvest
1965	1,125	16,818
1966	1,270	21,896
1967	1,320	19,007
1968	1,378	20,383
1969	1,582	29,266
1970	3,487	42,757
1971	4,542	48,449
1972	3,690	32,468
1973	4,145	29,248
1974	3,593	26,001
1975	2,802	15,357
1976	2,963	23,623
1977	4,066	41,815
1978	3,705	22,029
1979	3,200	30,963
1980	3,203	35,081
1981	4,078	68,746
1982	6,090	110,006
1983	7,541	118,728
1984	562	23,093
1985	---[a]	---[a]
1986	405	28,423
1987	431	34,142
1988	409	30,514
1989	386	29,317
1990	406	32,290
1991	711	40,693
1992	655	49,611
1993	773	56,656

[a] Data not available.

Table 23. Number of permits issued and salmon harvested during the personal use salmon fishery in the Copper River, 1984-1993.

Year	Number Permits Issued	Estimated Salmon Harvest
1984	5,328	49,940
1985	---[a]	---[a]
1986	4,031	44,047
1987	4,259	46,908
1988	4,251	45,921
1989	4,584	58,914
1990	5,689	70,478
1991	6,222	85,136
1992	6,387	89,279
1993	7,914	99,327

[a] Data not available.

Table 24. Allowable versus observed salmon harvests during the personal use salmon fishery in the Copper River, 1984-1993.

Year	Sonar Goal	Estimated Sonar	Difference	Allowable Harvest[a]	Estimated Harvest	Difference
1984	411,000	536,806	125,806	91,452	49,940[b]	(41,512)[b]
1985	411,000	436,313	25,313	66,328	---[b]	---[b]
1986	411,000	508,600	97,600	84,400	44,047	(40,353)
1987	411,000	475,734	64,734	76,184	46,908	(29,276)
1988	411,000	488,398	77,398	79,350	45,921	(33,429)
1989	411,000	607,869	196,869	109,217	58,914	(50,303)
1990	411,000	581,859	170,859	102,715	70,478	(32,237)
1991	516,000	579,435	63,435	75,400	85,136	9,277
1992	516,000	601,952	85,952	81,500	89,279	7,779
1993	516,000	833,387	317,387	139,350	99,327	(40,023)

[a] If sonar difference less than 0, then guideline harvest equals 60,000. If sonar difference greater than 0, then guideline harvest equals 60,000 + (0.25 * sonar difference).

[b] Data not available.

Table 25. Guideline versus observed salmon harvests during the subsistence salmon fishery in the Copper River, 1984-1993.

Year	Sonar Goal	Estimated Sonar	Difference	Guideline Harvest[a]	Estimated Harvest	Difference
1984	411,000	536,806	125,806	20,000	23,093	3,093
1985	411,000	436,313	25,313	20,000	---[b]	---[b]
1986	411,000	508,600	97,600	20,000	28,423	8,423
1987	411,000	475,734	64,734	20,000	34,142	14,142
1988	411,000	488,398	77,398	20,000	30,514	10,514
1989	411,000	607,869	196,869	20,000	29,317	9,317
1990	411,000	581,859	170,859	20,000	32,290	12,290
1991	516,000	579,435	63,435	35,000	41,417	6,417
1992	516,000	601,952	85,952	35,000	42,910	7,910
1993	516,000	833,387	317,383	35,000	56,655	21,655

[a] If sonar difference less than 0, then guideline harvest equals 35,000. If sonar difference greater than 0, then guideline harvest equals 35,000 + (0.11 * sonar difference).

[b] Data not available.

Table 26. Allowable versus observed salmon harvests, by week, during the personal use salmon fishery in the Copper River, 1991-1993.

	1991 Data		
Week	Allowed Harvest	Observed Harvest	Difference
1	6,000	1,920	(5,620)
2	12,000	9,935	(5,145)
3	15,000	13,859	(4,991)
4	12,000	5,938	(9,142)
5	9,000	6,605	(4,705)
Rest	21,400[a]	37,143	15,743

	1992 Data		
Week	Allowed Harvest	Observed Harvest	Difference
1	6,000	3,733	(4,417)
2	12,000	5,007	(11,293)
3	15,000	10,540	(9,835)
4	12,000	17,721	1,421
5	9,000[a]	10,099	(2,126)
Rest	27,500	34,400	6,900

	1993 Data		
Week	Allowed Harvest	Observed Harvest	Difference
1	6,000	7,722	1,722
2	12,000	13,629	1,629
3	15,000	15,111	111
4	12,000	14,236	2,236
5	9,000	10,766	1,766
Rest	85,350[a]	37,863	47,487

[a] Ten percent of the 60,000 salmon harvest quota, plus 25% of escapement past sonar counter that exceeds 516,000 salmon.

FIGURES

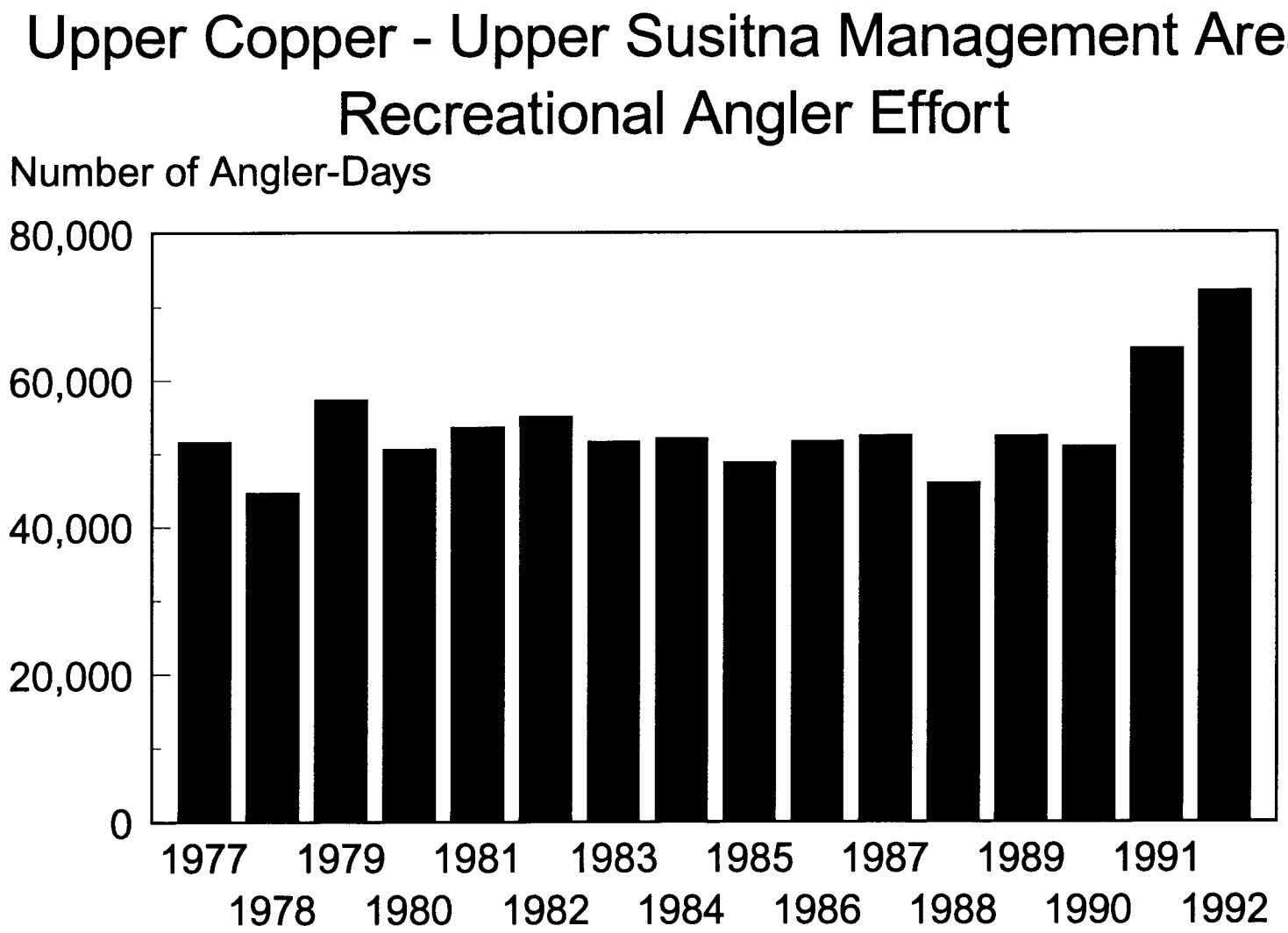


Figure 1. Number of angler-days expended by recreational anglers fishing UCUSMA waters, 1977-1992.

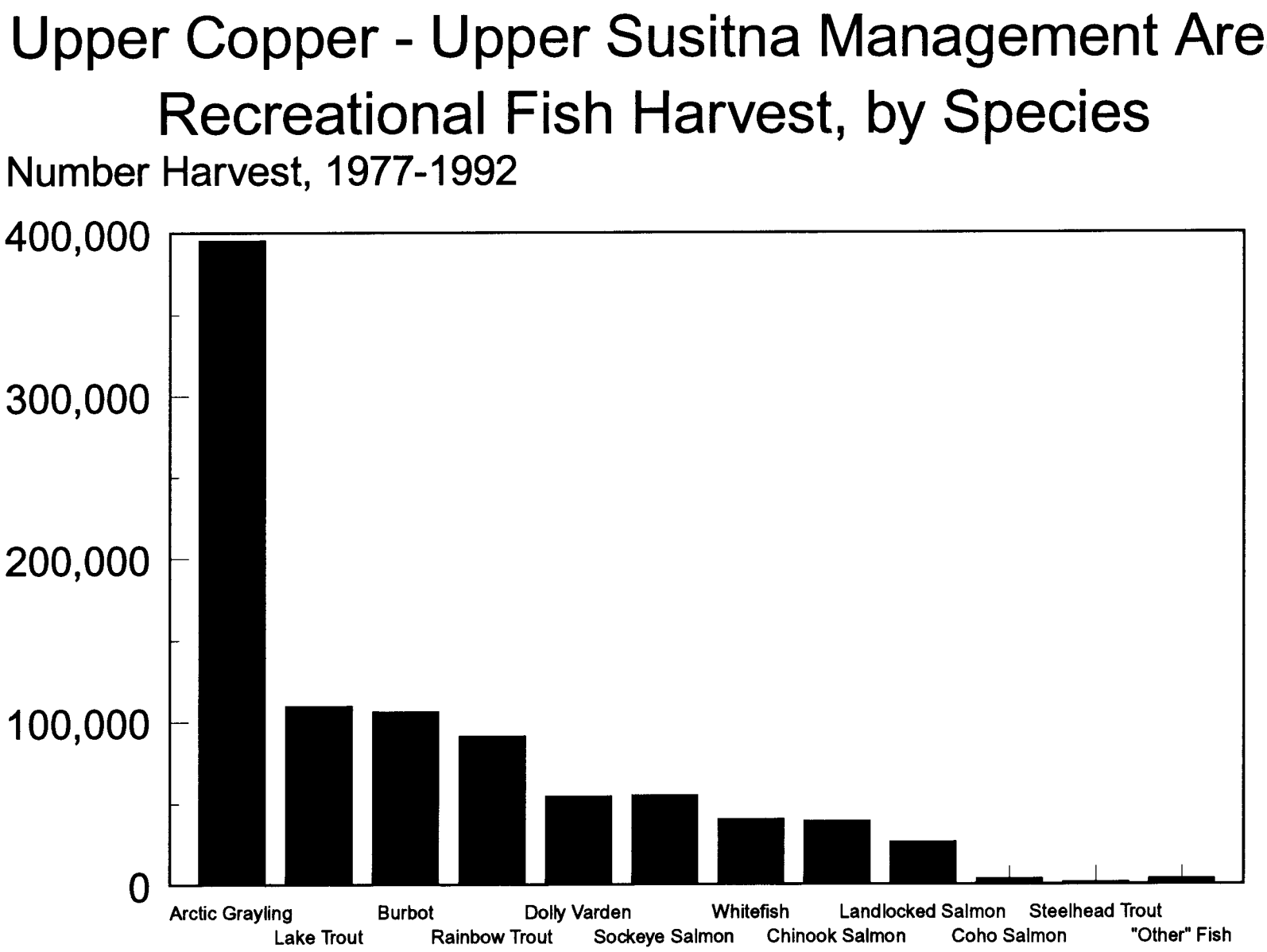


Figure 2. Number of fish harvested, by species, by recreational anglers fishing UCUSMA waters, 1977-1992.

