

Special Publication No. 06-26

**Kvichak River Sockeye Salmon Stock Status and
Action Plan, 2006; a Report to the Alaska Board of
Fisheries**

by

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and

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November 2006

Alaska Department of Fish and Game

Divisions of Sport Fish and Commercial Fisheries



Symbols and Abbreviations

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| | | | | | |
|---|--------------------|--|---|---|-------------------------|
| Weights and measures (metric) | | General | | Measures (fisheries) | |
| centimeter | cm | Alaska Administrative Code | AAC | fork length | FL |
| deciliter | dL | all commonly accepted abbreviations | e.g., Mr., Mrs., AM, PM, etc. | mid-eye-to-fork | MEF |
| gram | g | all commonly accepted professional titles | e.g., Dr., Ph.D., R.N., etc. | mid-eye-to-tail-fork | METF |
| hectare | ha | at | @ | standard length | SL |
| kilogram | kg | compass directions: | | total length | TL |
| kilometer | km | east | E | | |
| liter | L | north | N | Mathematics, statistics | |
| meter | m | south | S | <i>all standard mathematical signs, symbols and abbreviations</i> | |
| milliliter | mL | west | W | alternate hypothesis | H _A |
| millimeter | mm | copyright | © | base of natural logarithm | e |
| | | corporate suffixes: | | catch per unit effort | CPUE |
| Weights and measures (English) | | Company | Co. | coefficient of variation | CV |
| cubic feet per second | ft ³ /s | Corporation | Corp. | common test statistics | (F, t, χ^2 , etc.) |
| foot | ft | Incorporated | Inc. | confidence interval | CI |
| gallon | gal | Limited | Ltd. | correlation coefficient | |
| inch | in | District of Columbia | D.C. | (multiple) | R |
| mile | mi | et alii (and others) | et al. | correlation coefficient | r |
| nautical mile | nmi | et cetera (and so forth) | etc. | (simple) | |
| ounce | oz | exempli gratia | | covariance | cov |
| pound | lb | (for example) | e.g. | degree (angular) | ° |
| quart | qt | Federal Information Code | FIC | degrees of freedom | df |
| yard | yd | id est (that is) | i.e. | expected value | E |
| | | latitude or longitude | lat. or long. | greater than | > |
| Time and temperature | | monetary symbols | | greater than or equal to | ≥ |
| day | d | (U.S.) | \$, ¢ | harvest per unit effort | HPUE |
| degrees Celsius | °C | months (tables and figures): first three letters | Jan, ..., Dec | less than | < |
| degrees Fahrenheit | °F | registered trademark | ® | less than or equal to | ≤ |
| degrees kelvin | K | trademark | ™ | logarithm (natural) | ln |
| hour | h | United States (adjective) | U.S. | logarithm (base 10) | log |
| minute | min | United States of America (noun) | USA | logarithm (specify base) | log ₂ etc. |
| second | s | U.S.C. | United States Code | minute (angular) | ' |
| | | U.S. state | use two-letter abbreviations (e.g., AK, WA) | not significant | NS |
| Physics and chemistry | | | | null hypothesis | H ₀ |
| all atomic symbols | | | | percent | % |
| alternating current | AC | | | probability | P |
| ampere | A | | | probability of a type I error (rejection of the null hypothesis when true) | α |
| calorie | cal | | | probability of a type II error (acceptance of the null hypothesis when false) | β |
| direct current | DC | | | second (angular) | " |
| hertz | Hz | | | standard deviation | SD |
| horsepower | hp | | | standard error | SE |
| hydrogen ion activity (negative log of) | pH | | | variance | |
| parts per million | ppm | | | population | Var |
| parts per thousand | ppt, ‰ | | | sample | var |
| volts | V | | | | |
| watts | W | | | | |

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PLAN, 2006; A REPORT TO THE ALASKA BOARD OF FISHERIES**

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ABSTRACT

In response to the guidelines established in the *Sustainable Salmon Fisheries Policy* (ADF&G 2000), the Alaska Department of Fish and Game (ADF&G) first classified the Kvichak River sockeye salmon *Oncorhynchus nerka* stock as a "Stock of Yield Concern" in 2001 (Bristol Bay Staff 2000). The classification of Kvichak River sockeye salmon was subsequently changed to a "Stock of Management Concern" in 2003. This classification change was based on the definition of "management concern" found in the policy. A "management concern" is defined as, "a concern arising from a chronic inability, despite use of specific management measures, to maintain escapements for salmon stocks within the bounds of Sustainable Escapement Goal (SEG), Biological Escapement Goal (BEG), Optimal Escapement Goal (OEG), or other specified management objectives for the fishery." The increased protection provided by commercial, sport, and subsistence fisheries restrictions and closures that have occurred in recent years appears to be helping the Kvichak River sockeye salmon stock recover: there was a surplus harvest of Kvichak River sockeye salmon in the commercial fishery in 2006; minimum escapement goals were met in 2005 and 2006; recruits per spawner have improved in recent years; and the Kvichak River sockeye salmon stock exploitation rates have been significantly reduced in recent years. Even with these recent improvements, there is still need for concern. The sockeye salmon escapements to the Kvichak River have fallen below the lower end of the current escapement goal during 7 of the past 11 years, including 5 of the past 7 years. Therefore, it is recommended that the Kvichak River sockeye salmon stock remain classified as a "Stock of Management Concern." ADF&G would like to see the continued improvement of the Kvichak River sockeye salmon stock before demoting to a lower classification.

Key words: Kvichak River, sockeye salmon, *Oncorhynchus nerka*, stock of concern, commercial, fishing, ADF&G, sustainable salmon fisheries policy, Alaska Board of Fisheries, Bristol Bay, Alaska.

INTRODUCTION

The *Sustainable Salmon Fisheries Policy* (SSFP; 5 AAC 39.222) directs the Alaska Department of Fish and Game (ADF&G) to provide the Alaska Board of Fisheries (BOF), at regular meetings, with reports on the status of salmon stocks and identify any salmon stocks that present a concern related to yield, management, or conservation. In the Bristol Bay Management Area one stock (Kvichak River sockeye salmon, *Oncorhynchus nerka*) has been identified (Figures 1 and 2). This report provides ADF&G's assessment of this candidate stock of concern and recommendation that Kvichak River sockeye salmon remain a stock of management concern.

