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Kvichak River Sockeye Salmon Stock Status and Action Plan, 2009; a Report to the Alaska Board of Fisheries

by

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and

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November 2009

Alaska Department of Fish and Game Divisions of Sport Fish and Commercial Fisheries

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Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Measures (fisheries)

fork length	FL
mideye to fork	MEF
mideye to tail fork	METF
standard length	SL
total length	TL

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	*e*
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	*E*
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	log_2, etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

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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 (department) first classified the Kvichak River sockeye salmon *Oncorhynchus nerka* stock as a "Stock of Yield Concern" in 2001 (Bristol Bay Staff 2000). A yield concern is defined as "a concern arising from a chronic inability, despite use of specific management measures, to maintain expected yields." 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 has been helping the Kvichak River sockeye salmon stock recover: minimum escapement goals were met during the last 5 years (2005–2009); there was a surplus harvest of Kvichak River sockeye salmon in the commercial fishery from 2005–2009; and return per spawner has improved in recent years. Even with these recent improvements, there is still need for concern. Therefore, it is recommended that the Kvichak River sockeye salmon stock remain a stock of concern, but be reclassified from a "Stock of Management Concern" to a "Stock of Yield Concern."

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 Policy for the Management of *Sustainable Salmon Fisheries* (SSFP; 5 AAC 39.222) directs the Alaska Department of Fish and Game (department) to provide the Alaska Board of Fisheries (board), 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 the department's assessment of this stock of concern and recommendation that Kvichak River sockeye salmon be reclassified as a stock of yield concern.

KVICHAK RIVER SOCKEYE SALMON

Stock Assessment

Prior to the decline beginning in 1997, the Kvichak River sockeye salmon stock, on average, was the largest contributor to the Bristol Bay salmon harvest. The Kvichak River sockeye salmon 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 thousand to 24 million sockeye salmon (Table 1). The largest recorded total run (catch and escapement) was 48 million in 1965, a peak cycle year (Table 1). The department has operated a counting tower to enumerate salmon escapements on the Kvichak River since 1955. Additionally, each spring from 1975–2003, the number of migrating smolt was 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 Sustainable Escapement Goal (SEG) for Kvichak River sockeye salmon, adopted in 1997, is 2 million to 10 million for off-cycle years and 6 million to 10 million for pre-peak and peak years (Fair 2000). Setting an SEG for the Kvichak River sockeye salmon run has proven difficult because of perceived 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 to 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 (Figure 3). However, the lower escapement goal has been met for each of the last 5 years (2005–2009) (Table 2).

Commercial harvest, or yield, has improved in recent years (2005–2009) (Table 1; Figure 4). During the last 5 years, actual yield was more than the historical median yield of 1.8 million in off-cycle years except in 2005 and 2007 (Table 3 and Figure 4). Commercial fishing was restricted in Naknek-Kvichak District at some point each year from 1996–2007, forcing the fishery into the Naknek River Special Harvest Area. There were no restrictions to commercial fishing in 2008 and 2009. As directed in the *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 River drainage.

Prior to commercial fishing, area residents harvested Bristol Bay salmon for subsistence uses. The board determination of the amount reasonably necessary for subsistence uses is described in 5 AAC 01.336 as 157,000 to 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 Naknek-Kvichak District, sockeye salmon subsistence harvest averaged about 92,000 from 1985–1994 and 72,000 from 1995–2004. Annual subsistence harvest of Kvichak River sockeye salmon averaged 67,000 fish from 1988–1997 (Jones et al. 2009) with recent harvests (1998–2007) averaging 46,000 fish.

In 2009, 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). The escapement goal review team recommended a change to the Kvichak River sockeye salmon escapement goal. Currently, there are 2 goals, one for pre-peak and peak years, and one for off-cycle years. In recent years the ability to define a pre-peak or peak run was made increasingly difficult as the runs declined. A pre-peak/peak goal, largely composed of 5-year-old 2-ocean fish, was originally established because it was believed that production differed from that of off-cycle years, and therefore, it was advantageous to separate them. However, a new look at the production of pre-peak/peak versus off-cycle years shows similarity such that we cannot conclude they are different (Baker et al. 2009). Therefore, the review team recommended the pre-peak/peak escapement goal of 6 million to 10 million be dropped and that the off-cycle goal of 2 million to 10 million be expanded to include all years.

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 2009). 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 preseason and inseason projections to provide information on run size. Additionally, the department 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 board meeting. In response to the "Stock of Yield Concern" designation, the board 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 December 2003 Bristol Bay board meeting, several regulation changes were adopted concerning the Naknek-Kvichak District. The Kvichak River 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)).

During the December 2006 Bristol Bay board meeting, it was recommended that the Kvichak River sockeye salmon stock remain classified as a "Stock of Management Concern" (Morstad and Baker 2006). The department stated that it would like to see the continued improvement of

the Kvichak River sockeye salmon stock for 4 or 5 years before recommending the stock for reclassification.