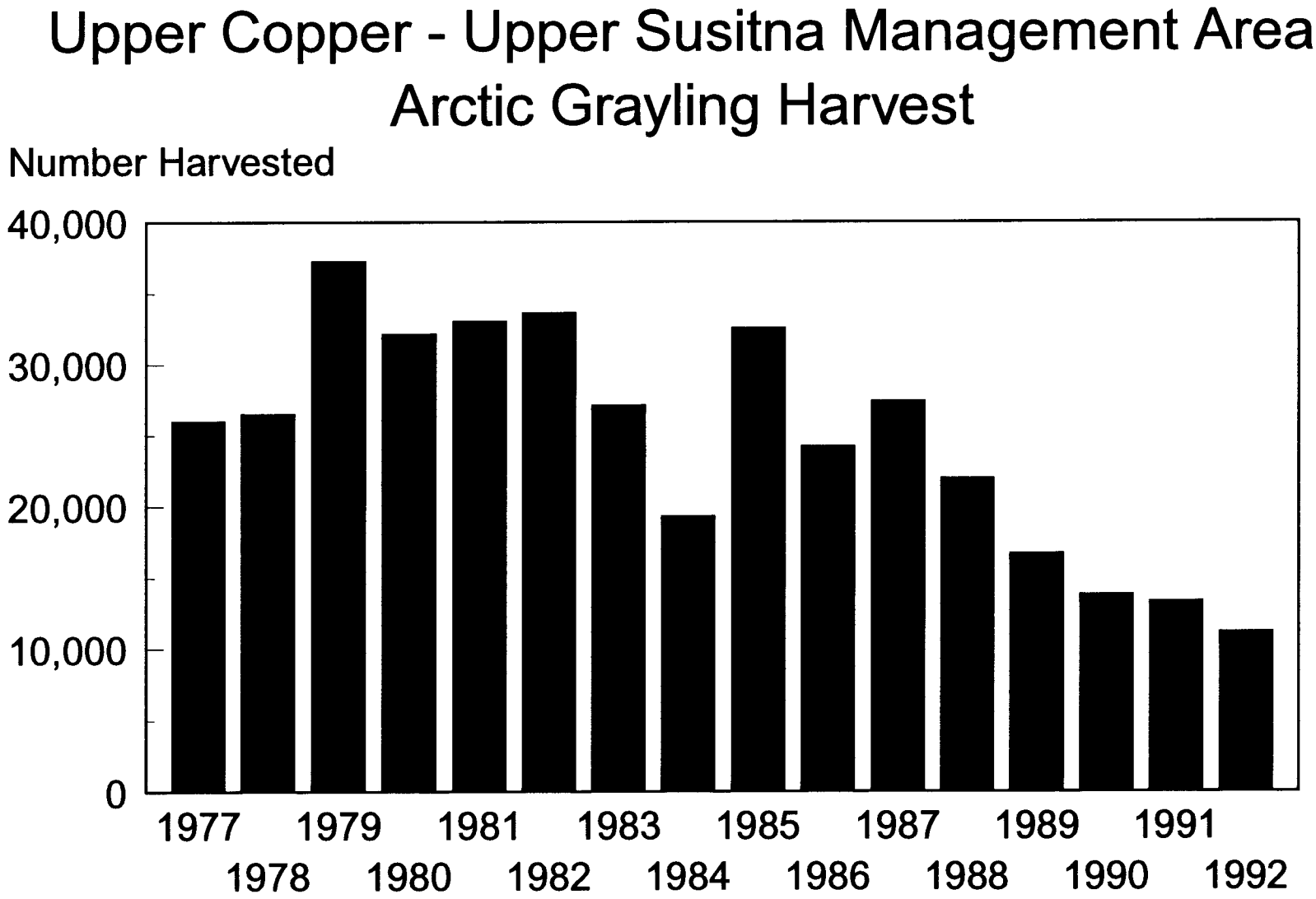


Figure 3. Harvest of Arctic grayling by recreational anglers fishing UCUSMA waters, 1977-1992.

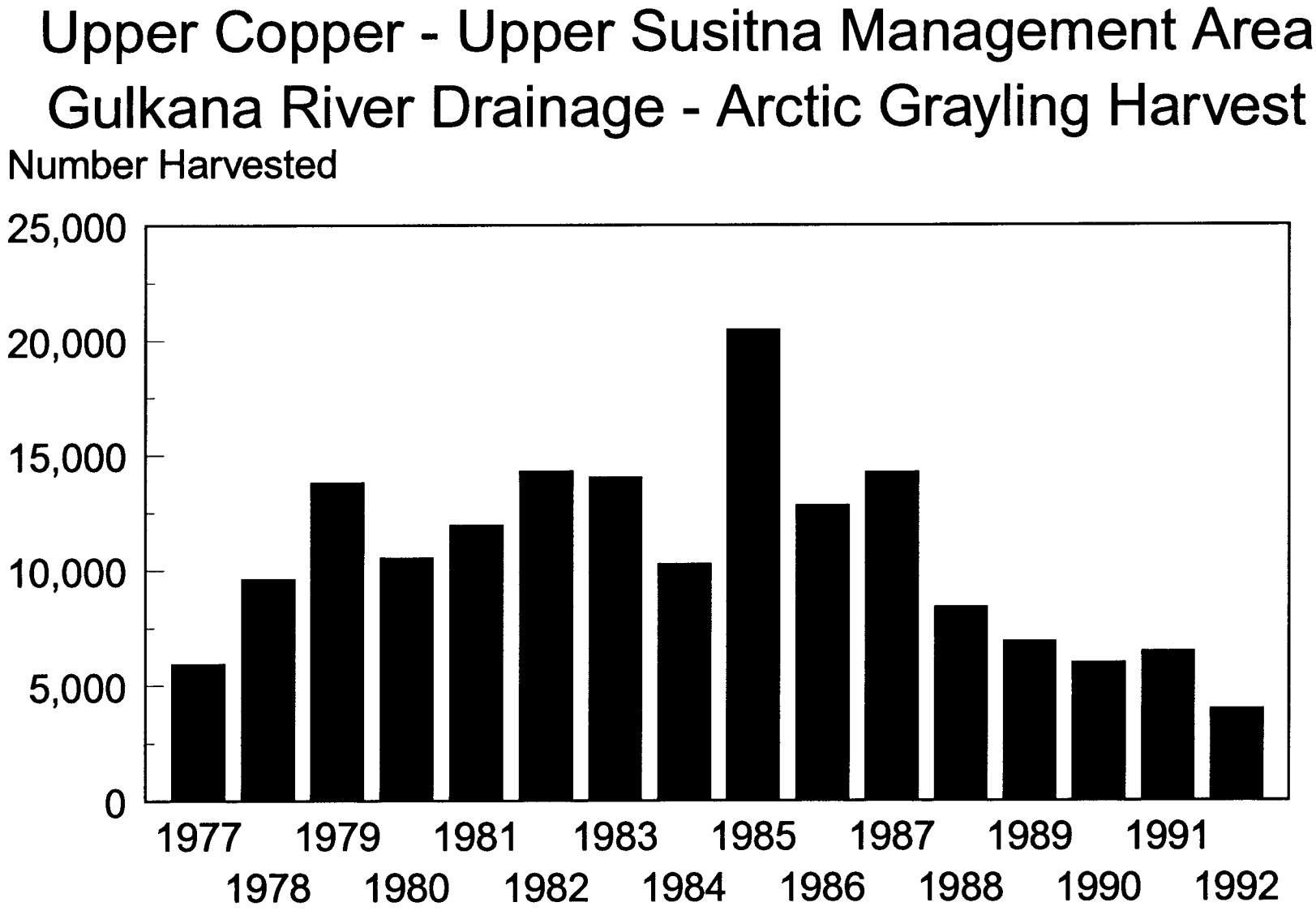


Figure 4. Harvest of Arctic grayling by recreational anglers fishing in the Gulkana River drainage, 1977-1992.

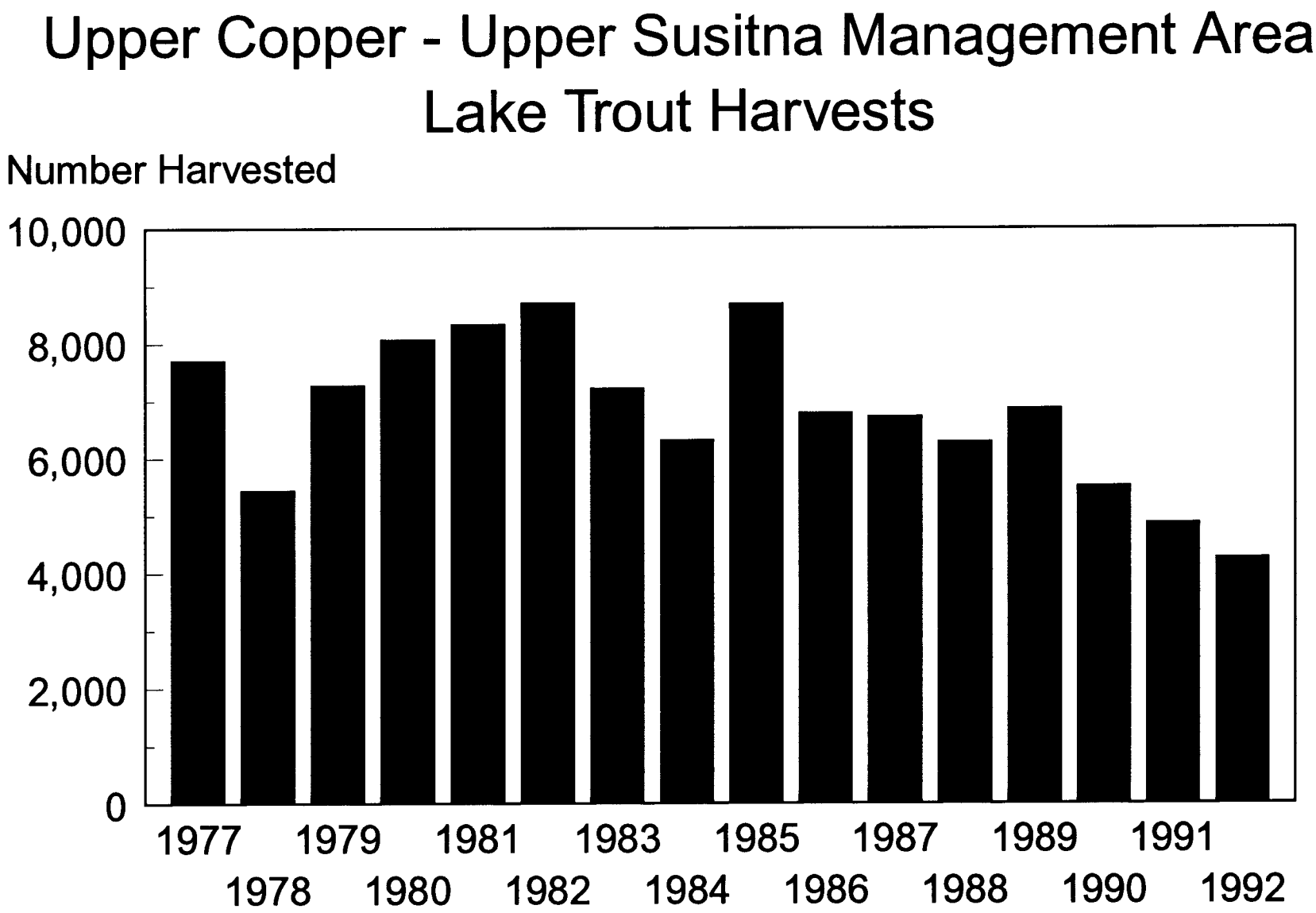


Figure 5. Harvest of lake trout by recreational anglers fishing UCUSMA waters, 1977-1992.

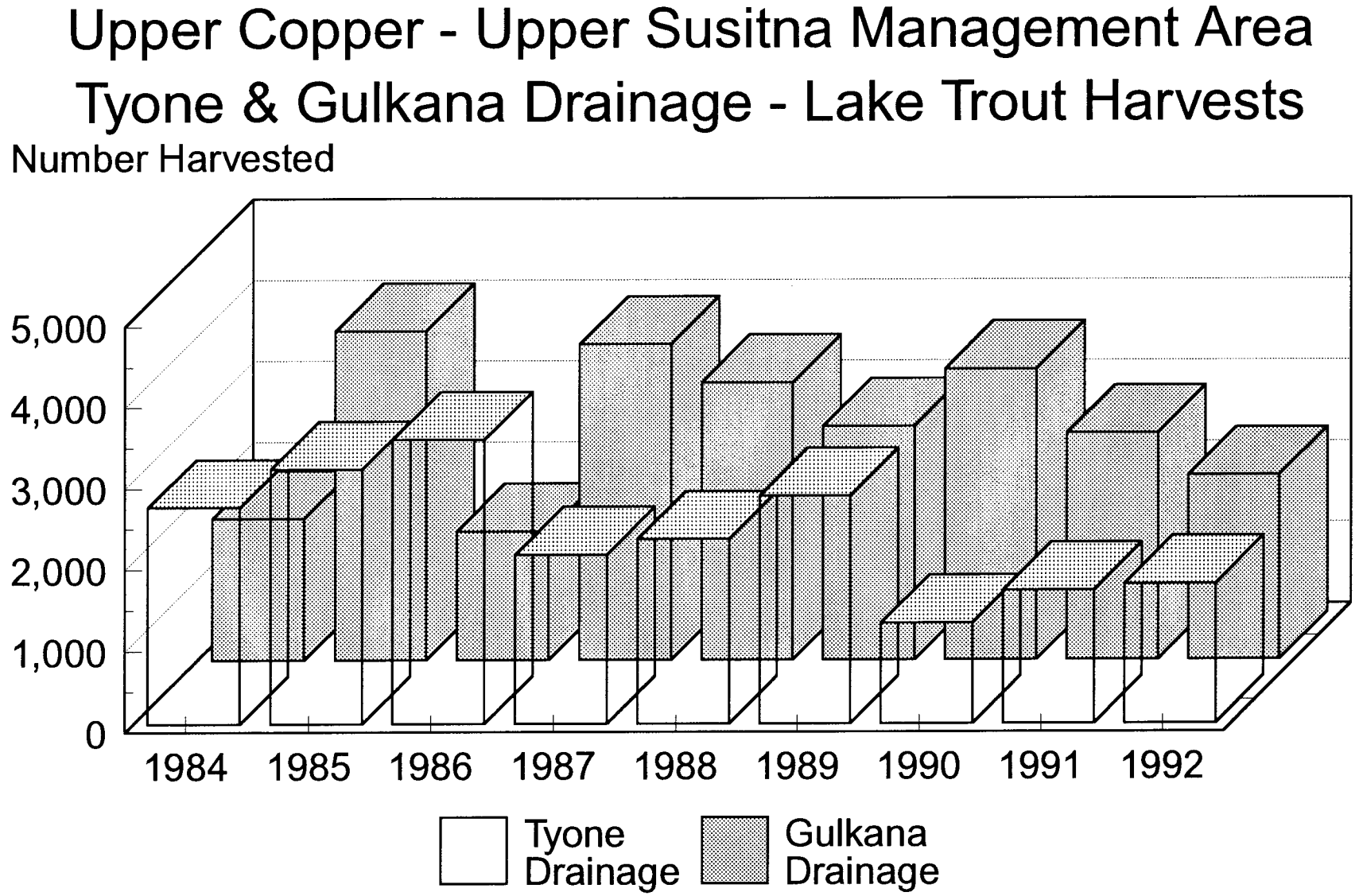


Figure 6. Harvest of lake trout by recreational anglers fishing the Tyone and Gulkana River drainages, 1984-1992.

