CHAPTER 2: SOCKEYE SALMON STOCK STATUS AND ESCAPEMENT GOALS IN SOUTHEAST ALASKA

by

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ABSTRACT

Following a 2005 review of existing escapement goals for Southeast Alaska and the Yakutat area, three sockeye salmon (*Oncorhynchus nerka*) goals (Chilkat Lake, Chilkoot Lake and McDonald Lake) were revised and one goal (the Akwe River) was eliminated. There are currently 13 escapement goals for sockeye producing systems in the Southeast Alaska and Yakutat area. Over the last five years, escapement measures have been generally within or above the escapement goal ranges for at least four years; exceptions include Tahltan, McDonald and Hugh Smith lakes. Hugh Smith Lake was classified as a *stock of management concern* in 2003. In 2003 ADF&G lowered the escapement goal ranges and cooperated in stocking Hugh Smith Lake with hatchery-produced pre-smolts. The Board of Fisheries approved an action plan for the stock's recovery, and approved an *optimal escapement goal*, which explicitly included the hatchery-produced returns. Hugh Smith escapements were above the upper end of the new goal range from 2003 to 2005, but large numbers of the stocked fish counted as escapement failed to successfully spawn in the lake. Because the stocked returns were identifiable with an otolith mark, we were able to show that the Board-approved action plan was effective at reducing the harvest of this stock in the mixed-stock fisheries, and we showed that the number of naturally produced sockeye has increased in the escapement. ADF&G recommends removing the *stock of concern* designation from the Hugh Smith stock. We found no other stock in our review that we can recommend as *stocks of concern*. Although sockeye yields have generally been maintained in Southeast Alaska over two decades, yields are below peak historic levels. Yields in the Yakutat area have declined since the early 1990s, although escapement goals have been met in most cases.

Key words: Sockeye salmon, *Oncorhynchus nerka*, escapement, escapement goals, escapement goal ranges, stock status, lakes, Situk River, Chilkat Lake, Chilkoot Lake, Tahltan Lake, McDonald Lake, Hugh Smith Lake, stocks of concern

INTRODUCTION

Sockeye salmon (*Oncorhynchus nerka*) that are harvested in Southeast Alaska and the Yakutat area originate from three sources: transboundary rivers that flow through Canada and into Alaska (such as the Alsek, Taku, and Stikine rivers), coastal lakes (such as Chilkat and Chilkoot lakes in northern Lynn Canal, McDonald Lake near Ketchikan, as well as the Situk River near Yakutat; Figure 2.1), and Canadian rivers systems (such as the Nass and Skeena rivers). There are over 200 sockeye producing systems in the region (Van Alen 2000). Many but not all of these are small producers, however, their combined production is substantial. Most sockeye salmon originate in lake systems, but in Southeast Alaska and the Yakutat area, sockeye salmon also originate in riverine areas within the region's large mainland glacial systems. In addition to the larger systems in the Southeast Region, we have long-term stock assessment information for several smaller producers in the Yakutat area, including the Lost, Italio, Akwe and East Alsek-Doame rivers, and information on Redoubt Lake near Sitka, Speel Lake near Juneau, and Hugh Smith Lake near Ketchikan. Harvest information is recorded on a district-specific basis (Figure 2.2), and because stock-specific harvest information does not exist, it is usually not possible to study the productivity of a particular stock.

The timing of the return varies among runs throughout the region, and within individual stocks in several of the larger drainages. Sockeye salmon are available to fisheries in the region between early June and mid-September. Peak abundance occurs during the month of July. Spawn timing is also highly variable, with most spawning occurring between early August and late October.

Many of the region's sockeye salmon systems are monitored, most by the Alaska Department of Fish and Game (ADF&G). But in recent years monitoring efforts have been augmented by other agencies, including the U.S. Forest Service (USFS), National Marine Fisheries Service-Auke Bay Laboratory, and the Canadian Department of Fisheries and Oceans (CDFO) on Canadian portions of the transboundary rivers, as well as by non-governmental groups including several tribal associations and aquaculture associations. A subset of the region's sockeye salmon systems

have been examined intensively and over a long enough time period to gain sufficient understanding of stock productivity to develop escapement goals (Figure 2.1).