Regulatory History

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

Permits are required to harvest salmon for subsistence purposes in the Kvichak River drainage. Since 1990, under state regulations, nearly all state of Alaska residents have been eligible to participate in subsistence salmon fishing in all Bristol Bay drainages. In Katmai National Park, only local residents who are descendents of Katmai residents who lived in the Naknek Lake and River drainage, and in Lake Clark National Preserve only local residents may subsistence fish.

The commercial fishery occurs from June 1 to September 30 and is opened by emergency order. There are 3 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 is an umbrella plan for Bristol Bay that 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 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 sockeye salmon 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 Naknek-Kvichak District and to establish management measures for the department to achieve the allocation.

Stock of Concern Analyses

Escapement

During the most recent 5 years, the minimum escapement goal was achieved in all 5 years (Table 2; Figure 3). It should be noted that the lower end of the peak goal in 2005 and pre-peak goal in 2009 were changed from 6 million to 2 million (implemented in 1998; Table 2).

Yield

During the last 5 years, the actual yield was more than the historical median yield of 1.8 million in off-cycle years except 2005 and 2007 (Table 3 and Figure 4).

Harvest Rate

The commercial fishing harvest rate on Kvichak River 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 River sockeye salmon stocks was less than 2%. There was an increase in the harvest rate in 2009 (58%); however, the harvest rate was below 50% from 2000 through 2008.

Return per Spawner

There has been an increase in the production (return per spawner) of the Kvichak River sockeye salmon stock in recent years. 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 about 4 returns per spawner.

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 harvestable surplus of Kvichak River sockeye salmon in the commercial fishery during 2005–2009; minimum escapement goals were met from 2005–2009; recruits per spawner have improved in recent years; and Kvichak River sockeye salmon stock harvest rates have been significantly reduced in recent years. Even with these recent improvements, there is still need for concern. Therefore, it is recommended that the Kvichak River sockeye salmon stock remain a stock of concern.

A yield concern was defined in the SSFP as "a concern arising from a chronic inability, despite use of specific management measures, to maintain expected yields." However, the amount or degree of yield that constitutes a yield concern was not defined; therefore, when to define a yield concern is subject to interpretation.

Because escapements have been met in recent years, but there are concerns regarding yield; it is recommended that the Kvichak River sockeye salmon stock be reclassified from a "stock of management concern" to a "stock of yield concern."

KVICHAK RIVER SOCKEYE SALMON ACTION PLAN

REVIEW OF 2006 ACTION PLAN

Current Stock Status

In response to the guidelines established in the Policy for the Management of Sustainable Salmon Fisheries, the Alaska Board of Fisheries, during the October 1–3, 2003 work session, classified the Kvichak River sockeye salmon stock as a management concern (Bristol Bay Staff 2003). 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 and established the amount reasonably necessary for subsistence (ANS) as 157,000 to 172,171 salmon, including 55,000 to 65,000 sockeye salmon for the Kvichak River drainage.

Habitat Factors Adversely Affecting the Stock

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

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-Kvichak 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 Management and Allocation Plan.*

5 AAC 09.200. *Description of districts and sections.*

5 AAC 09.310. *Fishing seasons.*

ACTION PLAN DEVELOPMENT HISTORY

Kvichak Sockeye Salmon Action Plan Goal

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

Previous Actions

During the board meeting in January 2001, the department presented a summary of 4 potential action plans (Bristol Bay staff 2000) of which 3 reduced the exploitation rate on Kvichak River stocks in each eastside district. During deliberation, the board made the following changes: (1) In the Ugashik District, when the preseason forecast of Kvichak River 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 Egegik District, when the NRSHA is open to commercial fishing then fishing in Egegik District is restricted to the Egegik River Special Harvest Area (ERSHA) and will remain in the ERSHA until fishing resumes in Naknek-Kvichak District; and (3) Naknek-Kvichak 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 Naknek River escapement goal range from 1.4 million to 2.0 million sockeye salmon. During the 2003 board meeting, the department presented one additional action plan item to further reduce the exploitation rate on Kvichak River stocks (Bristol Bay 2003). The board 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 sockeye salmon forecast for the Kvichak River projected a harvestable surplus of 6.6 million sockeye salmon with an escapement goal of 6.0 million. The board 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 Naknek-Kvichak District prior to June 23 with most of the harvest caught in the General District. Commercial fishing was restricted to Naknek Section for the drift fleet and marginal fishing in Kvichak Section for set gillnet gear. Escapement to Kvichak River was on track until July 6 when it fell more than one day behind. At that time, Naknek-Kvichak District was closed and fishing was restricted to the NRSHA. 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 in 2005 and 2006 was that Kvichak River met its escapement objectives.

The department 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, restrictions in current regulations are sufficient to minimize exploitation and ensure the vast majority of the sockeye salmon returning to 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.