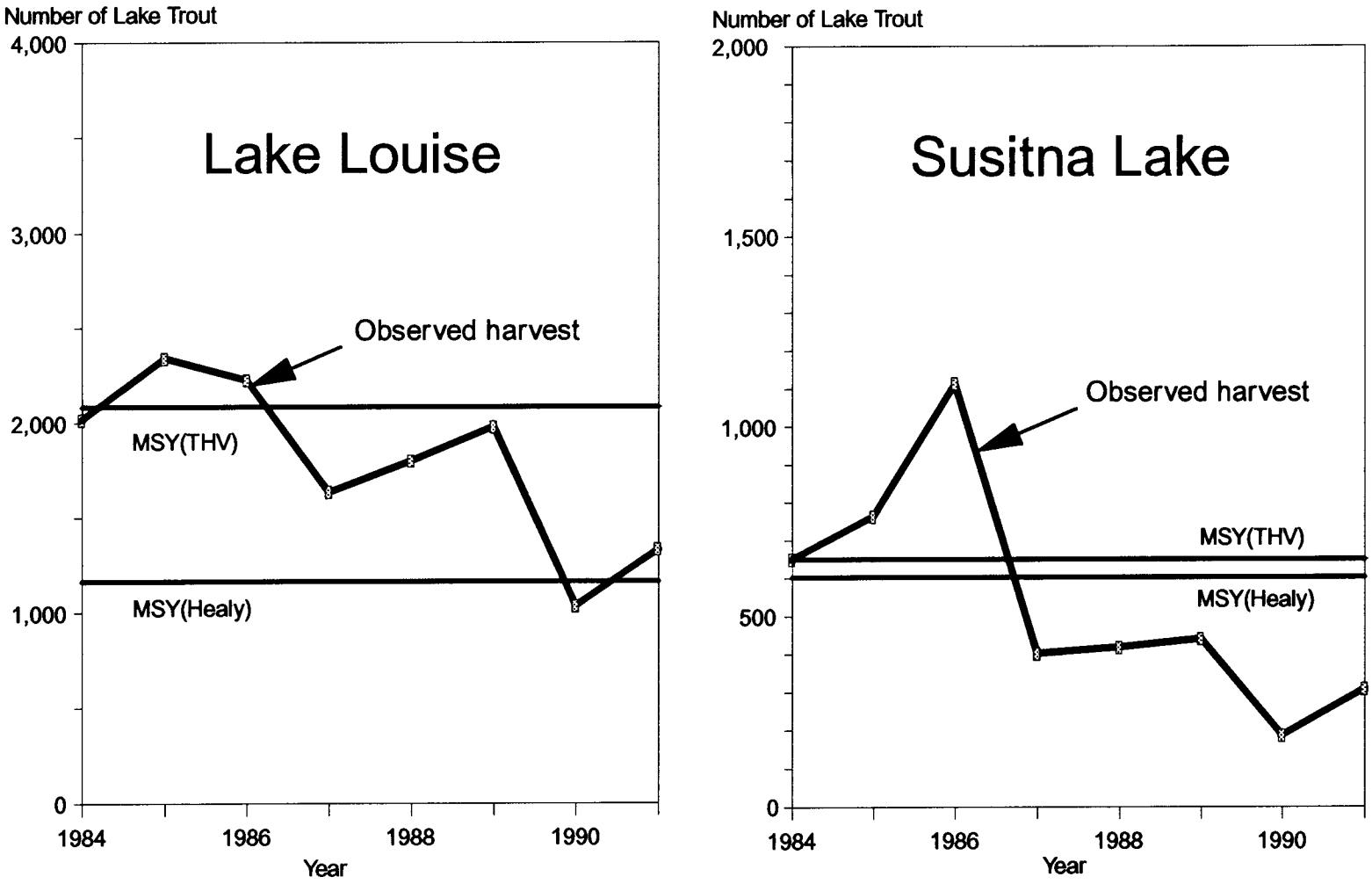
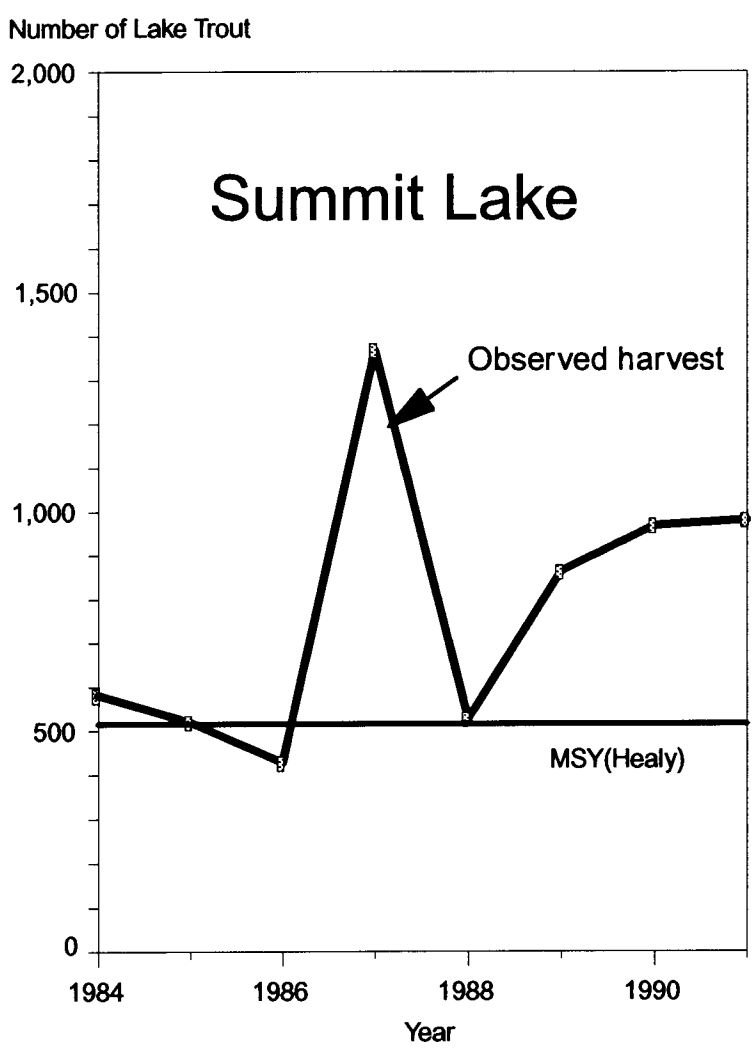


Figure 7. Observed versus maximum sustainable harvests of lake trout in Lake Louise and Susitna Lake.



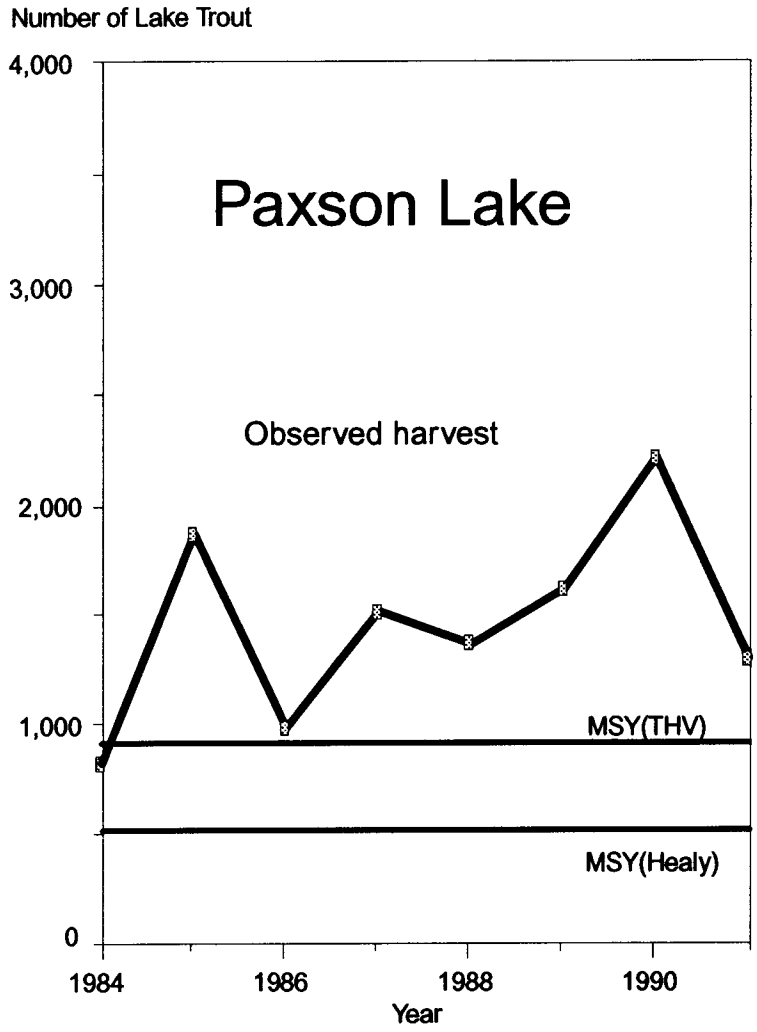


Figure 8. Observed versus maximum sustainable harvests of lake trout in Summit and Paxson lakes.

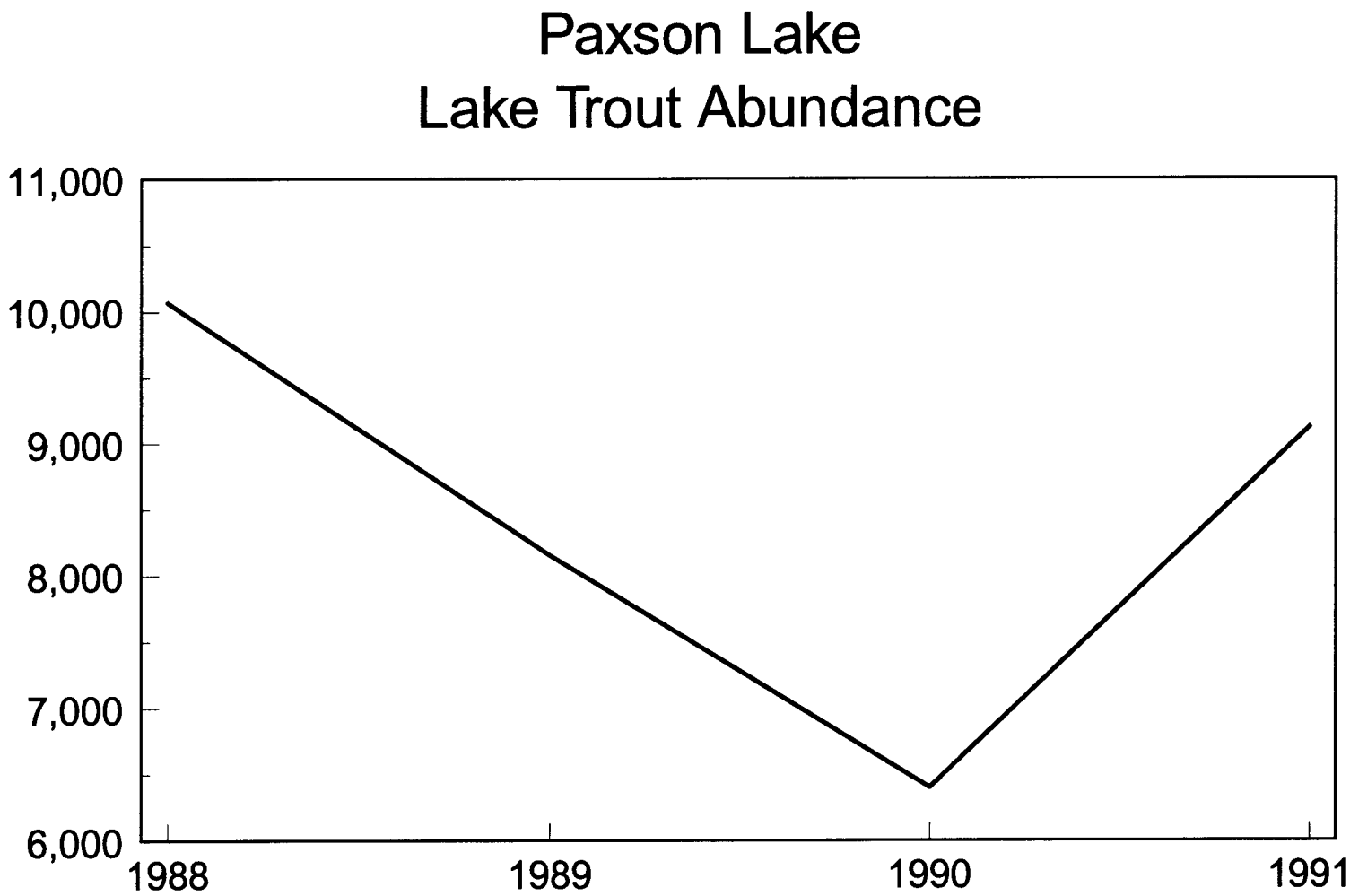


Figure 9. Abundance of mature lake trout in Paxson Lake, 1988-1991.

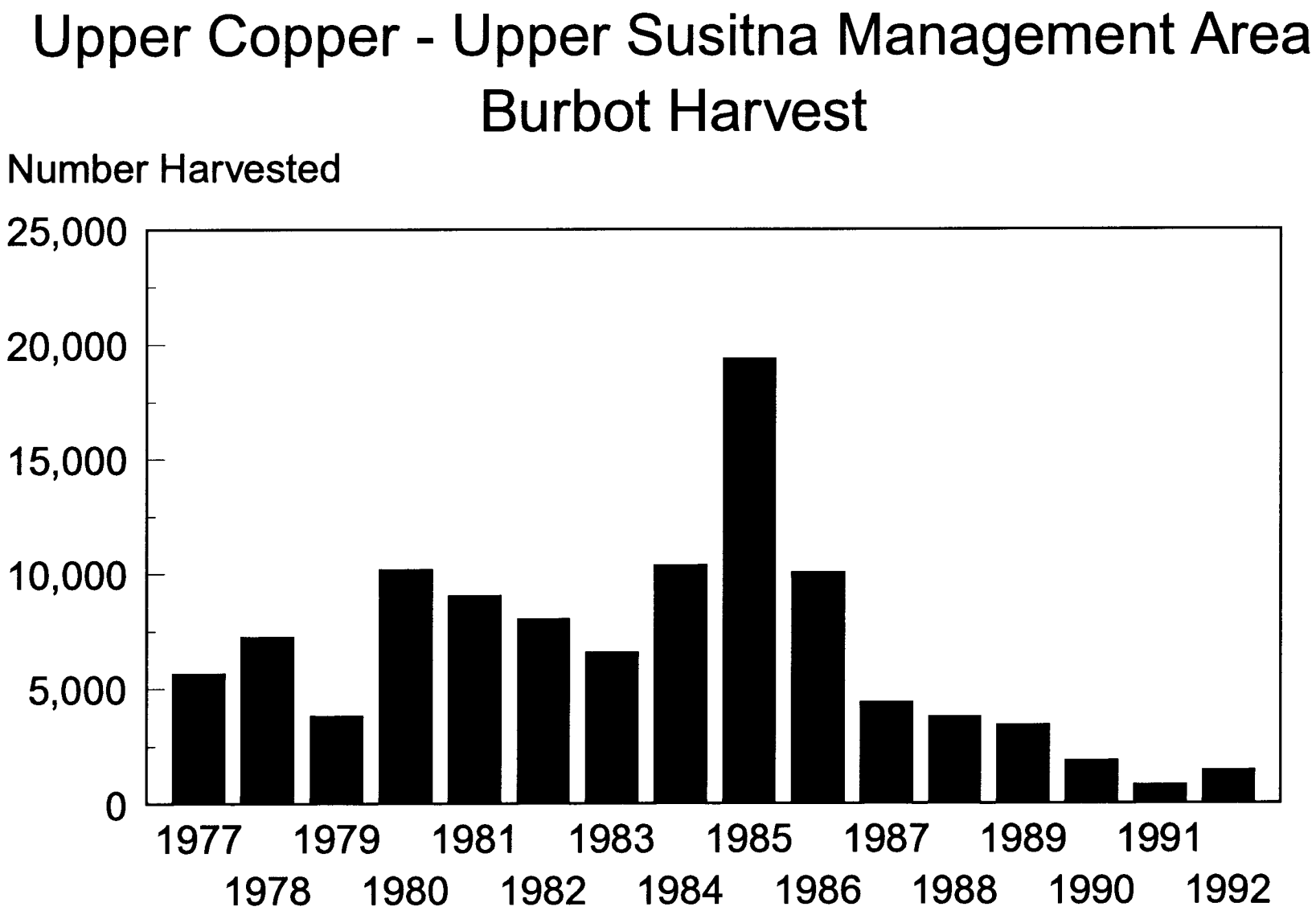


Figure 10. Harvest of burbot by recreational anglers fishing UCUSMA waters, 1977-1992.