KVICHAK RIVER SOCKEYE SALMON

Stock Assessment

Previously the Kvichak River sockeye salmon stock, on average, was the largest contributor to the Bristol Bay salmon harvest. The Kvichak stock has historically had a 5-year cycle with individual years labeled as: peak, pre-peak and off-cycle years. Since 1955, the number of Kvichak River spawners has ranged from 227,000 to 24 million sockeye salmon (Table 1). The largest recorded total run was 48 million in 1965, a peak cycle year (Table 1). ADF&G has operated a counting tower to enumerate salmon escapements on the Kvichak River since 1955. Additionally, each spring from 1975 to 2003, the number of migrating smolt were estimated using hydroacoustics. In conjunction, age, length, and weight information was obtained from smolt sampled with fyke nets (Crawford and Fair 2003); this also began in 1975 and is ongoing.

The current Biological Escapement Goal (BEG) for Kvichak River sockeye salmon, adopted in 1997, is 2 million to 6 million for off-cycle years and 6 million to 10 million for pre-peak and peak years (Fair 2000). Setting a BEG for the Kvichak River sockeye salmon run has proven difficult because of divergence in productivity between cycle years and off-cycle years, poor density dependence in spawner-recruit data, and a lack of fit for Ricker type spawner-recruit

curves. In addition to the goal, an exploitation rate of 50% was set on runs of 4–20 million to provide guidance in setting goals within the range. The management objective for a given off-cycle year would then be defined as 50% of the total inshore Kvichak River run, and would never be less than 2 million or greater than 10 million. The management objective for a given pre-peak or peak cycle year would then be defined as 50% of the total inshore Kvichak River run, and would never be less than 6 million or greater than 10 million. Beginning in 1996, escapements were frequently less than the lower goal with 7 of the past 11 years below the goal (Figure 3).

Commercial harvests have also declined in recent years from a combined average of approximately 5.7 million (1966 to 1995) to an average of approximately 1.4 million (1996 to 2005; Figure 4). Moreover, commercial fishing was restricted in the Naknek-Kvichak District at some point each year since 1996, forcing the fishery into the Naknek River Special Harvest Area. In recent years, as directed in *Kvichak River Sockeye Salmon Management Plan* (5 AAC 67.025), sport fishing restrictions have routinely been imposed when escapements were projected to be less than 2 million fish. Restrictions have generally taken the form of bag limit reductions and area closures designed to minimize potential conflicts with subsistence users. Prior to enacting the current management plan, the poor return in 2000 resulted in a closure of the sockeye salmon sport fishery in the entire Kvichak drainage.

Prior to commercial fishing, area residents harvested Bristol Bay salmon for subsistence uses. The BOF determination of the amount reasonably necessary for subsistence uses is described in 5 AAC 01.336 as 157,000–172,171 salmon in the Bristol Bay area, “including 55,000 to 65,000 Kvichak River sockeye salmon; this finding does not include salmon stocks in the Alagnak River.” In the Naknek-Kvichak District, sockeye subsistence harvest averaged about 92,000 from 1985–1994 and 72,000 from 1995–2004. Annual subsistence harvest of Kvichak River sockeye salmon averaged 60,000 fish from 1985 to 2004 (Westing et al. 2006) with recent harvests ranging from 33,000 to 53,000 (2000–2005).

In April 2006 an interdivisional salmon escapement goal review team, including staff from the Divisions of Commercial Fisheries and Sport Fish, was formed to comprehensively review the existing salmon escapement goals in the Bristol Bay Management Area based on the *Policy for the Management of Sustainable Salmon Fisheries* (5 AAC 39.222) and the *Policy for Statewide Salmon Escapement Goals* (5 AAC 39.223). While this review is ongoing, fisheries data analyses indicate that the current Kvichak River sockeye salmon escapement goal will be changed from a BEG to a Sustainable Escapement Goal (SEG), but otherwise remain unchanged. Results of this escapement goal review will be presented at the December 2006 BOF meeting.

Commercial Fisheries Management

The Bristol Bay commercial fishery is managed using several measures of inseason run strength so that spawning escapement goals are met by distributing the escapement through time based on the historical run timing schedule. Commercial fishing periods are opened based on both spawning escapement and harvest indicators. Commercial fishing in Bristol Bay is not opened by emergency order until indicators suggest a harvestable surplus of sockeye salmon is available.

Daily and cumulative inseason escapement estimates, based on visual counts from towers, are compared to expected counts derived from historical averages of counts and run timing. This gives managers the ability to determine whether a run is smaller, the same, or larger than

expected. Unfortunately, sockeye salmon often require several days to travel from fishing districts to the counting towers. Therefore, inriver test fishing projects have been established to estimate the number of sockeye salmon that have left the fishing district but have not yet reached the counting tower (West and Fair 2006). This allows managers to provide adequate fishing opportunity to harvest surplus production while still achieving spawning escapement goals.

Commercial harvest information is used in a similar fashion to spawning escapement information. The actual daily and cumulative number of sockeye salmon harvested is compared to expected numbers derived from pre- and inseason projections to provide information on run size. Additionally, ADF&G conducts district test fishing during closed fishing periods to gauge the relative abundance and distribution of sockeye salmon within areas that may be open to harvest.

Previous Alaska Board of Fisheries Actions

The Kvichak River sockeye salmon stock was found to be a “Stock of Yield Concern” during the January 2001 Alaska Board of Fisheries meeting. In response to the “Stock of Yield Concern” designation, the BOF modified 5AAC 06.357 *Ugashik River Sockeye Salmon Special Harvest Area Management Plan*, 5AAC 06.359 *Egegik River Sockeye Salmon Special Harvest Area Management Plan*, 5AAC 06.360 *Naknek River Sockeye Salmon Special Harvest Area Management Plan*, and 5AAC 67.025 *Kvichak River Drainage Sockeye Salmon Management Plan* to provide additional protection for Kvichak River sockeye salmon. Bristol Bay fisheries were managed in accordance with these plans with no directed commercial fishing and a reduced sport fishery for Kvichak River sockeye salmon.

During the 2003 December Bristol Bay BOF meeting, several regulation changes were adopted concerning the Naknek/Kvichak District. The Kvichak sockeye salmon stock was elevated from a Stock of Yield Concern to a Stock of Management Concern due to the recent chronic inability to meet escapement goals. A Stock of Management Concern is defined (5 AAC 39.222) as “a concern arising from a chronic inability, despite use of specific management measures, to maintain escapements for a salmon stock within the bounds of the SEG, BEG, Optimal Escapement Goal (OEG), or other specified management objectives for the fishery.”

With this 2003 action came the stipulation that if the Kvichak River run is forecasted to be less than 30% above the minimum BEG, fishing will begin in the Special Harvest Areas of Naknek, Egegik and Ugashik Rivers (5 AAC 06.360 (h)).