Alaska's Sustainable Salmon Fisheries Policy (5AAC 39.222) was adopted into state regulation in 2000. This policy requires ADF&G to report on salmon stock status to the Alaska Board of Fisheries on a regular basis. The Policy for Statewide Escapement Goals (5 AAC 39.223) directs ADF&G to document existing salmon escapement goals, establish goals for stocks for which escapement can be reliably measured, and perform an analysis when these goals are created or modified. In order to meet requirements of the policies, Geiger et al. (2004) produced ADF&G's first report on stock status and escapement goals of sockeye salmon for the Southeast Alaska and Yakutat region. This chapter represents an updated, and somewhat abridged, version of that report, including changes in escapement goals recommended by ADF&G.

The first records of substantial commercial sockeye salmon catches date to 1883, when just over 100,000 fish were reported in the commercial harvest, although there was some level of commercial activity before that year (Byerly et al. 1999; Figure 2.3). Subsistence, personal use, and sport fishers harvest and use sockeye salmon in Southeast Alaska and the Yakutat area. After Alaskan statehood the commercial harvest can be used as a proxy for the total harvest, or even total abundance, in this area of the state because the commercial harvest has been such a large fraction of the runs. Catch records show commercial harvests in the Yakutat area in the early 20th century, with a peak of 453,000 in 1914. Annual commercial catches in Southeast Alaska and the Yakutat area were consistently in excess of 2 million fish from 1902 to 1920, peaking at 3.5 million in 1914. From 1925 to 1945 major fishing districts were defined, and a number of management measures and weekend fishing closures were introduced. Catches began a slow decline during this period, and ranged from 1.1 million to 2.5 million per year through the mid-1940s. By 1940 many runs were severely overfished and catch trends were on their way down. Until the 1940s, harvests of sockeye salmon in southern Southeast Alaska were more stable and consistent than in northern portions of the region. However, catches dropped in both areas in the 1940s (Figure 2.3). The region's commercial catch of sockeye salmon reached a trough of 490,000 in 1949 and generally remained below 1 million fish annually through the 1960s. After statehood, harvests in the Yakutat area generally increased up to a peak of nearly 350,000 in 1993 (Figure 2.4), and then declined to about the levels of the 1970s (slightly above 100,000).

Throughout Alaska, many salmon stocks declined in the early 1970s and then increased in the mid- to late-1970s— partially due to ocean-climate effects called the "regime shift" (Mantua et al. 1997; Beamish et al. 1998). Sockeye harvest levels began increasing in the late 1970s, especially in southern Southeast Alaska, although not as dramatically as with most other Alaskan salmon stocks (e.g., see Heinl and Geiger *in this volume*) and consistently exceeded 2 million fish between the late 1980s and late 1990s. Van Alen (2000) and others cite increased sockeye production spawning channels on the Skeena River in Canada as the main reason for the increased catch of sockeye salmon in southern Southeast Alaska, beginning in the 1980s.

The sockeye salmon is the primary species harvested in the region's drift gillnet fisheries during the summer months of June through late August, although substantial harvests of summer chum, pink, and coho salmon occur as well in the drift gillnet fisheries. During September and early October the fisheries target coho and fall-run chum salmon. There are five traditional drift gillnet fishing areas in Southeast Alaska: District 101 (Tree Point and Portland Canal), District 106 (Sumner and Clarence straits), District 108 (Stikine), District 111 (Taku-Snettisham), and District 115 (Lynn Canal). In addition, there is a terminal harvest area near the Snettisham

Hatchery where drift gillnet gear is allowed to harvest returns of Snettisham Hatchery sockeye salmon. Each of the traditional fisheries harvests mixed stocks of sockeye salmon.