		Actual Yield		Actual Escapement		Total Inshore Return	
Year	Type	Pre-Peak & Peak	Off-cycle	Pre-Peak & Peak	Off-Cycle	Pre-Peak & Peak	Off-Cycle
1956	Peak	4,168,343		9,443,318		13,611,661	
1957	Off-Cycle		3,540,189		2,842,810		6,382,999
1958	Off-Cycle		549,396		534,785		1,084,181
1959	Off-Cycle		281,930		673,811		955,741
1960	Peak	7,976,500		14,602,360		22,578,860	
1961	Off-Cycle		6,863,814		3,705,849		10,569,663
1962	Off-Cycle		1,833,401		2,580,884		4,414,285
1963	Off-Cycle		223,459		338,760		562,219
1964	Off-Cycle		763,486		957,120		1,720,606
1965	Peak	17,785,664		24,325,926		42,111,590	
1966	Off-Cycle		4,168,575		3,755,185		7,923,760
1967	Off-Cycle		1,800,652		3,216,208		5,016,860
1968	Off-Cycle		387,565		2,557,440		2,945,005
1969	Off-Cycle	3,760,565		8,394,204		12,154,769	
1970	Peak	16,581,224		13,935,306		30,516,530	
1971	Off-Cycle		3,764,861		2,387,392		6,152,253
1972	Off-Cycle		342,150		1,009,962		1,352,112
1973	Off-Cycle		21,791		226,554		248,345
1974	Off-Cycle	148,595		4,433,844		4,582,439	
1975	Peak	1,605,407		13,140,450		14,745,857	
1976	Off-Cycle		1,458,180		1,965,282		3,423,462
1977	Off-Cycle		739,464		1,341,144		2,080,608
1978	Off-Cycle		3,815,636		4,149,288		7,964,924
1979	Pre-Peak	13,418,829		11,218,434		24,637,263	
1980	Peak	12,743,074		22,505,268		35,248,342	
1981	Off-Cycle		5,234,733		1,754,358		6,989,091
1982	Off-Cycle		1,858,475		1,134,840		2,993,315
1983	Off-Cycle		16,534,901		3,569,982		20,104,883
1984	Pre-Peak	12,523,803		10,490,670		23,014,473	
1985	Peak	6,183,103		7,211,046		13,394,149	
1986	Off-Cycle		787,303		1,179,322		1,966,625
1987	Off-Cycle		3,526,824		6,065,880		9,592,704
1988	Off-Cycle		2,654,364		4,065,216		6,719,580

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Table 1.–Page 2 of 2.

		Actual Yield		Actual Escapement		Total Inshore Return	
Year	Type	Pre-Peak & Peak	Off-cycle	Pre-Peak & Peak	Off-Cycle	Pre-Peak & Peak	Off-Cycle
1989	Pre-Peak	11,456,509		8,317,500		19,774,009	
1990	Peak	10,551,217		6,970,020		17,521,237	
1991	Off-Cycle		3,808,873		4,222,788		8,031,661
1992	Off-Cycle		5,718,947		4,725,864		10,444,811
1993	Off-Cycle		5,287,523		4,025,166		9,312,689
1994	Pre-Peak	13,893,613		8,355,936		22,249,549	
1995	Peak	17,391,906		10,038,720		27,430,626	
1996	Off-Cycle		1,983,269		1,450,578		3,433,847
1997	Off-Cycle		179,480		1,503,732		1,683,212
1998	Off-Cycle		1,069,294		2,296,074		3,365,368
1999	Pre-Peak	6,663,209		6,196,914		12,860,123	
2000	Peak	1,033,814		1,827,780		2,861,594	
2001	Off-Cycle		330,538		1,095,348		1,425,886
2002	Off-Cycle		0		703,884		703,884
2003	Off-Cycle		34,244		1,686,804		1,721,048
2004	Pre-Peak	2,163,318		5,500,134		7,663,452	
Historical Years							
Median		9,263,859	1,800,652	8,918,761	1,965,282	18,647,623	3,423,462
Max		17,785,664	16,534,901	24,325,926	6,065,880	42,111,590	20,104,883
Min		148,595	0	1,827,780	226,554	2,861,594	248,345
n		18	31	18	31	18	31
Recent Years							
2005	Off-Cycle		532,450		2,320,332		2,852,782
2006	Off-Cycle		2,687,895		3,068,226		5,756,121
2007	Off-Cycle		1,420,384		2,810,208		4,230,592
2008	Off-Cycle		2,873,889		2,757,912		5,631,801
2009[a]	Off-Cycle		3,278,651		2,266,140		5,544,791

[a] 2009 are preliminary estimates.

Table 2.–Escapement analysis of Kvichak River sockeye salmon, 2005–2009.

Year	Actual Escapement	Escapement Goal	Difference	% deviation from Goal [a]	Escapement > Goal	Frequency of Occurrence [b]
2005	2,320,332	2,000,000	320,332	16%	Yes	14 (n=27)
2006	3,068,226	2,000,000	1,068,226	53%	Yes	17 (n=27)
2007	2,810,208	2,000,000	810,208	41%	Yes	17 (n=27)
2008	2,757,912	2,000,000	757,912	38%	Yes	17 (n=27)
2009	2,266,140	2,000,000	266,140	13%	Yes	13 (n=27)

[a] Percent deviation = (Actual – Goal) / Goal.