Regulatory History

Kvichak River sockeye salmon have been utilized for subsistence for centuries. This system’s main producer is sockeye salmon and its importance is increased due to the system’s inclusion of the villages of Levelock, Igiugig, Pedro Bay, Kokhanok, Iliamna/Newhalen, Nondalton, and Port Alsworth.

Permits are required to harvest salmon for subsistence purposes in the Kvichak River drainage. Since 1990, under state regulations, all state of Alaska residents have been eligible to participate in subsistence salmon fishing in all Bristol Bay drainages. Gillnets up to 25 fathoms are the only recognized legal subsistence gear.

The commercial fishery is closed between June 1 and September 30, but it can be opened by emergency order. There are three management plans addressing commercial fishing within the Naknek-Kvichak District. The first is referred to as the *Commercial Set and Drift Gillnet Sockeye*

Salmon Fisheries Management and Allocation Plan (5AAC 06.355; ADF&G 2001). This plan specifies the allocation of sockeye salmon between commercial set and drift gillnet fisheries within the district and establishes management measures to achieve allocation. Part of this plan (5AAC 06.364 (e); ADF&G 2001) attempts to provide adequate Kvichak River sockeye salmon spawning escapement by managing, to the extent practicable, a fishery in the Naknek Section with limited set and drift gillnet gear fishing during ebb tides.

The second plan is referred to as the *Naknek River Sockeye Salmon Special Harvest Area Management Plan* (5AAC 06.360; ADF&G 2001). This plan states that on or after June 27, if Kvichak River cumulative escapement is one or more days behind the historical schedule for meeting the goal, the following actions are taken:

1. The Naknek-Kvichak District will be closed, and to reduce the potential for interception of Kvichak River sockeye salmon in other districts,
 - a. Fishing in the Egegik District may be restricted to the Egegik River Special Harvest Area;
 - b. Fishing in the Ugashik District will occur within a restricted area prior to June 29; and
 - c. If Naknek River spawning escapement is projected to be greater than 800,000 sockeye salmon, the Naknek River Special Harvest Area can open, and the upper spawning escapement goal for the Naknek River will be raised from 1.4 million to 2.0 million sockeye salmon.

The third plan is referred to as the *Naknek-Kvichak District Commercial Set and Drift Gillnet Sockeye Salmon Fisheries Management and Allocation Plan* (5AAC 06.364; ADF&G 2001). The purpose of this plan is to establish the allocation of sockeye salmon between the commercial set and drift gillnet fisheries within the Naknek-Kvichak District and to establish management measures for ADF&G to achieve the allocation.

Stock of Concern Analyses

Escapement

During the most recent 5 years, the minimum escapement goal was achieved in 2005 and 2006 (Table 2; Figure 3). The minimum escapement goal has been met in only 4 out of the last 11 years: 1998, 1999, 2005, and 2006 (Figure 3). It should be noted that the off-cycle escapement goal was changed from 4 million to 2 million (variable) in 1997 (implemented in 1998; Table 2). Escapements in 1996 and 1997 would not have met the current off-cycle goal of 2 million although the shortfall is not alarming. However, ADF&G was concerned with the 70% escapement shortfall during a Kvichak peak year (2000). There have been two pre-peak (1959 and 1964) and no peak year escapements which were less than the escapement in 2000. ADF&G was encouraged that the minimum escapement goal was met in 2005 and 2006.

Yield

The actual yield was less than the median yield in all years (both peak and off-cycle) except one (2006) of the most recent 5-year period (Table 3 and Figure 4). The term "lower range of historic harvest" was not defined in the "Sustainable Salmon Fisheries Policy." Therefore, the degree of yield concern and the point at which a yield concern was classified were subject to interpretation.

Exploitation Rate

The commercial fishing exploitation rate on Kvichak sockeye salmon was significantly reduced in recent years, especially for very low runs (Figure 5). For example, in 2002 and 2003, the exploitation rate of Kvichak stocks was less than 2%.

Return per Spawner

There has been an increase in the production of the Kvichak River sockeye salmon stock in recent years. The return per spawner from brood years 1991–1999 averaged 0.8 fish per spawner (Figure 6). There has been an increase in the return per spawner in recent years (brood years 2000–2002) averaging 3.1 returns per spawner since 2000. We expect the return per spawner to increase for these recent years even further because the return for these broods has not been completed.

Stock of Concern Recommendation

The increased protection provided by commercial and sport fisheries restrictions and closures that have occurred in recent years appears to be helping the Kvichak River sockeye salmon stock recover: there was a surplus harvest of Kvichak River sockeye salmon in the commercial fishery in 2005 and 2006; minimum escapement goals were met in 2005 and 2006; recruits per spawner have improved in recent years; and Kvichak River sockeye salmon stock exploitation rates have been significantly reduced in recent years. Even with these recent improvements, there is still need for concern. The sockeye salmon escapements to the Kvichak River have fallen below the lower end of the current escapement goal during 7 of the past 11 years, including 5 of the past 7 years. Therefore, it is recommended that the Kvichak River sockeye salmon stock remain classified as a “Stock of Management Concern”. AD&FG would like to see the continued improvement of the Kvichak River sockeye salmon stock for 4 or 5 years before demoting to a lower classification.

KVICHAK RIVER SOCKEYE SALMON ACTION PLAN

ACTION PLAN REVIEW

Current Stock Status

In response to the guidelines established in the Sustainable Salmon Fisheries Policy, the Alaska Board of Fisheries during the October 1–3, 2003 work session classified the Kvichak River sockeye salmon stock as a management concern. This determination was based on the inability, despite the use of specific management measures, to maintain escapement for a salmon stock within the bounds of the BEG for 4 of the past 5 years.

Customary and Traditional Use Finding and the Amount Necessary

The Alaska Board of Fisheries has made a positive finding for Customary and Traditional Use for all salmon in the Bristol Bay area of 157,000 to 172,171 salmon. Of those, 55,000 to 65,000 sockeye salmon were determined reasonably necessary for Kvichak River drainage.

Habitat Factors Adversely Affecting the Stock

There are no habitat factors adversely affecting the Kvichak stock within the entire drainage.

Do New Or Expanding Fisheries On This Stock Exist?

Presently, there are no new or expanding fisheries on this stock. There are no proposals specific to expanding fisheries on this stock.

Existing Management Plans

The Board reviews existing management plans for consistency with principles and criteria of the Sustainable Salmon Fisheries Policy or adopts new management for the stock consistent with the principles and criteria of the Sustainable Salmon Fisheries Policy.