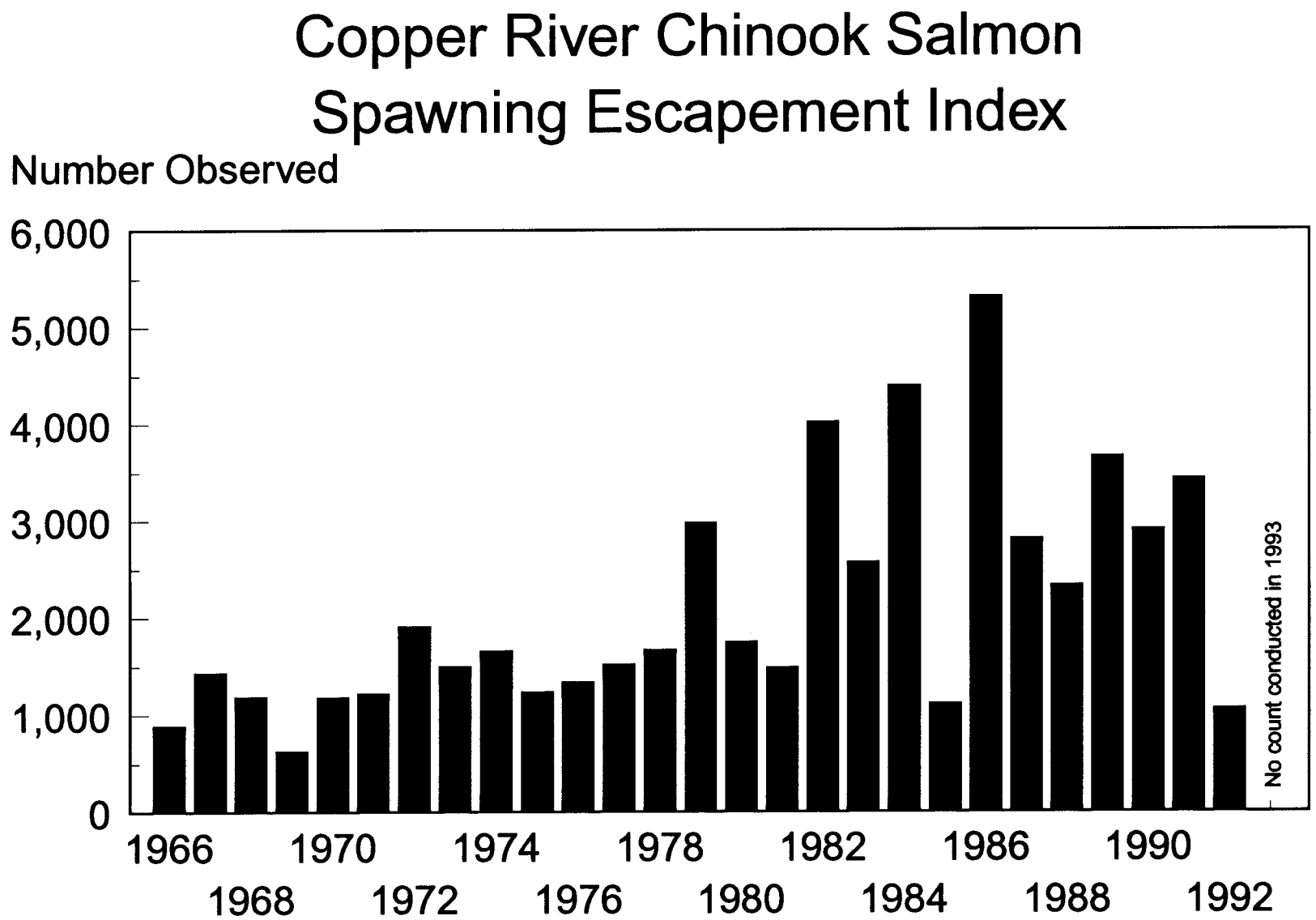


Figure 11. Observed spawning escapement index counts for chinook salmon in the Copper River drainage, 1966-1992.

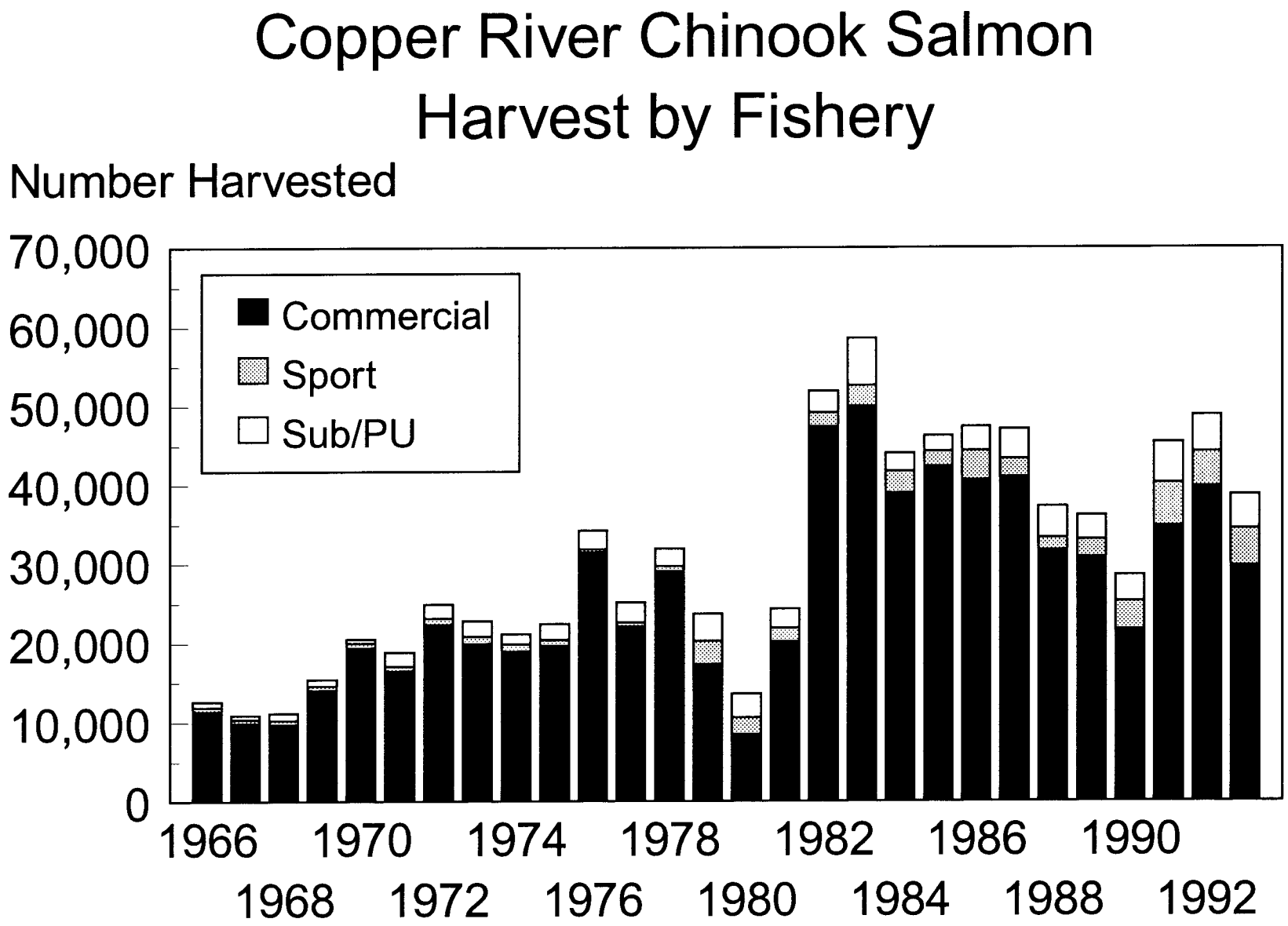


Figure 12. Harvest of Copper River chinook salmon, by fishery, 1966-1993.

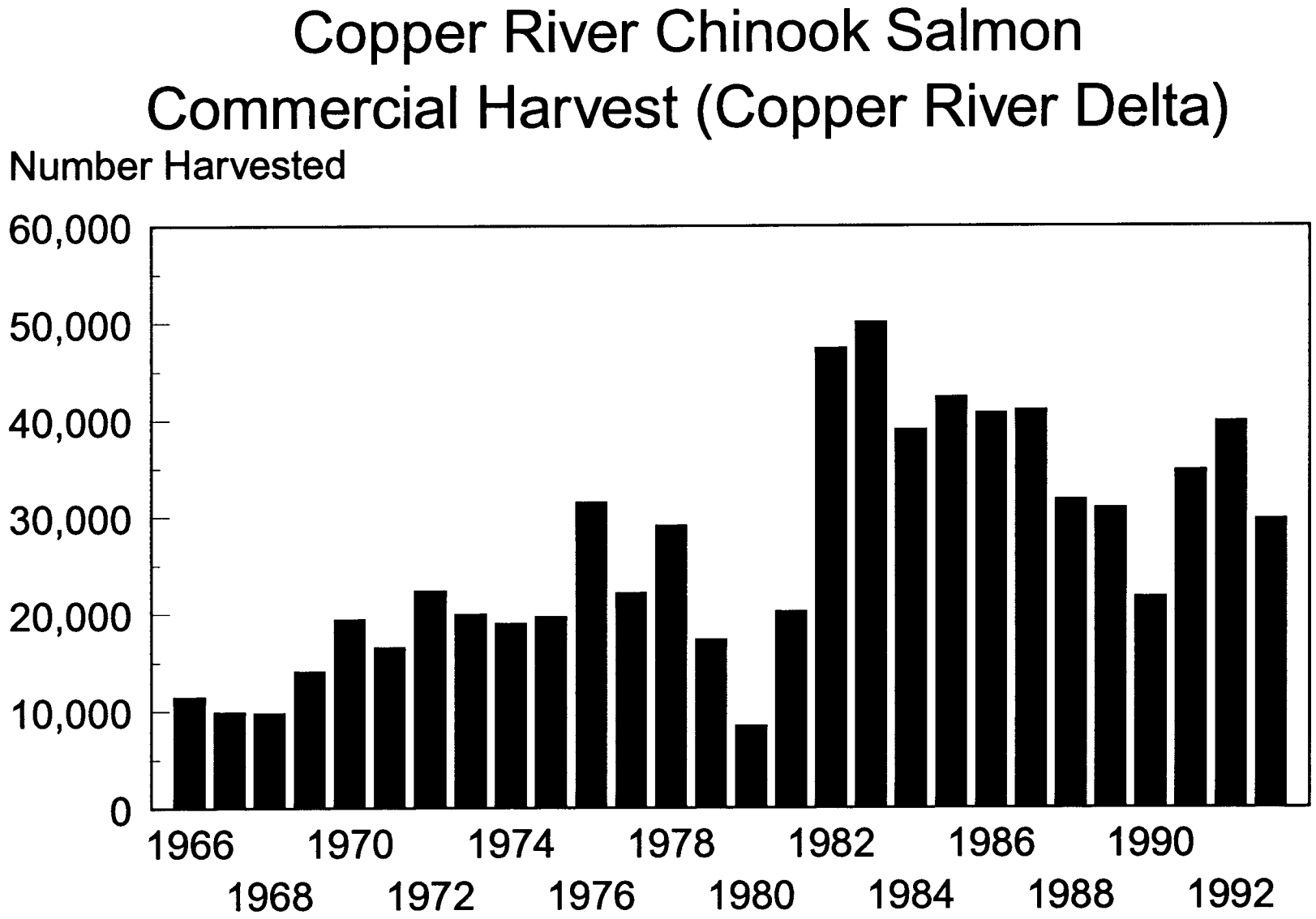


Figure 13. Commercial harvest of Copper River chinook salmon, 1966-1993.