[b] The number of escapement observations (1961–2004) which are less than the escapement of the current year.

Table 3.–Comparison of recent (2005–2009) pre-peak/peak and off-cycle yields to historical median yield for Kvichak River sockeye salmon.

Year	Actual Yield	Median Yield: Pre-Peak / Peak	Median Yield: Off-cycle	Difference	% Deviation from Median [a]	Yield < Lower Range [b]	Frequency [c]
2005	532,450		1,800,652	-1,268,202	-70%	No	8 (n=27)
2006	2,687,895		1,800,652	887,243	49%	Yes	17 (n=27)
2007	1,420,384		1,800,652	-380,268	-21%	No	11 (n=27)
2008	2,873,889		1,800,652	1,073,237	60%	Yes	17 (n=27)
2009[d]	3,278,651		1,800,652	1,477,999	82%	Yes	17 (n=27)

[a] Percent deviation = (Actual - Median) / Median.

[b] Lower range of pre-peak and peak years was 148,595 and off-cycle years was 0.

[c] The number of yield observations (1961–2004) which are less than the yield of the current year.

[d] 2009 Yield is a preliminary estimate.

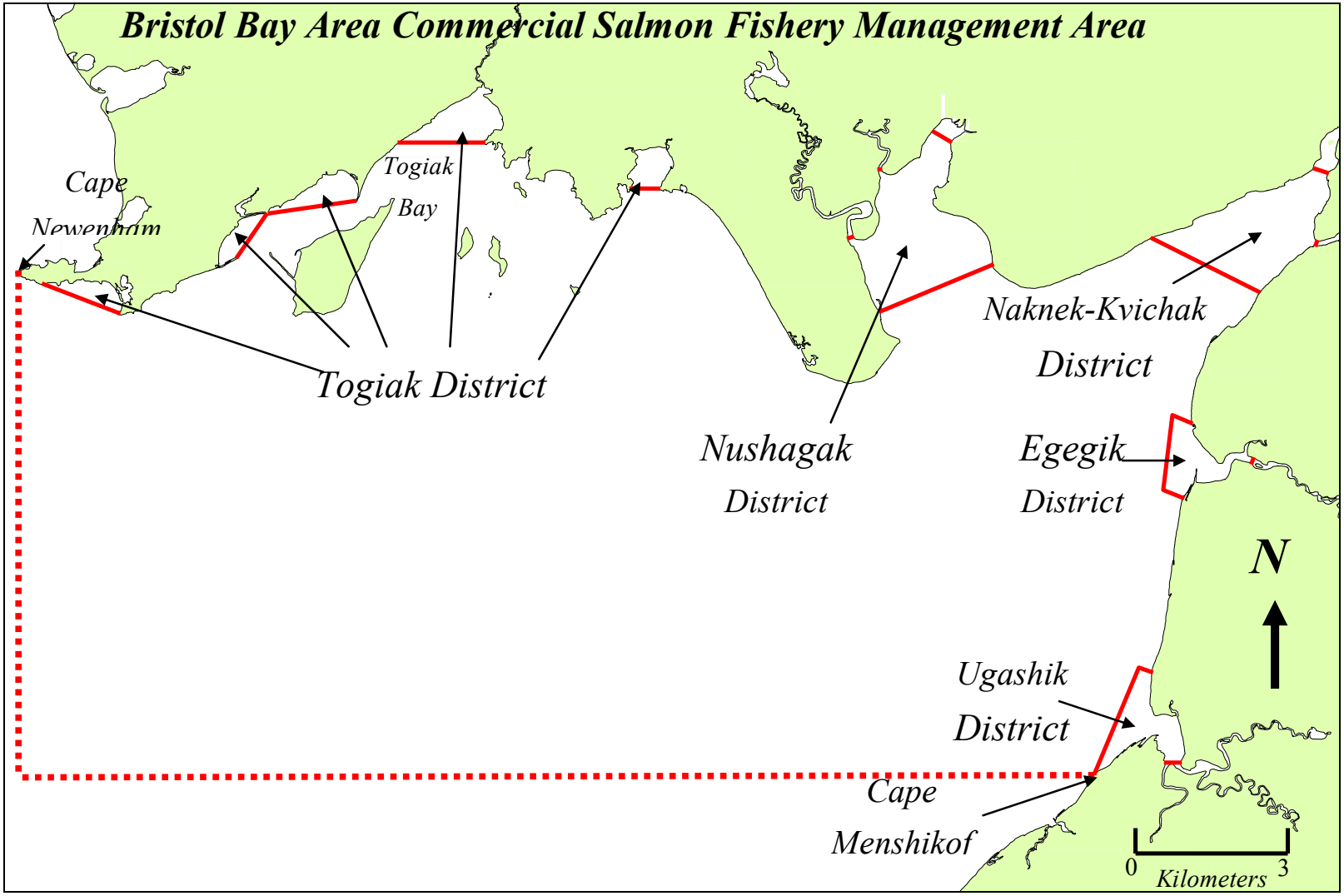

Figure 1.–Bristol Bay commercial salmon fishery management area, Alaska.