The following are the current regulations:

5 AAC 06.200. FISHING DISTRICTS, SUBDISTRICTS, AND SECTIONS.

5 AAC 06.310. FISHING SEASONS.

5 AAC 06.320. FISHING PERIODS.

5 AAC 06.355. BRISTOL BAY COMMERCIAL SET AND DRIFT GILLNET SOCKEYE SALMON FISHERIES MANAGEMENT AND ALLOCATION PLAN.

5 AAC 06.359. EGEGIK RIVER SOCKEYE SALMON SPECIAL HARVEST AREA MANAGEMENT PLAN.

5 AAC 06.360. NAKNEK RIVER SOCKEYE SALMON SPECIAL HARVEST AREA MANAGEMENT PLAN.

5 AAC 06.364. NAKNEK/KVCHIAK DISTRICT COMMERCIAL SET AND DRIFT GILLNET SOCKEYE SALMON FISHERIES MANAGEMENT AND ALLOCATION PLAN.

5 AAC 06.365. EGEGIK DISTRICT COMMERCIAL SET AND DRIFT GILLNET SOCKEYE SALMON FISHERIES MANAGEMENT AND ALLOCATION PLAN.

5 AAC 09.200. DESCRIPTION OF DISTRICTS AND SECTIONS.

5 AAC 09.310. FISHING SEASONS.

ACTION PLAN DEVELOPMENT

Kvichak Sockeye Salmon Action Plan Goal

To rebuild the Kvichak sockeye salmon run back to historical levels by attaining the escapement goal.

Previous Actions

During the BOF meeting in January of 2001, ADF&G presented a summary of four potential action plans (Bristol Bay staff, 2000) of which three reduced the exploitation rate on Kvichak stocks in each eastside district. In deliberation the BOF made the following changes: (1) In the Ugashik District, when the preseason forecast of Kvichak sockeye salmon does not provide for an exploitation rate greater than 40%, fishing time between June 16 to June 23 can not exceed 48-hours. In addition, if the Naknek River Special Harvest Area (NRSHA) is in effect anytime before June 29, fishing will be restricted to the Ugashik River Special Harvest Area (URSHA); (2) In the Egegik District, when the NRSHA is open to commercial fishing then fishing in the Egegik District is restricted to the Egegik River Special Harvest Area (ERSHA) and will remain in the ERSHA until fishing resumes in the Naknek/Kvichak District; and (3) In the

Naknek/Kvichak District, the district is closed to both gear groups when Kvichak River escapement falls one or more days behind the cumulative escapement goal curve on or after June 27. When fishing the NRSHA, an OEG is in effect raising the upper end of the escapement goal range from 1.4 million to 2.0-million sockeye salmon. During the 2003 BOF meeting, ADF&G presented one additional action plan item to further reduce the exploitation rate on Kvichak stocks (Bristol Bay 2003). The BOF required that fishing will begin in the Special Harvest Areas of Naknek, Egegik and Ugashik Rivers if the Kvichak River run is forecasted to be less than 30% above the minimum biological escapement goal (5 AAC 06.360 (h)).

Management Under Current Regulations

In 2004, the forecast for the Kvichak River projected a harvestable surplus of 6.6 million sockeye salmon with an escapement goal of 6.0 million. The BOF authorized a General District fishery in 2004, which opened areas outside of the normal district boundaries. With these additional areas open and a projected harvest of 6.6 million sockeye no restrictions were placed on the eastside fisheries. Limited fishing occurred in the Naknek/Kvichak District prior to June 23 with most of the harvest caught in the General District. Commercial fishing was restricted to the Naknek Section for the drift fleet and marginal fishing in the Kvichak Section for set gillnet gear. Escapement to Kvichak River was on track until July 6 when it fell more than 1 day behind. At that time, the District was closed and fishing was restricted to the NRSHA. The final escapement was 5.5 million sockeye salmon which was slightly less than the minimum escapement goal of 6.0 million. In 2005 and 2006, the preseason forecast projected a surplus of less than 30% above the minimum escapement goal and the eastside fisheries began in their respective special harvest areas. The outcome both in 2005 and 2006 was that the Kvichak River met its escapement objectives.

It is ADF&G's opinion that it has the necessary regulations to meet escapement objectives for Kvichak River sockeye salmon when the total run exceeds the minimum escapement goals and is forecasted within 30%. Further, it is the department opinion that the restrictions in current regulations are sufficient to minimize the exploitation and insure the vast majority of the sockeye salmon returning to the Kvichak River will escape the commercial fishery when total run is less than the minimum escapement goal.

Action Plan Alternatives

No new action plans necessary, continue under current plans.

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TABLES AND FIGURES

Table 1.—Historical yield, escapement and total inshore run of Kvichak River sockeye salmon.