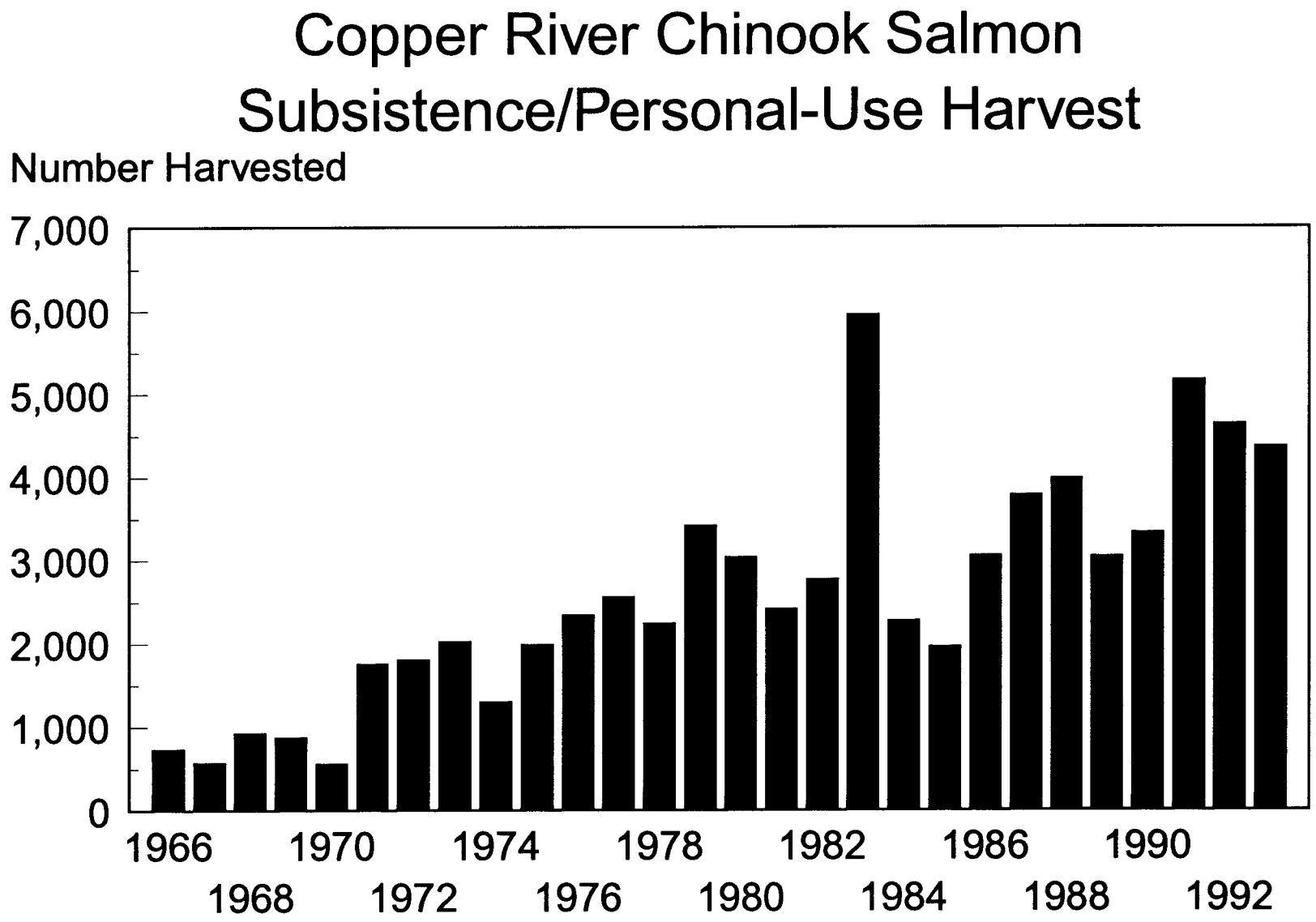


Figure 14. Subsistence/personal-use harvest of Copper River chinook salmon, 1966-1993.

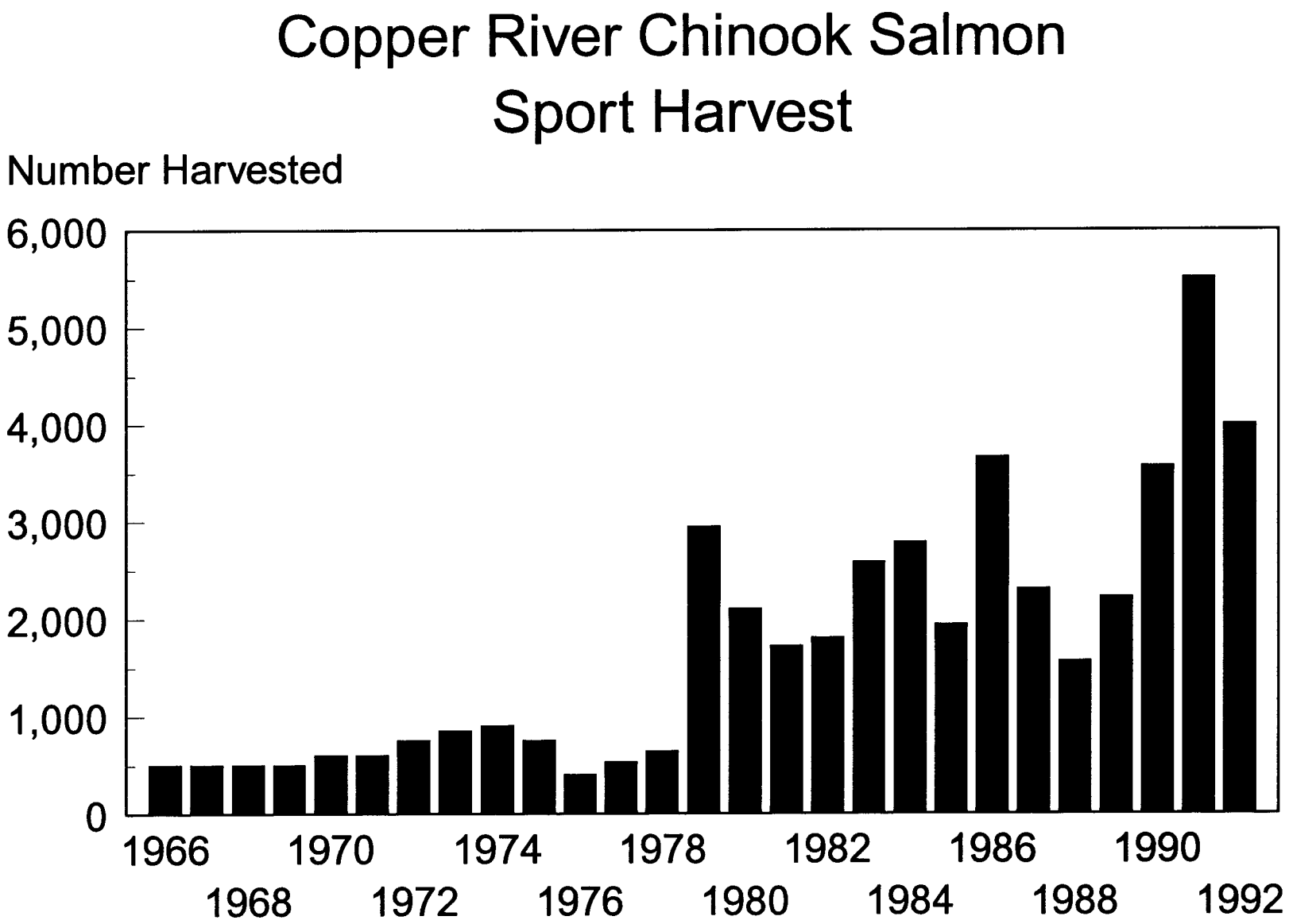


Figure 15. Sport harvest of Copper River chinook salmon, 1966-1992.

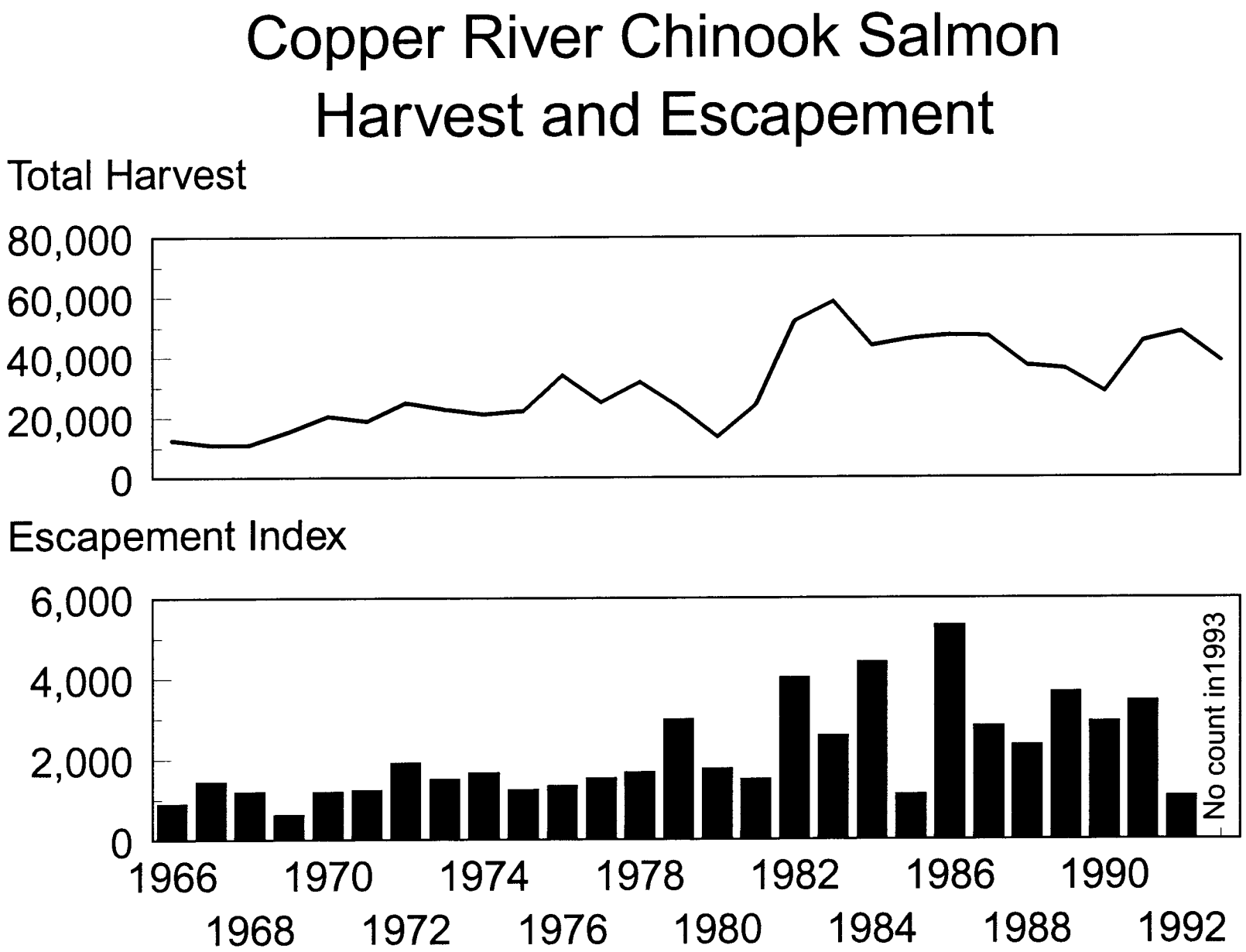


Figure 16. Comparison of Copper River chinook salmon harvest and spawning escapement index counts, 1966-1993.

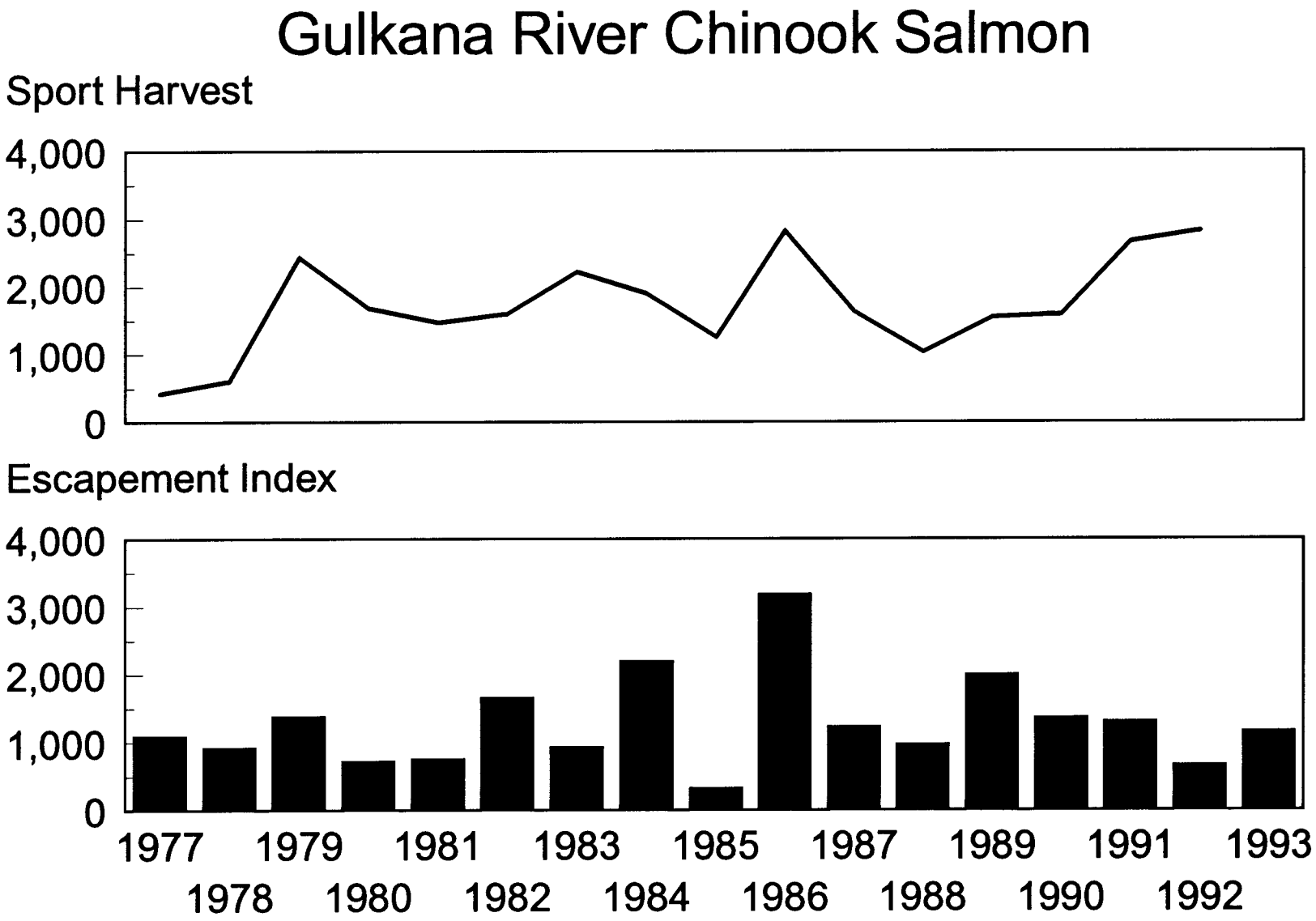


Figure 17. Comparison of chinook salmon harvest and spawning escapement index counts in the Gulkana River, 1977-1993.