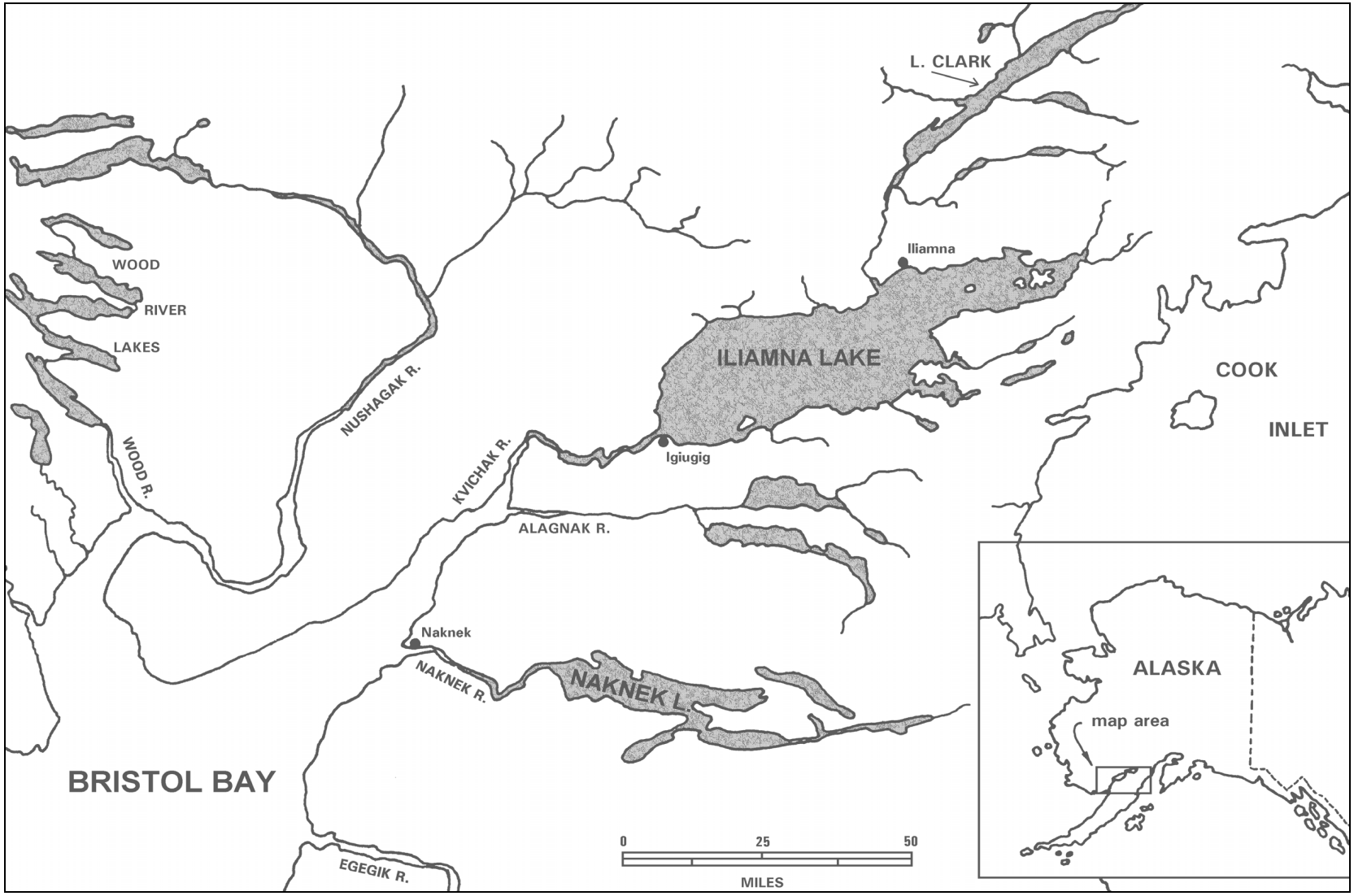

Figure 2.–Kvichak River drainage, Bristol Bay, Alaska.