| Year | Actual Yield | | Actual Escapement | | Total Inshore Run | |
|------|-----------------|------------------------|-------------------|-----------|-------------------|------------|
| | Pre-Peak & Peak | Off-cycle | Pre-Peak & Peak | Off-Cycle | Pre-Peak & Peak | Off-Cycle |
| 1959 | 281,930 | | 680,000 | | 961,930 | |
| 1960 | 7,976,500 | | 14,630,000 | | 22,606,500 | |
| 1961 | | 6,863,814 | | 3,705,849 | | 10,569,663 |
| 1962 | | 1,833,401 | | 2,580,884 | | 4,414,285 |
| 1963 | | 223,459 | | 338,760 | | 562,219 |
| 1964 | 763,486 | | 957,120 | | 1,720,606 | |
| 1965 | 17,785,664 | | 24,325,926 | | 42,111,590 | |
| 1966 | | 4,168,575 | | 3,775,184 | | 7,943,759 |
| 1967 | | 1,800,652 | | 3,216,208 | | 5,016,860 |
| 1968 | | 387,565 | | 2,557,440 | | 2,945,005 |
| 1969 | 3,760,565 | | 8,394,204 | | 12,154,769 | |
| 1970 | 16,581,224 | | 13,935,306 | | 30,516,530 | |
| 1971 | | 3,764,861 | | 2,387,392 | | 6,152,253 |
| 1972 | | 342,150 | | 1,009,962 | | 1,352,112 |
| 1973 | | 21,791 | | 226,554 | | 248,345 |
| 1974 | 148,595 | | 4,433,844 | | 4,582,439 | |
| 1975 | 1,605,407 | | 13,140,450 | | 14,745,857 | |
| 1976 | | 1,458,180 | | 1,965,282 | | 3,423,462 |
| 1977 | | 739,464 | | 1,341,144 | | 2,080,608 |
| 1978 | | 3,815,636 | | 4,149,288 | | 7,964,924 |
| 1979 | 13,418,829 | | 11,218,434 | | 24,637,263 | |
| 1980 | 12,743,074 | | 22,505,268 | | 35,248,342 | |
| 1981 | | 5,234,733 | | 1,754,358 | | 6,989,091 |
| 1982 | | 1,858,475 | | 1,134,840 | | 2,993,315 |
| 1983 | | 16,534,901 | | 3,569,982 | | 20,104,883 |
| 1984 | 12,523,803 | | 10,490,670 | | 23,014,473 | |
| 1985 | 6,183,103 | | 7,211,046 | | 13,394,149 | |
| 1986 | | 787,303 | | 1,179,322 | | 1,966,625 |
| 1987 | | 3,526,824 | | 6,065,880 | | 9,592,704 |
| 1988 | | 2,654,364 | | 4,065,216 | | 6,719,580 |
| 1989 | 11,456,509 | | 8,317,500 | | 19,774,009 | |
| 1990 | 10,551,217 | | 6,970,020 | | 17,521,237 | |
| 1991 | | 3,808,873 | | 4,222,788 | | 8,031,661 |
| 1992 | | 5,718,947 | | 4,725,864 | | 10,444,811 |
| 1993 | | 5,287,523 | | 4,025,166 | | 9,312,689 |
| 1994 | 13,893,613 | | 8,337,840 | | 22,231,453 | |
| 1995 | 17,391,906 | | 10,138,720 | | 27,530,626 | |
| 1996 | | 1,983,269 | | 1,450,578 | | 3,433,847 |
| 1997 | | 179,480 | | 1,503,732 | | 1,683,212 |
| 1998 | | 1,069,294 | | 2,296,074 | | 3,365,368 |
| 1999 | 6,392,296 | | 6,196,914 | | 12,589,210 | |
| 2000 | 1,026,986 | | 1,827,780 | | 2,854,766 | |
| 2001 | | 330,538 | | 1,095,348 | | 1,425,886 |
| MED | 9,263,859 | 1,858,475 | 8,366,022 | 2,387,392 | 18,647,623 | 4,414,285 |
| MAX | 17,785,664 | 16,534,901 | 24,325,926 | 6,065,880 | 42,111,590 | 20,104,883 |
| MIN | 148,595 | 21,791 | 680,000 | 226,554 | 961,930 | 248,345 |
| 2002 | | | | 703,884 | | 703,884 |
| 2003 | | 34,244 | | 1,686,804 | | 1,721,048 |
| 2004 | 2,211,186 | | 5,500,134 | | 7,711,320 | |
| 2005 | | 532,450 | | 2,320,332 | | 2,852,782 |
| 2006 | | 2,736,218 ^a | | 3,068,226 | | 5,804,444 |

^a Yield is a preliminary estimate in 2006.

Table 2.—Escapement analysis of Kvichak River sockeye salmon, 2002–2006.

| Year | Actual Escapement | Minimum Escapement Goal | Difference | % Deviation from Goal ^a | Escapement > Goal | Frequency of Occurrence^b |
|-------------|--------------------------|--------------------------------|-------------------|---|-----------------------------|--|
| 2002 | 703,884 | 2,000,000 | -1,296,116 | -65% | No | 3 (n=27) |
| 2003 | 1,686,804 | 2,000,000 | -313,196 | -16% | No | 9 (n=27) |
| 2004 | 5,500,134 | 6,000,000 | -499,866 | -8% | No | 4 (n=27) |
| 2005 | 2,320,332 | 2,000,000 | 320,332 | 16% | Yes | 13 (n=27) |
| 2006 | 3,068,226 | 2,000,000 | 1,068,226 | 53% | Yes | 18 (n=27) |

^a Percent deviation = (Actual - Goal) / Goal.

^b The number of escapement observations (1956–1998) which are less than the escapement of the current year.

Table 3.—Comparison of recent (2002–2006) pre-peak, peak and off-cycle yields to historical median yield for Kvichak River sockeye salmon.

| Year | Actual Yield | Historical Median Yield | | Difference | % Deviation from Median ^a | Yield < Lower Range ^b | Frequency of Occurrence ^c |
|------|--------------|--------------------------------|---------------------------|------------|--------------------------------------|----------------------------------|--------------------------------------|
| | | Pre-peak, Peak 1959–2000, n=18 | Off-cycle 1961–2001, n=25 | | | | |
| 2002 | 0 | | 1,858,475 | -1,858,475 | -100% | Yes | 0 (n=27) |
| 2003 | 34,244 | | 1,858,475 | -1,824,231 | -98% | No | 2 (n=27) |
| 2004 | 2,211,186 | 9,263,859 | | -7,052,673 | -76% | No | 5 (n=27) |
| 2005 | 532,450 | | 1,858,475 | -1,326,025 | -71% | No | 8 (n=27) |
| 2006 | 2,736,218 | | 1,858,475 | 877,743 | 47% | No | 18 (n=27) |

^a Percent deviation = (Actual - Median) / Median.

^b Lower range of Pre-Peak and Peak years was 148,595 and off-cycle years were 21,791.

^c The number of yield observations (1959–2001) which are less than the yield of the current year.

^d Yield is a preliminary estimate in 2006.