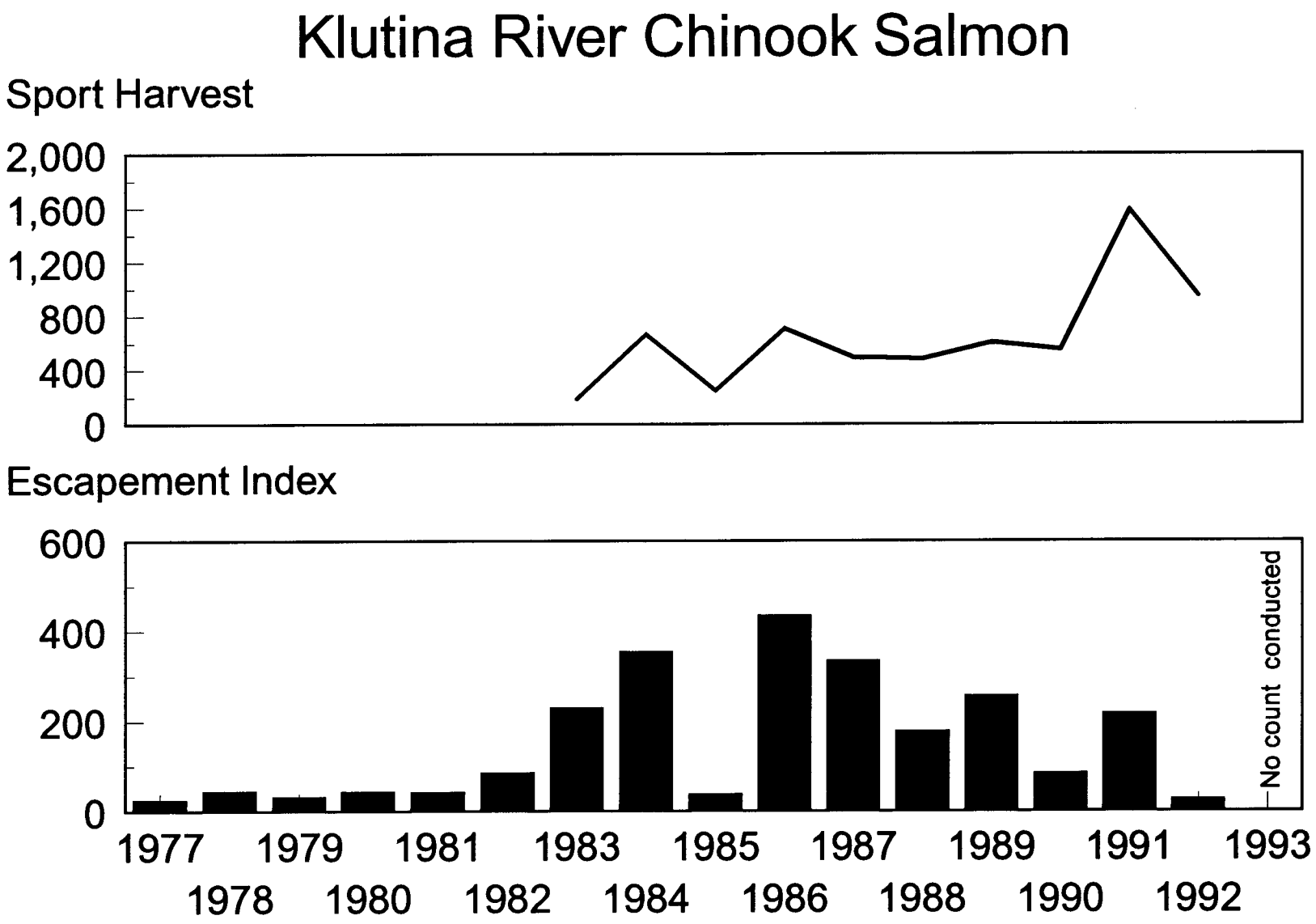


Figure 18. Comparison of chinook salmon harvest and spawning escapement index counts in the Klutina River, 1983-1992.

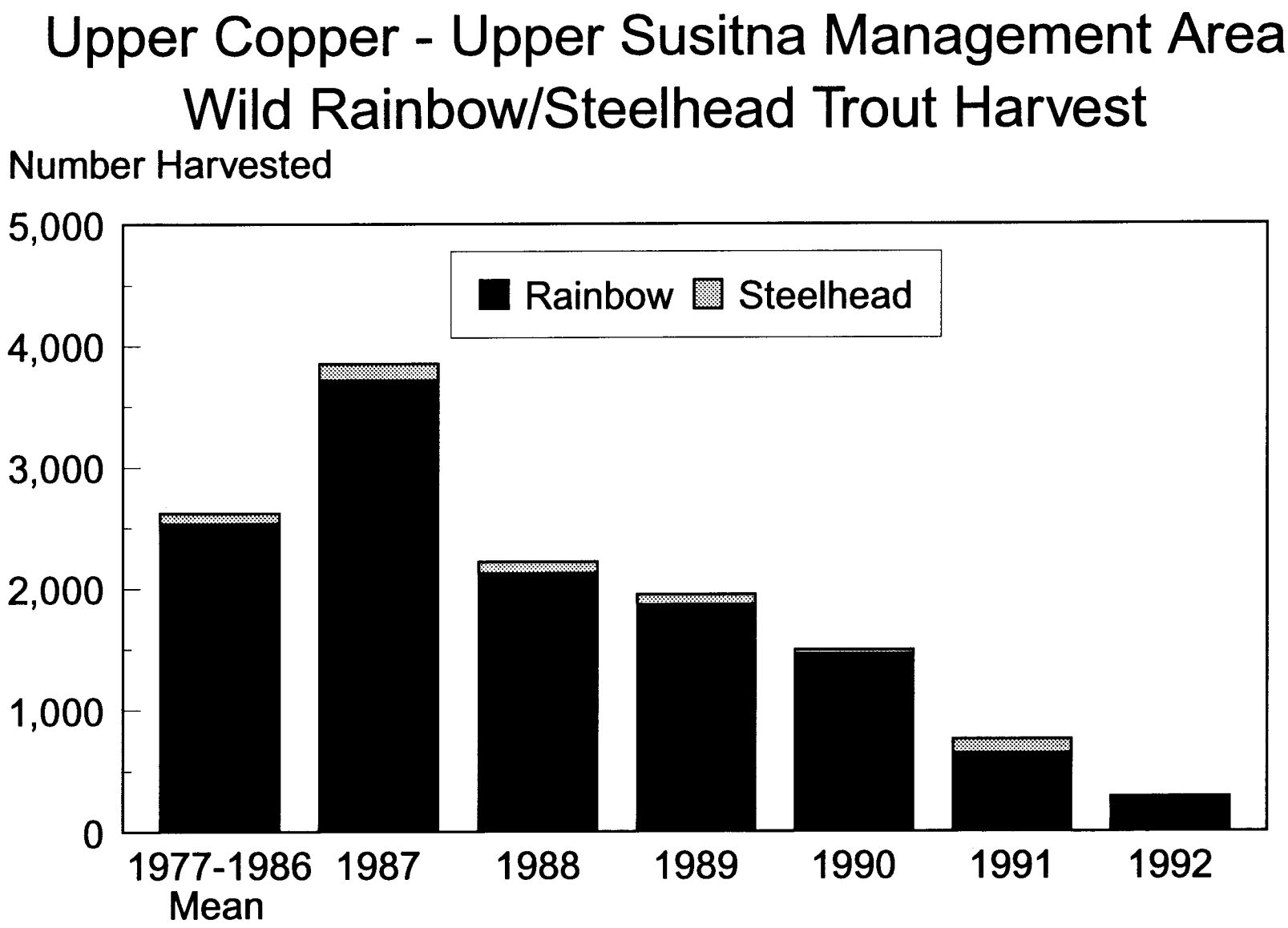


Figure 19. Harvest of wild rainbow/steelhead trout by recreational anglers fishing UCUSMA waters, 1977-1992.

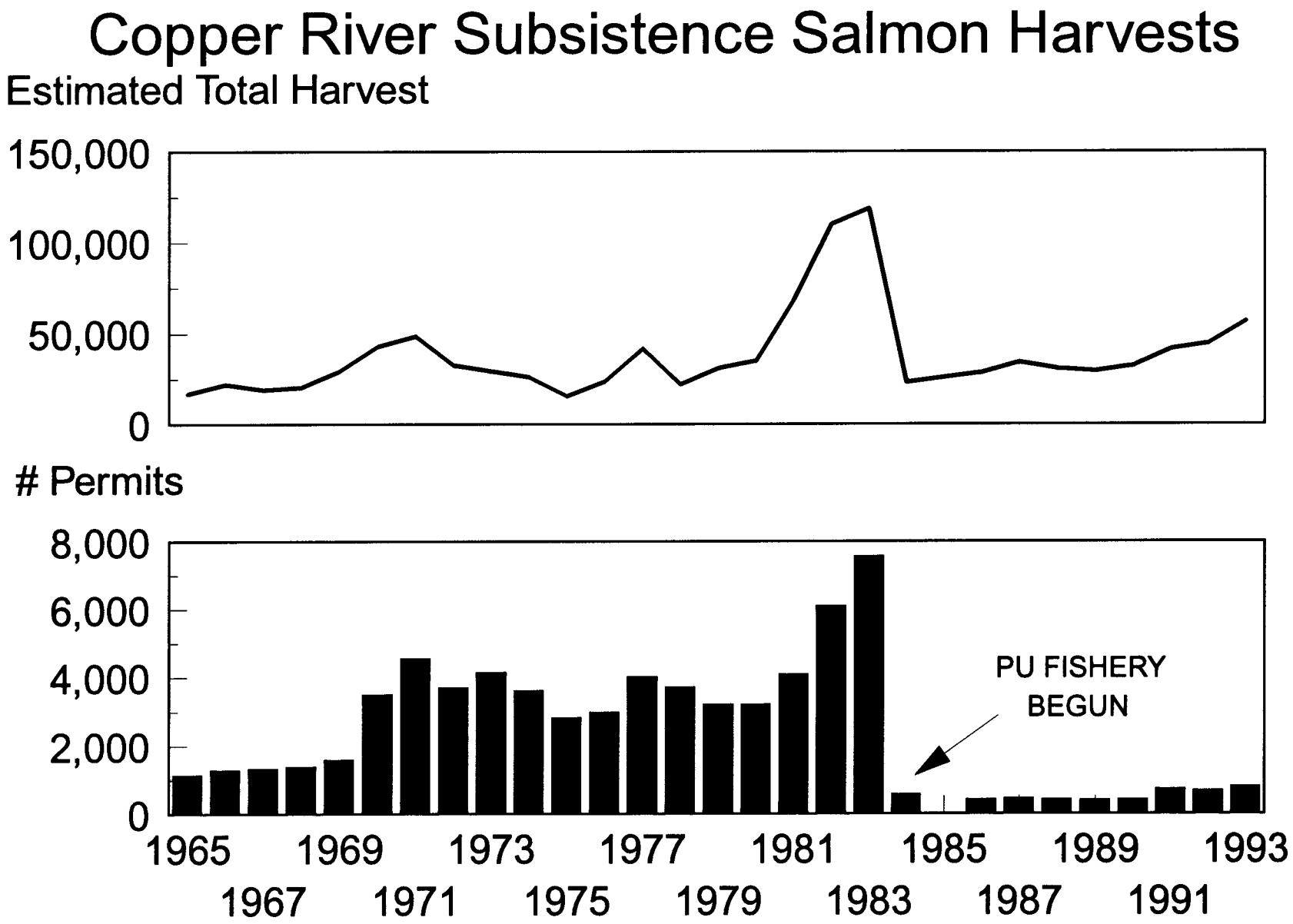


Figure 20. Estimated harvest and number of permits issued during the Copper River subsistence salmon fishery, 1965-1993.

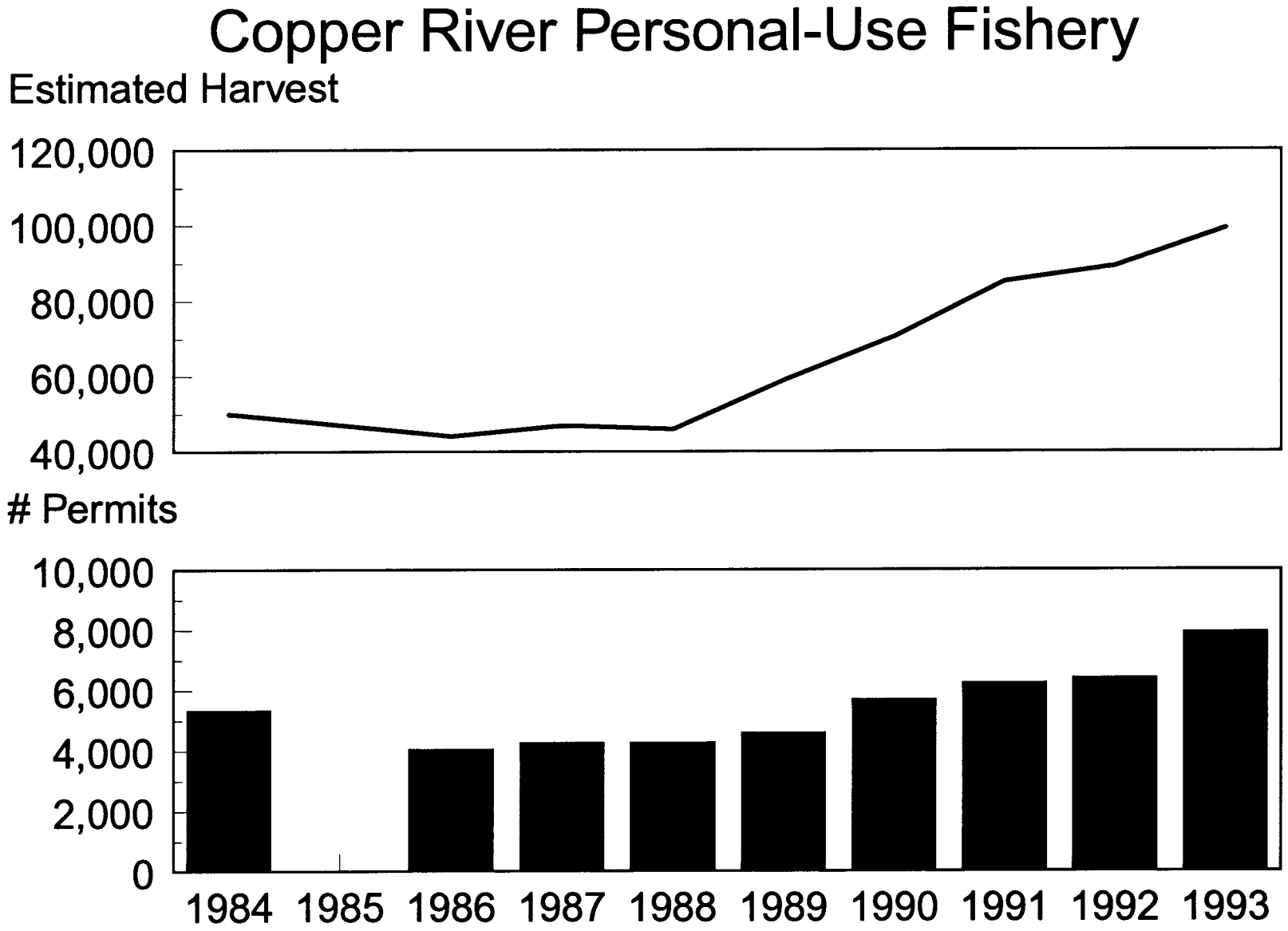


Figure 21. Estimated harvest and number of permits issued during the Copper River personal-use salmon fishery, 1984-1993.