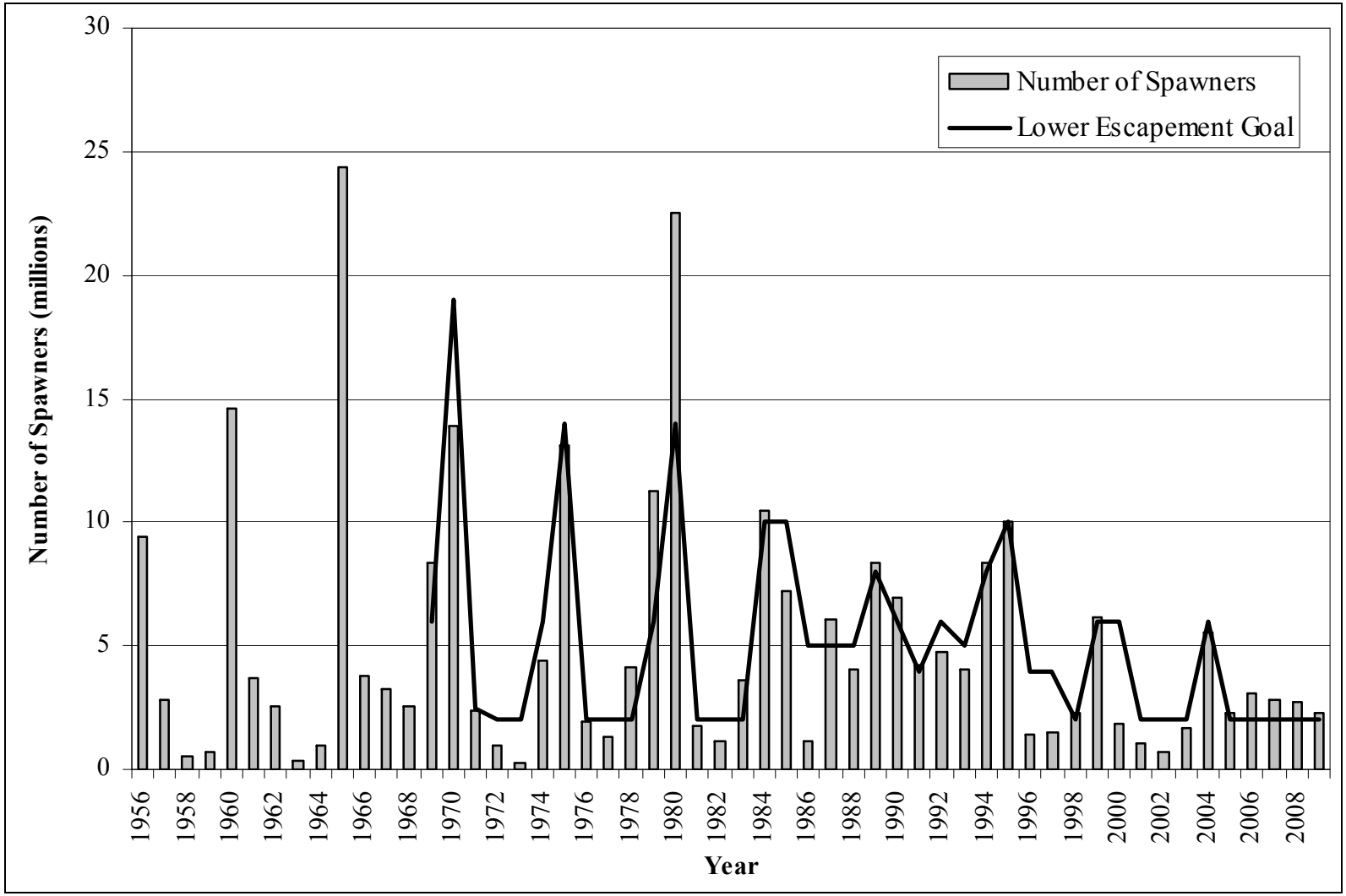

Figure 3.–Kvichak River sockeye salmon lower escapement goals (1969–2009) and number of spawners (1956–2009).