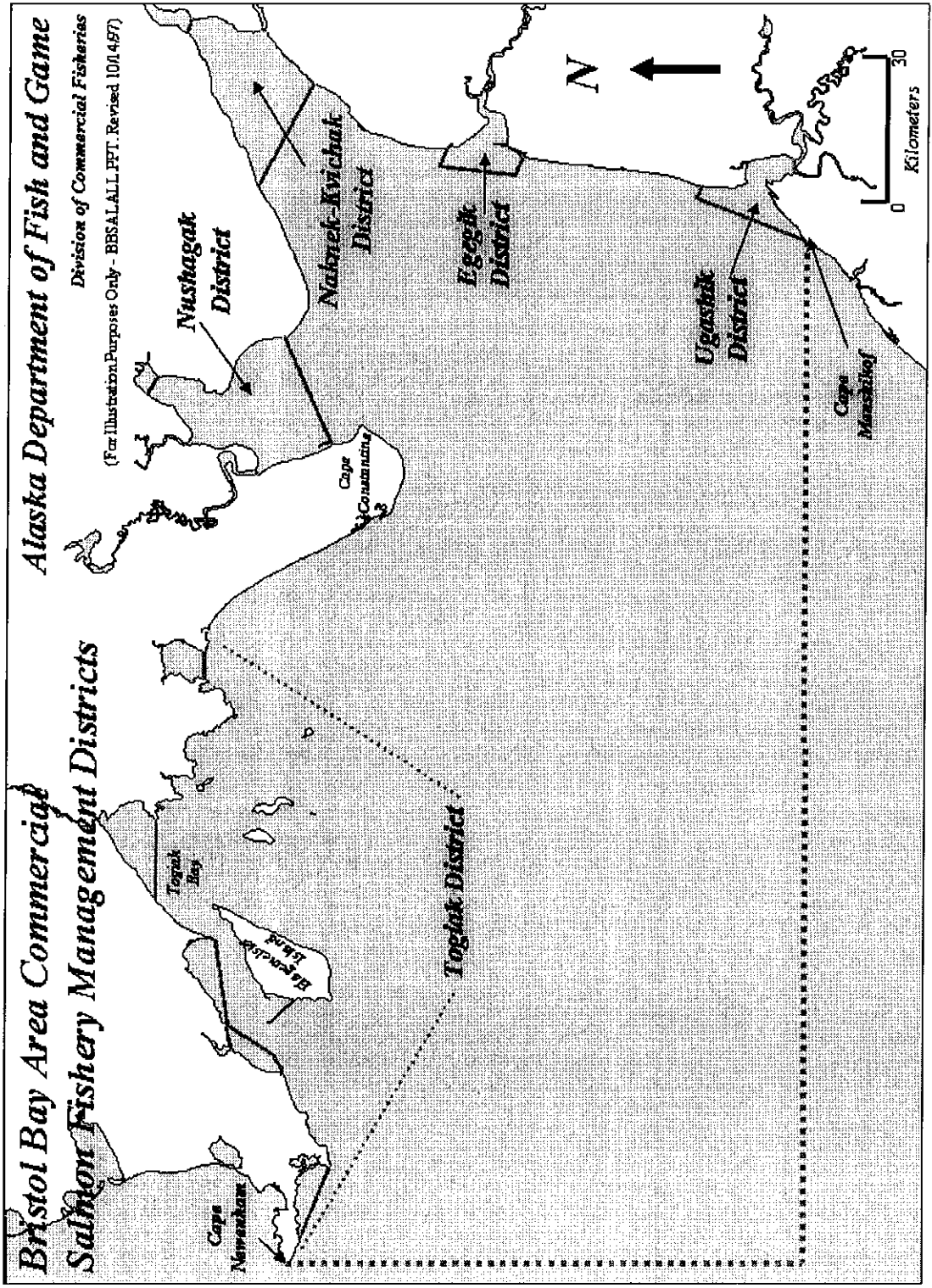


Figure 1.—Bristol Bay commercial salmon fishery management area, Alaska.

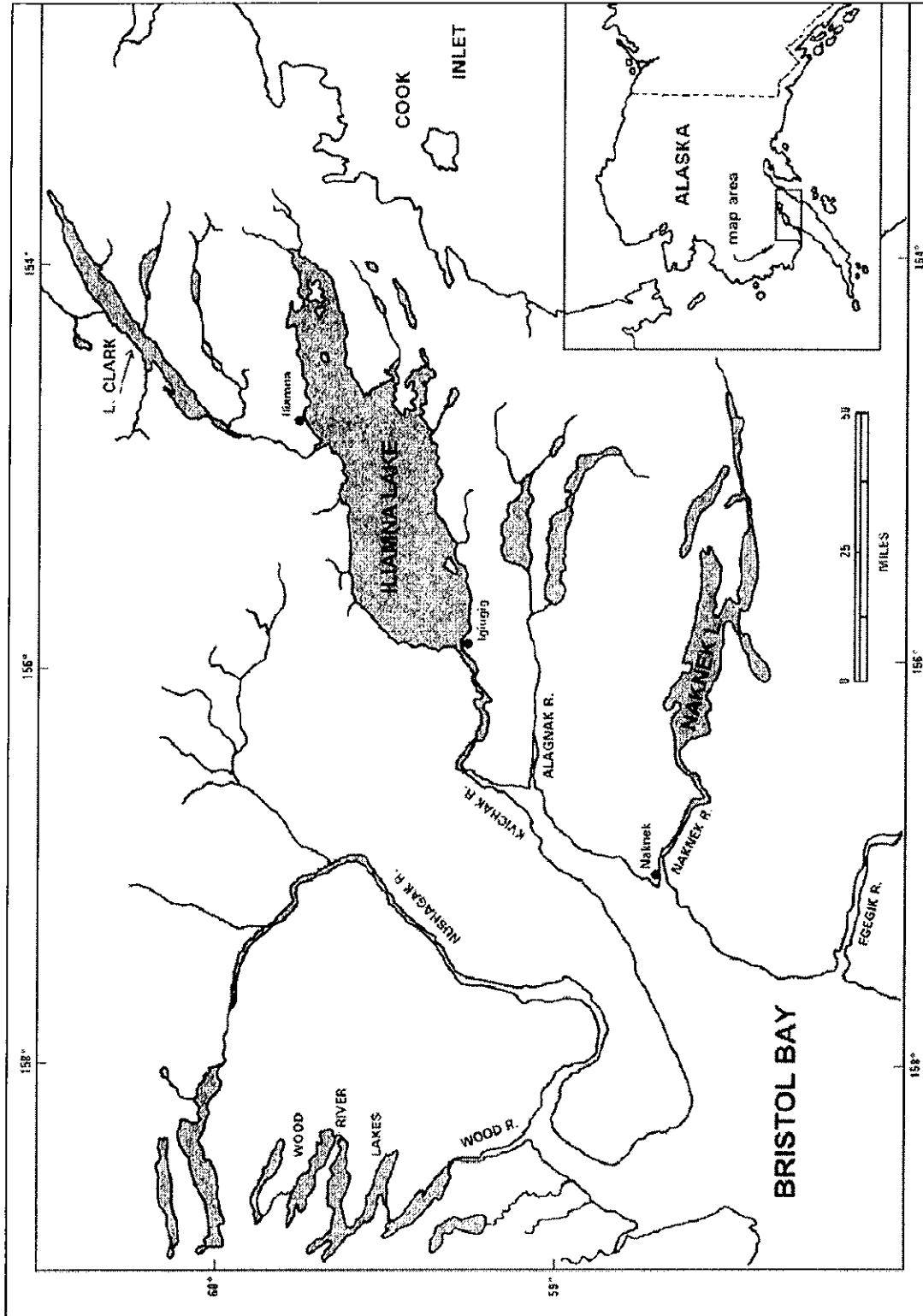


Figure 2.-Kvichak River drainage, Bristol Bay, Alaska.