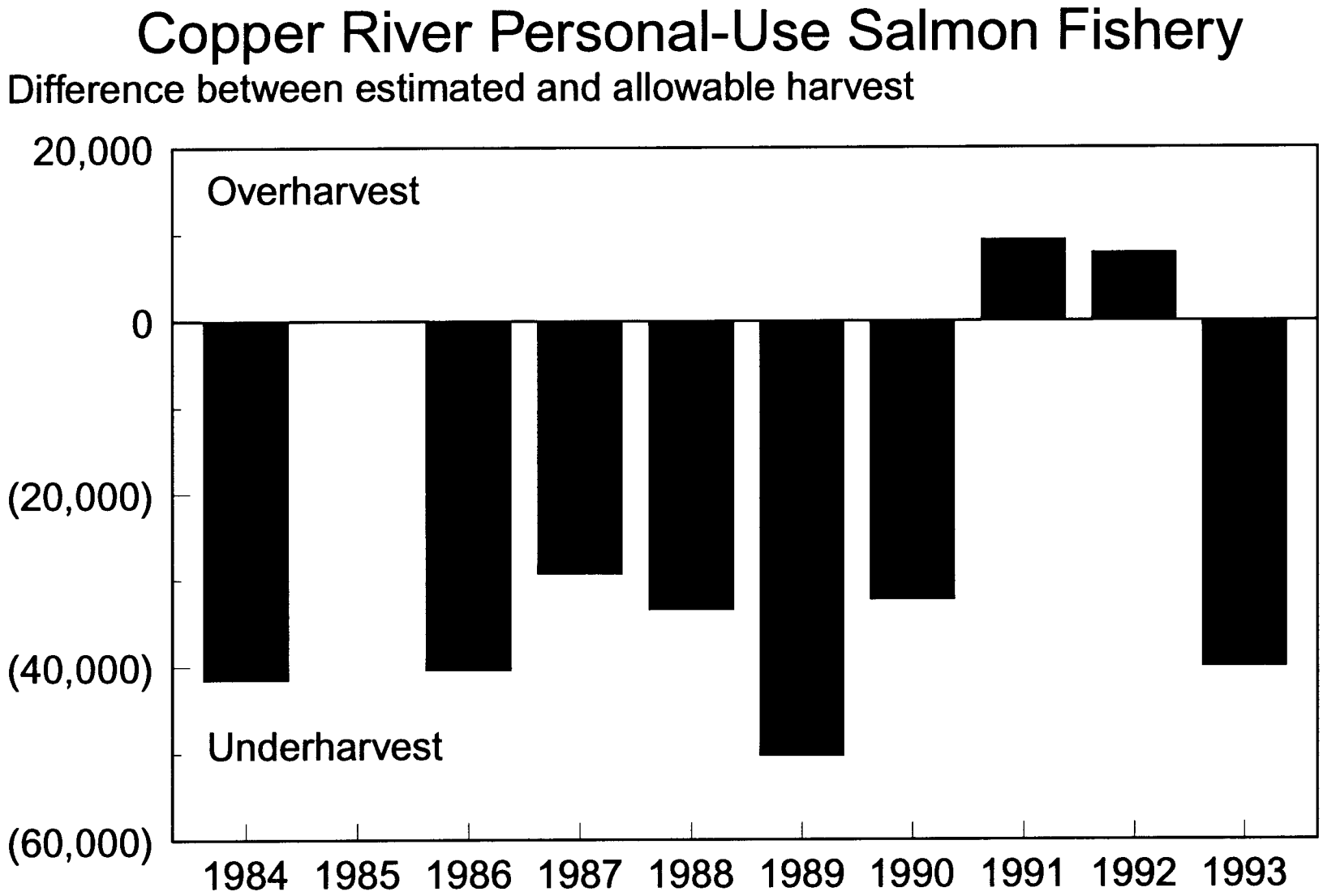


Figure 22. Difference between estimated and allowable harvests during the Copper River personal-use salmon fishery, 1984-1993.

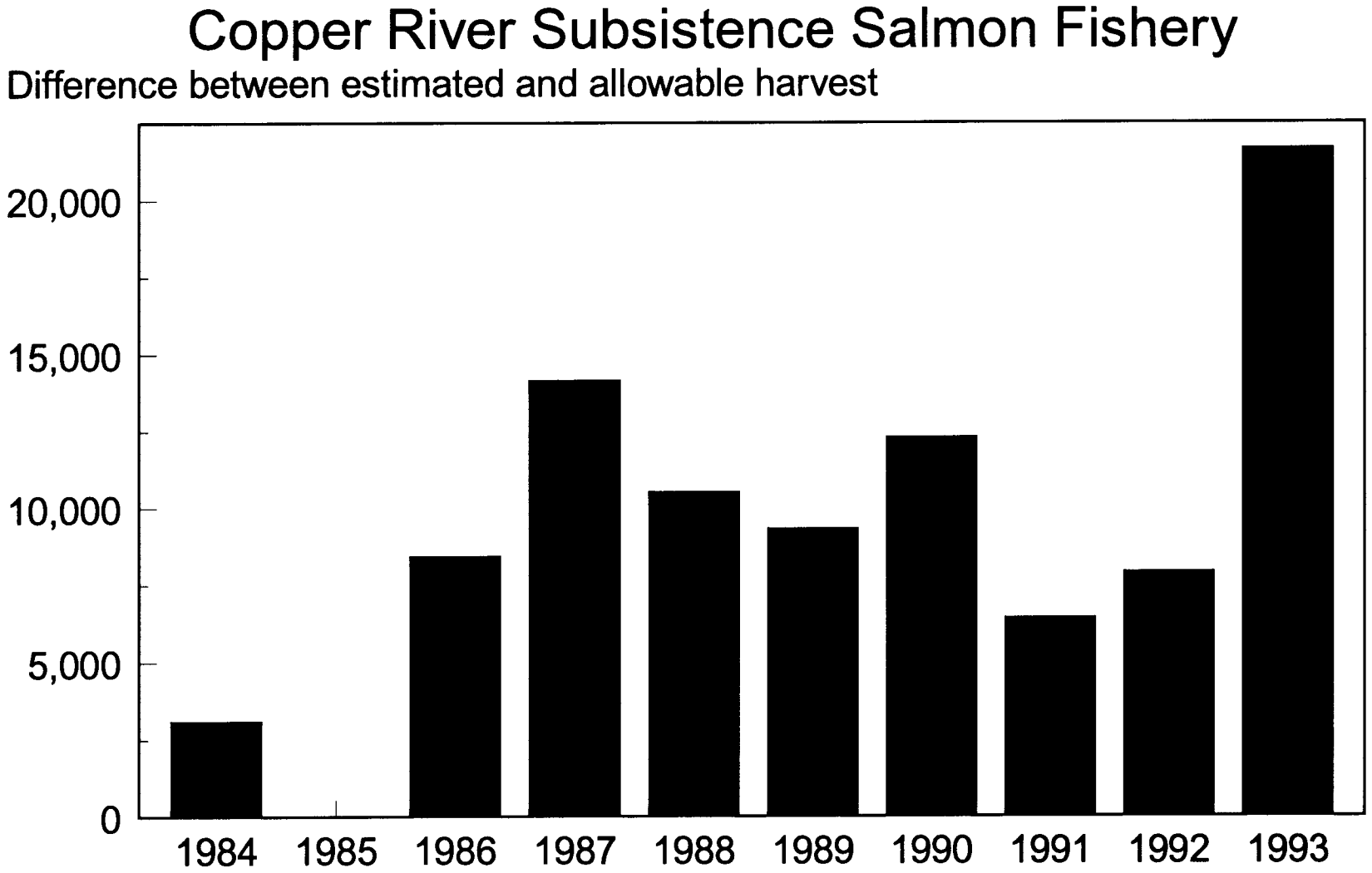


Figure 23. Difference between estimated and allowable harvests during the Copper River subsistence salmon fishery, 1984-1993.