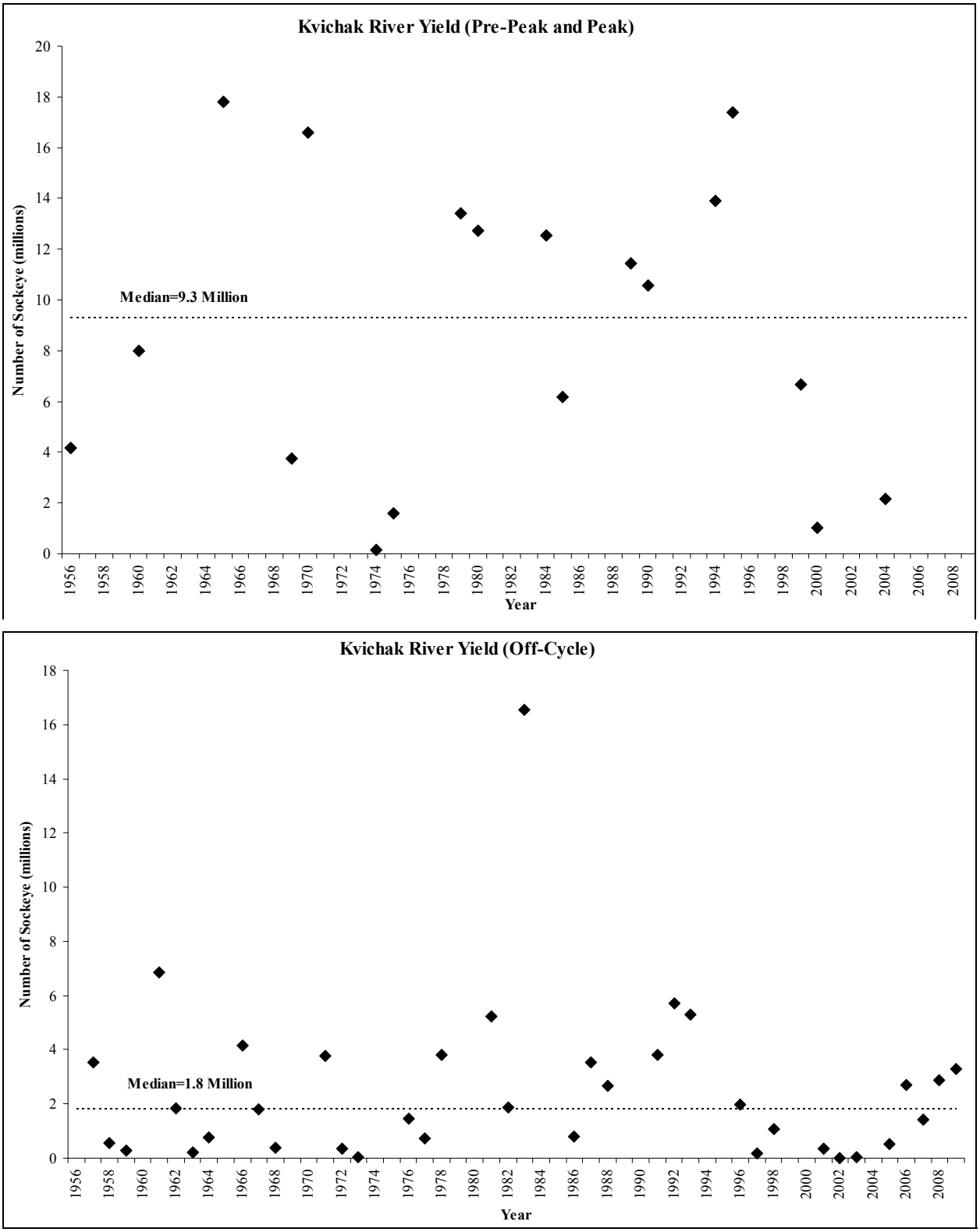

Figure 4.–Kvichak River sockeye salmon yield by year, 1956–2009.