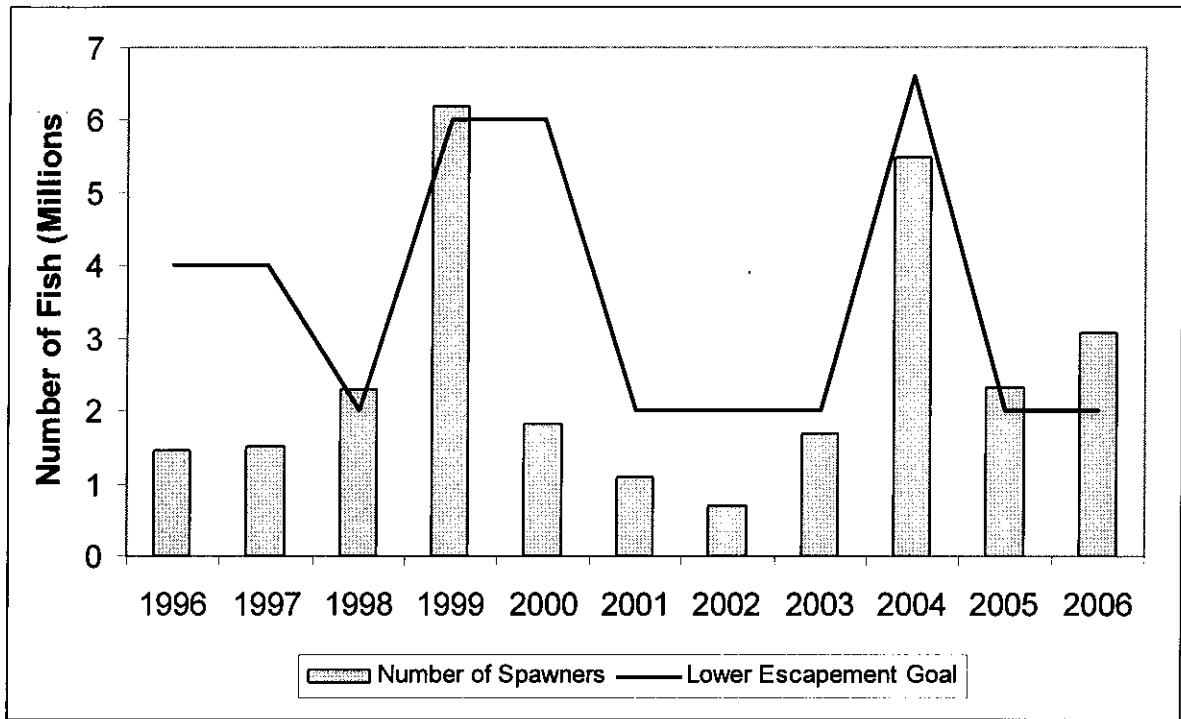


Figure 3.—Kovichak River sockeye salmon lower escapement goals and number of spawners, 1996–2006.

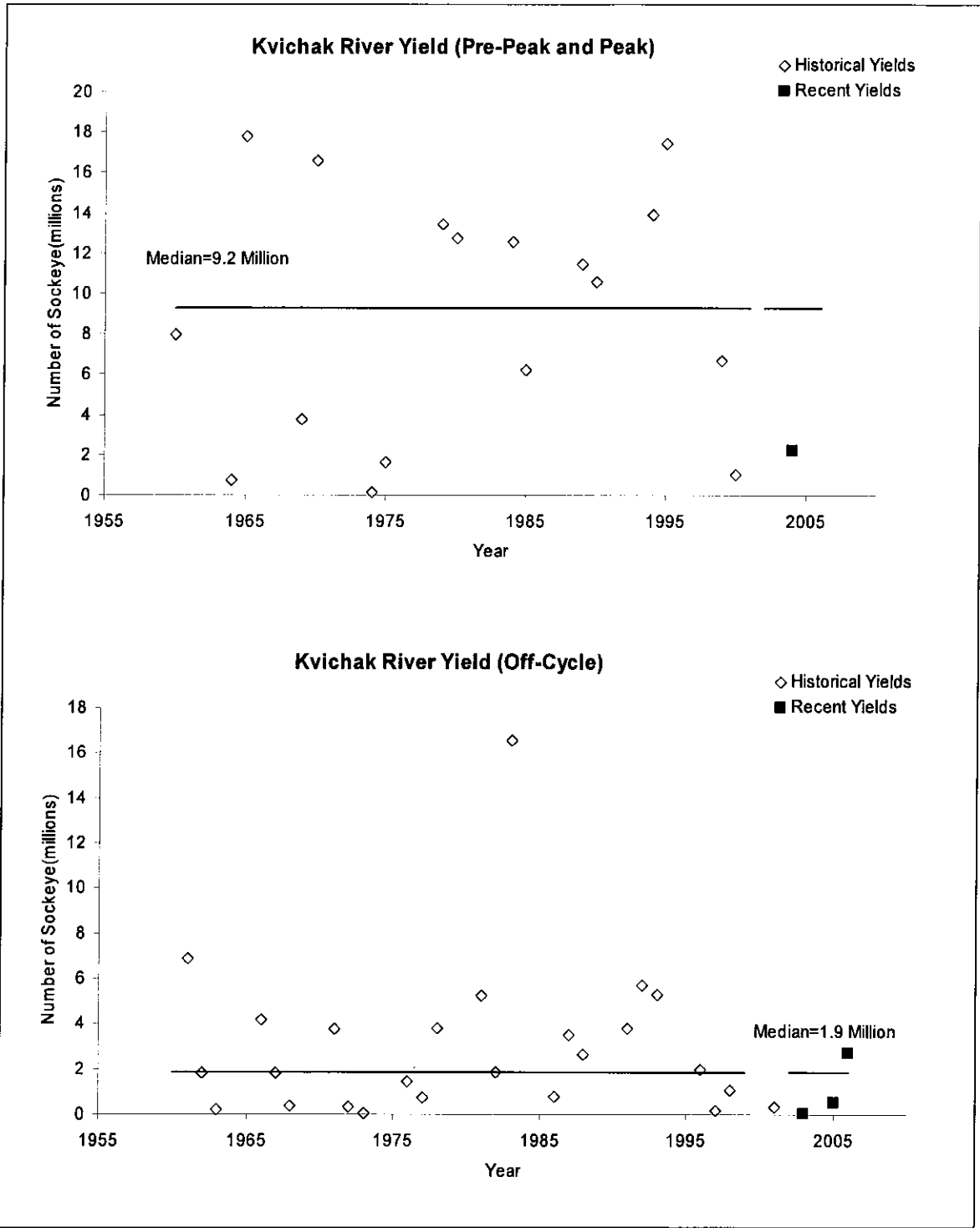


Figure 4.—Kvichak River sockeye salmon yield by year.