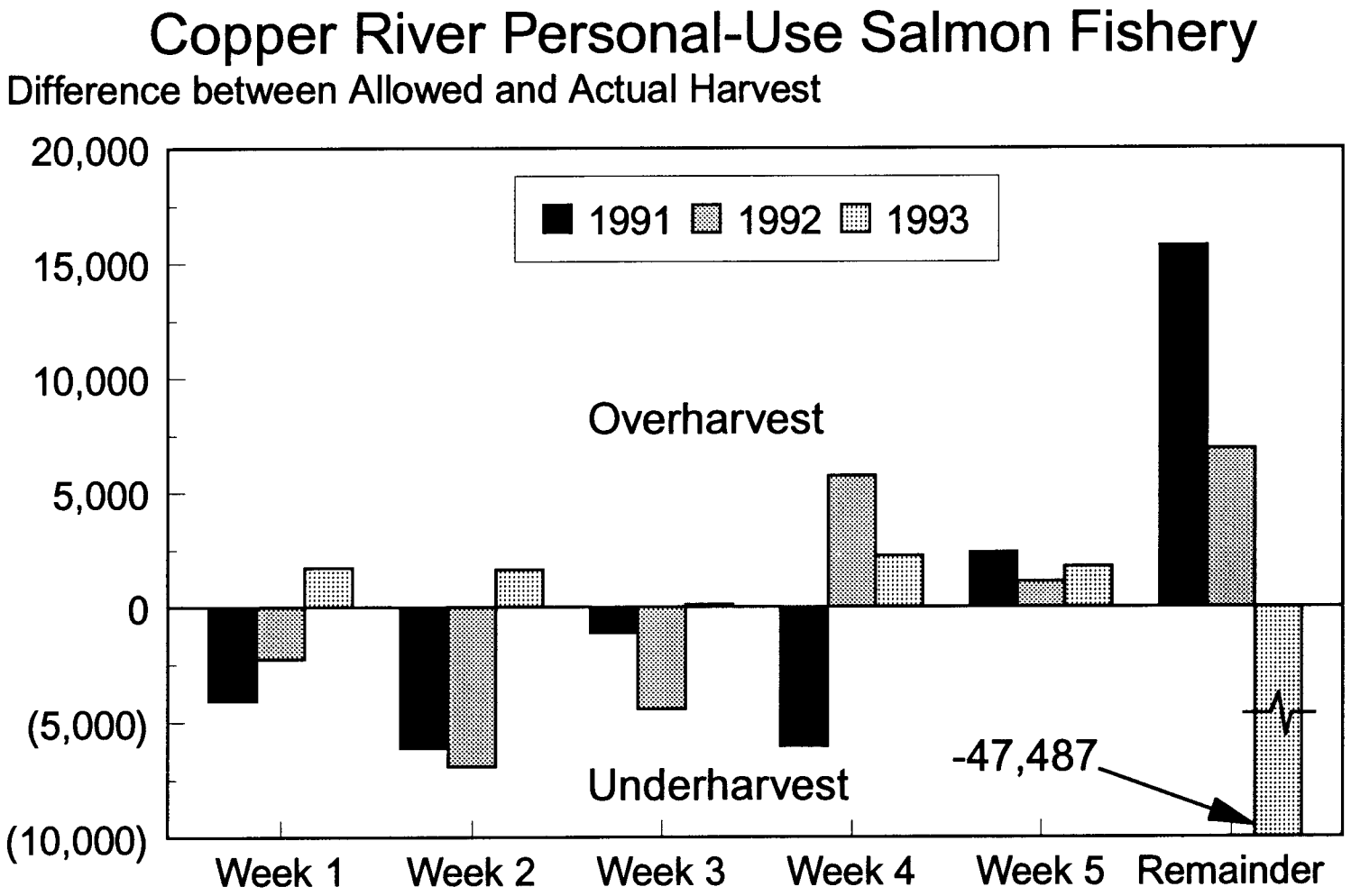
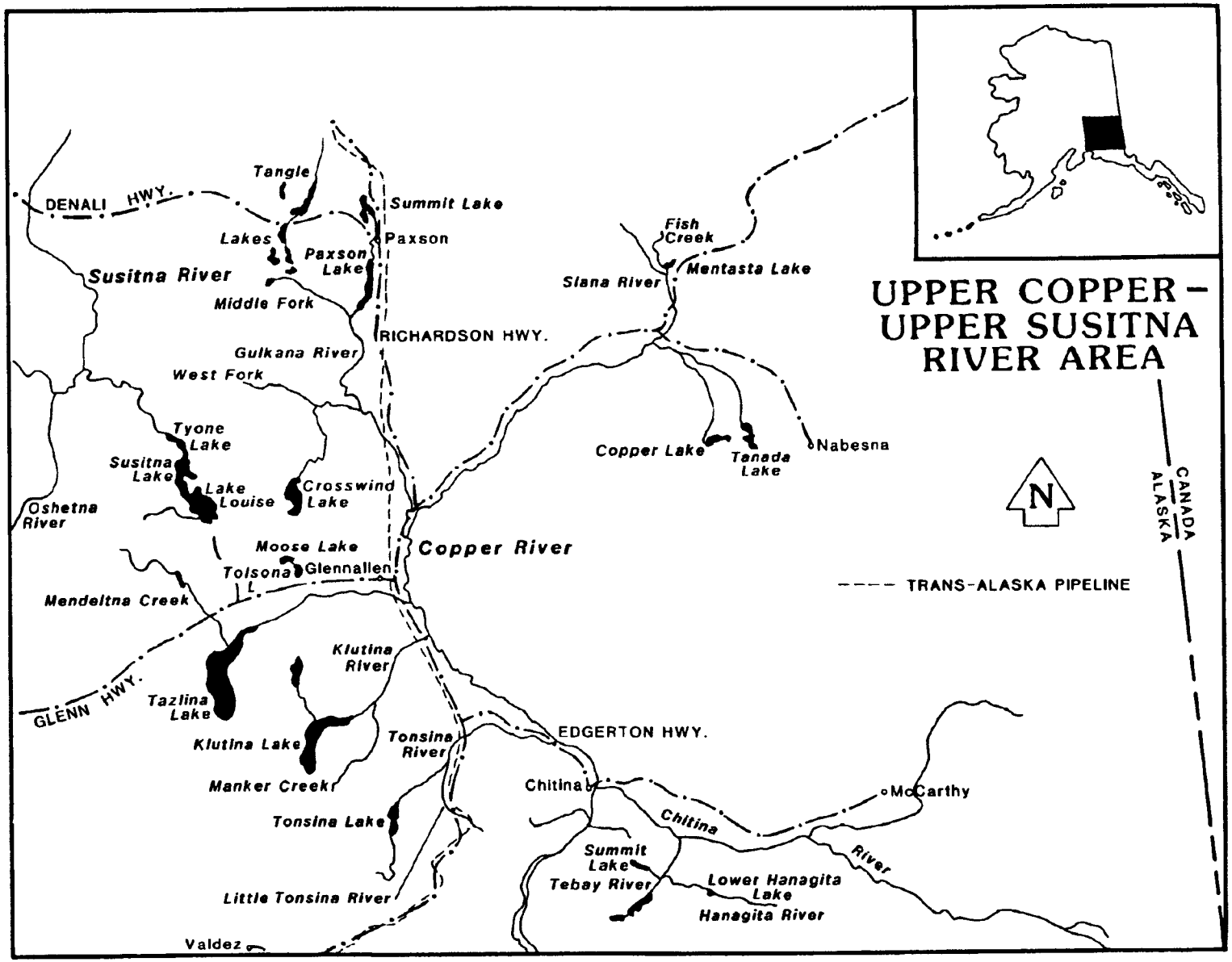
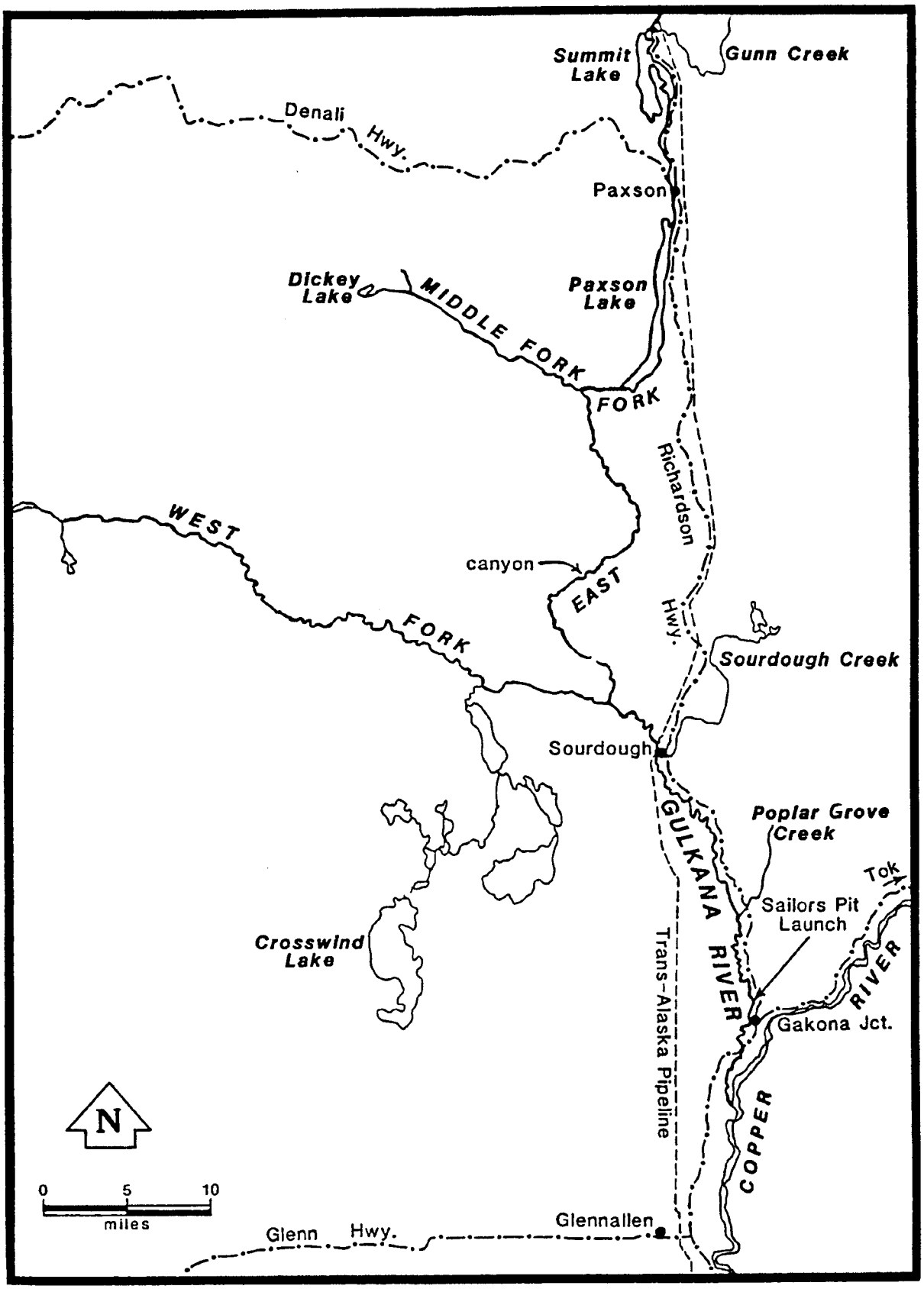


Figure 24. Difference between estimated versus allowable harvests, by week, during the Copper River personal-use salmon fishery, 1991, 1992 and 1993.

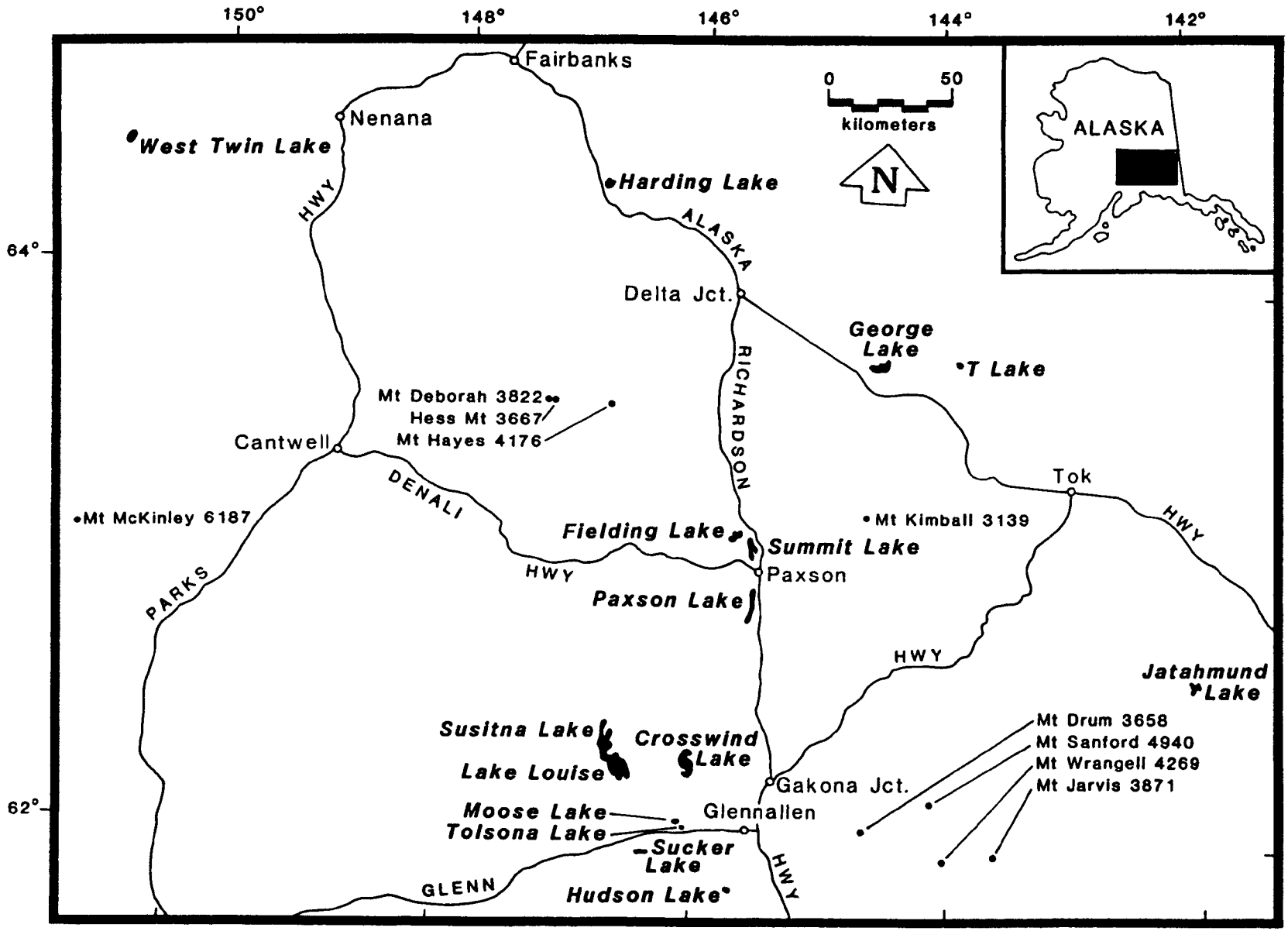
MAPS



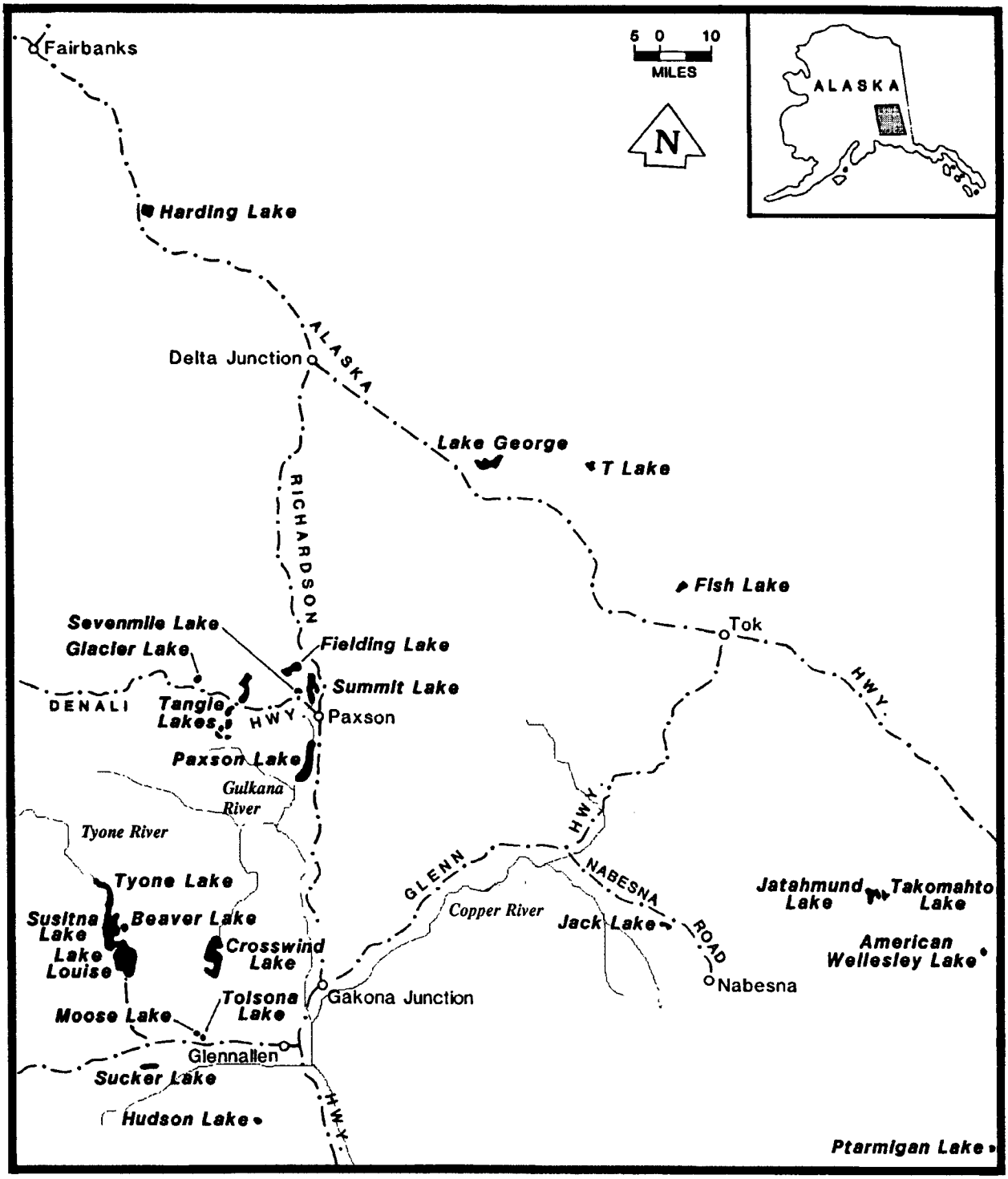
Map 1. The Upper Copper-Upper Susitna River Management Area (UCUSMA).



Map 2. The Gulkana River drainage.



Map 3. Lakes supporting major lake trout fisheries in the UCUSMA.



Map 4. Lakes supporting major burbot fisheries in the UCUSMA.