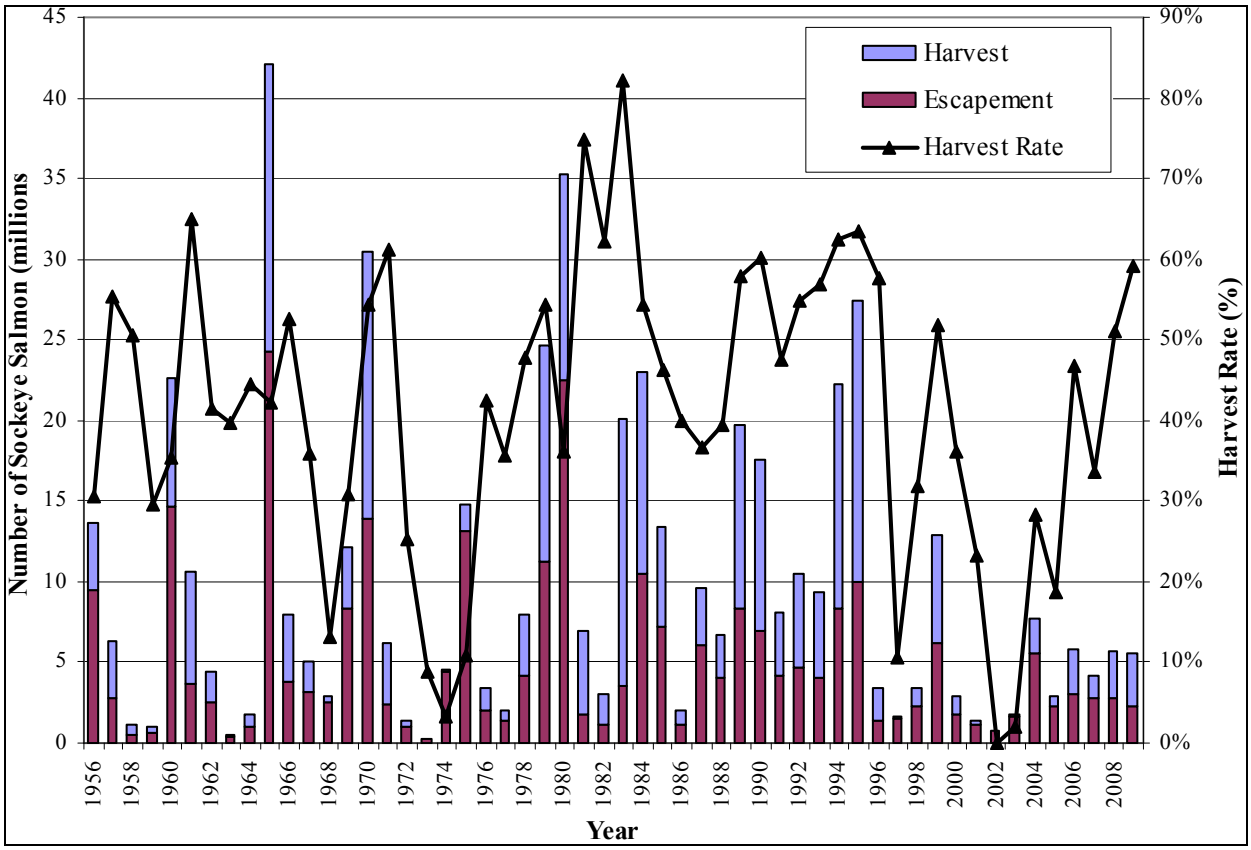

Figure 5.–Kvichak River sockeye salmon catch, escapement, and harvest rate, 1956–2009.

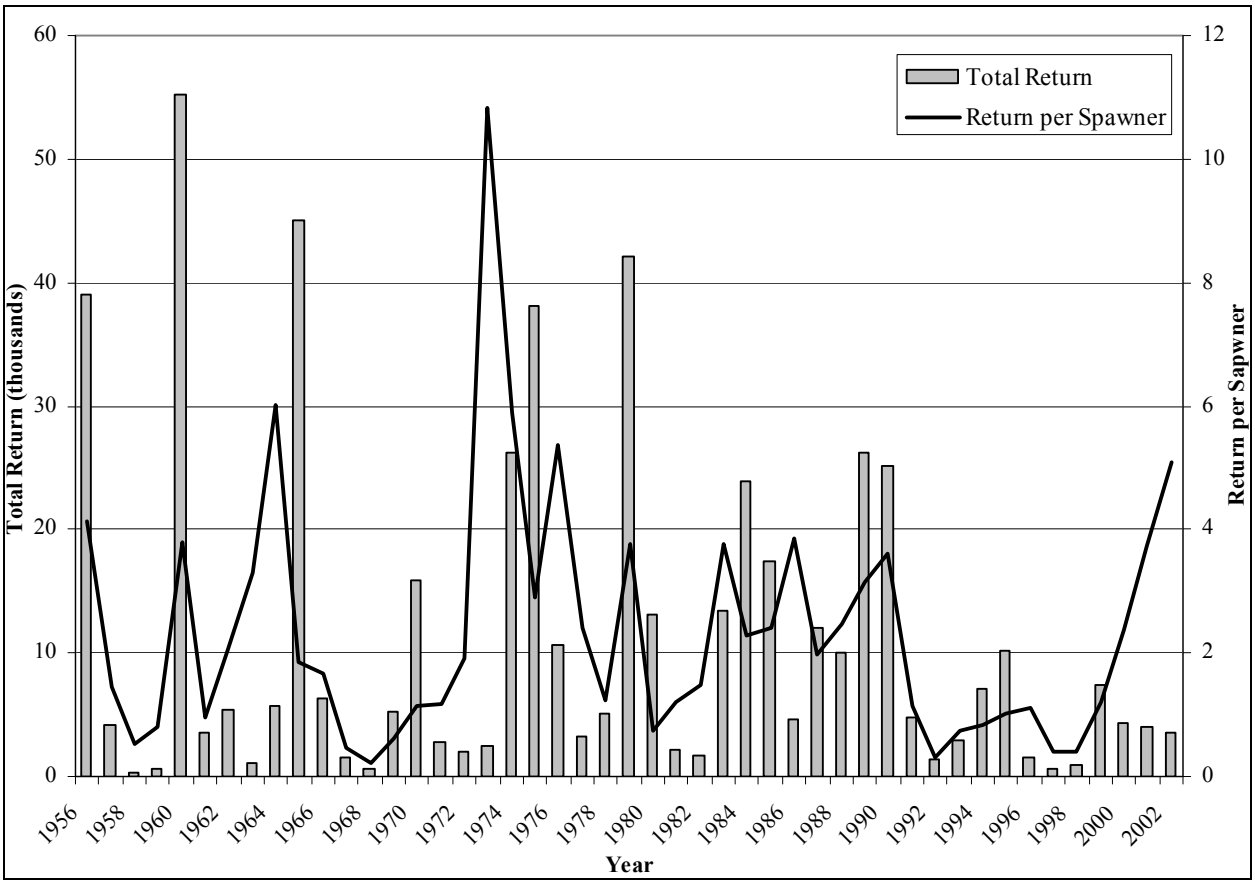

Figure 6.–Total returns and return per spawner by brood year for sockeye salmon in the Kvichak River system, 1956–2002.