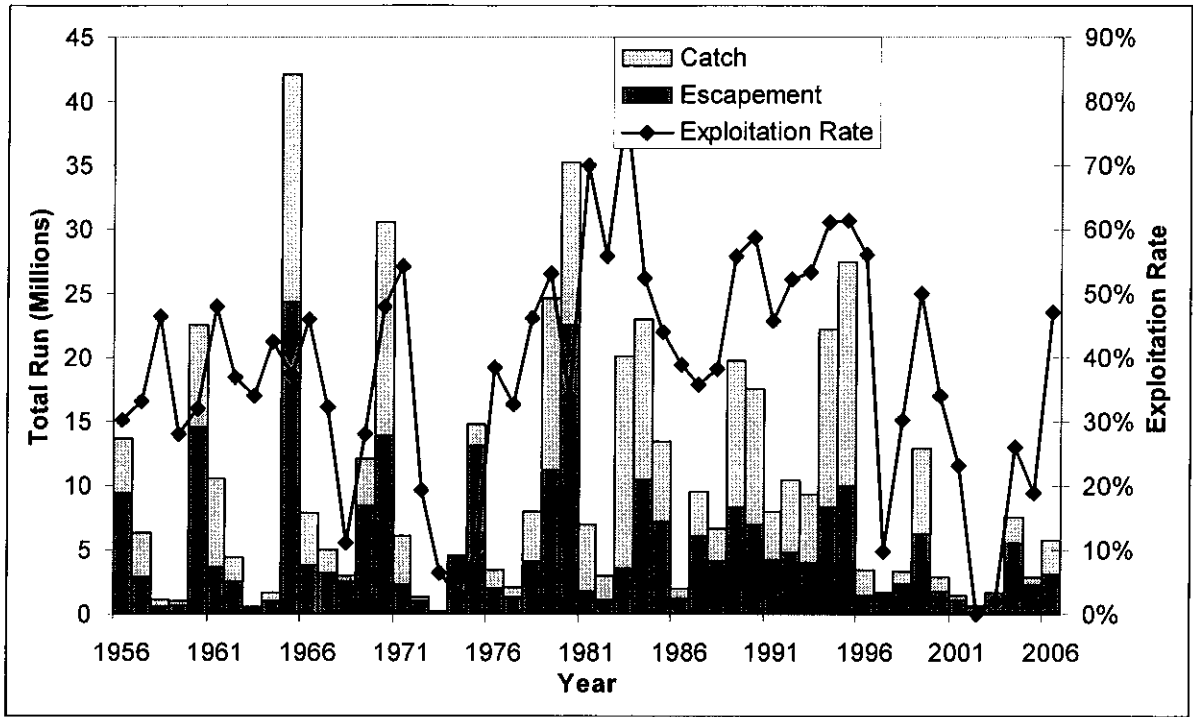


Figure 5.—Kvichak River sockeye salmon catch, escapement, and exploitation rate, 1956–2006.

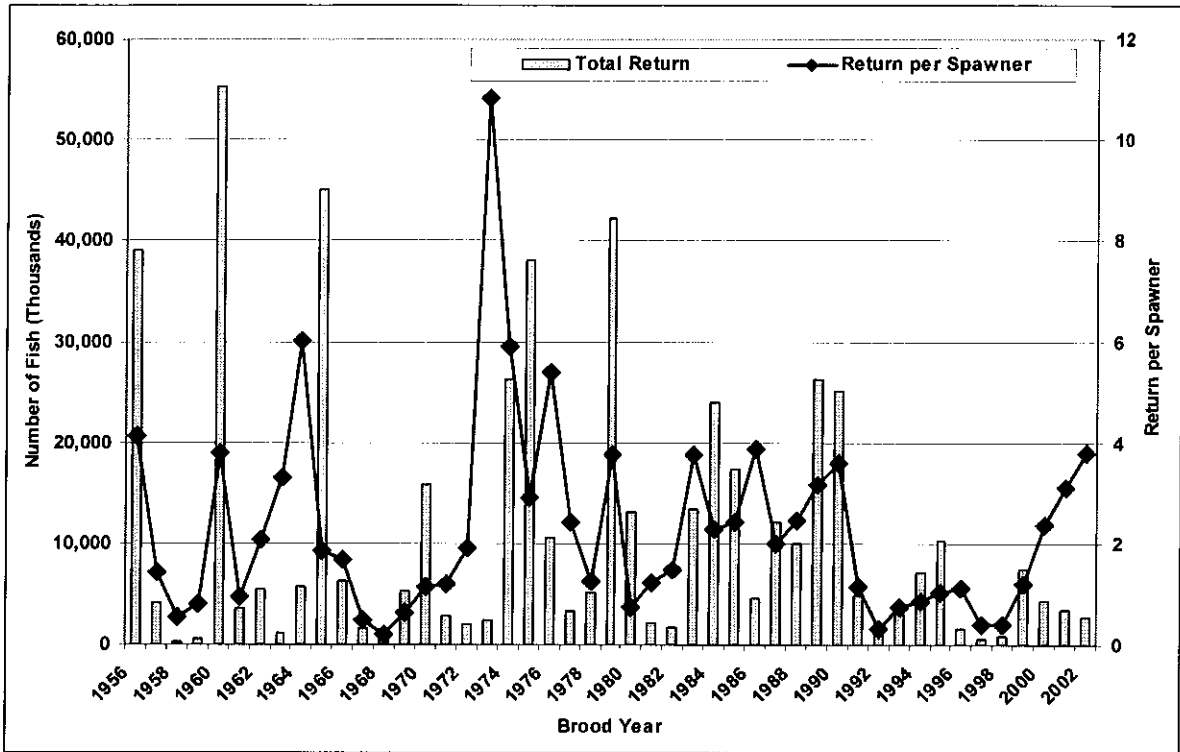


Figure 6.—Total returns and return per spawner by brood year for sockeye salmon in the Kvichak River system, 1956–2002.