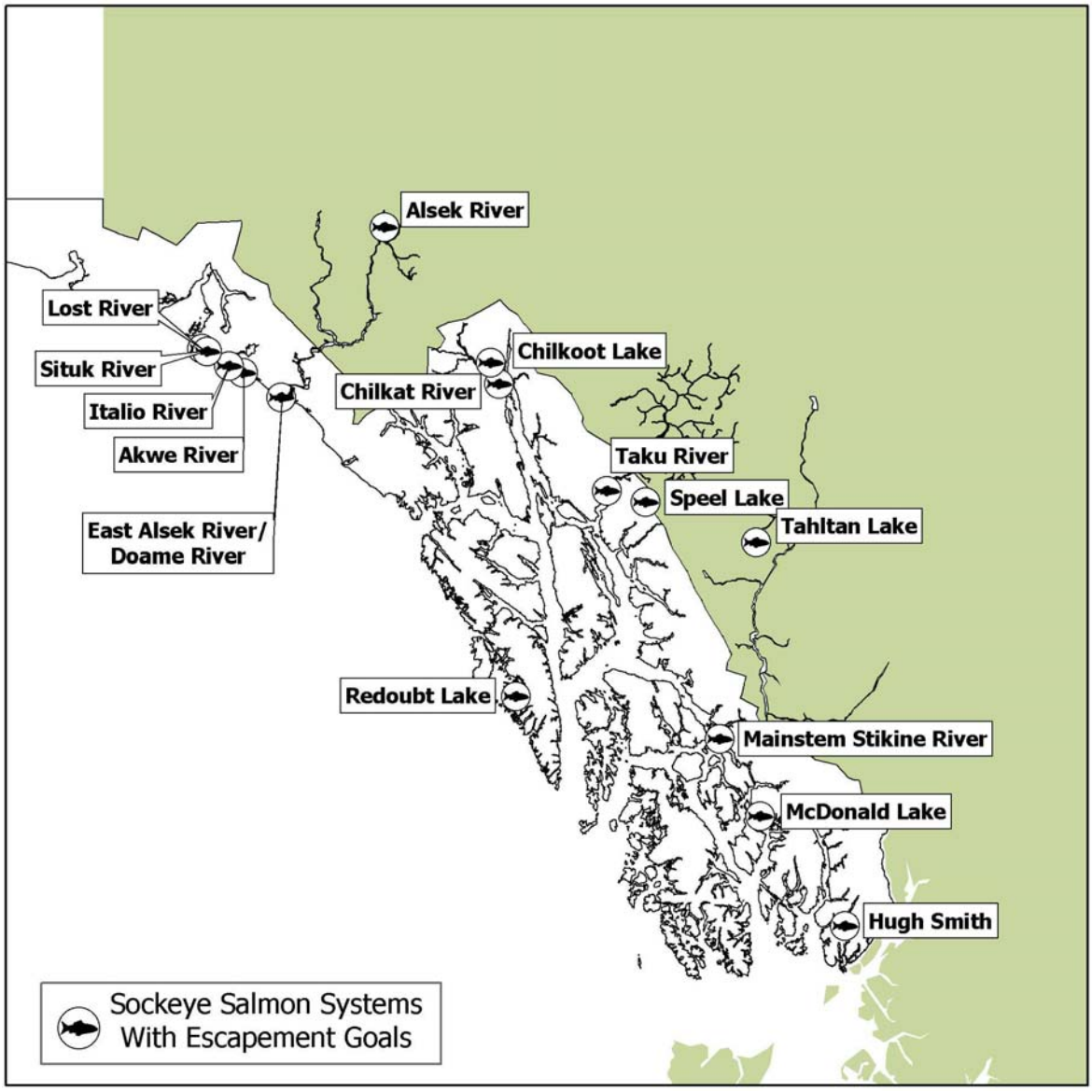

Figure 2.1–Sockeye salmon systems in Southeast Alaska and the Yakutat area that had escapement goals between 2002 and 2005. Escapement goals have been eliminated for the Akwe and Italio systems in the Yakutat area.

Management of the District 101, 106, 108, and 111 fisheries is governed by specific agreements with Canada in the Pacific Salmon Treaty as well as consideration of domestic stocks. The Tree Point fishery (in District 101) is constrained by the current Pacific Salmon Treaty agreement to harvest 13.8% of the annual allowable harvest of Nass River sockeye salmon. The District 106

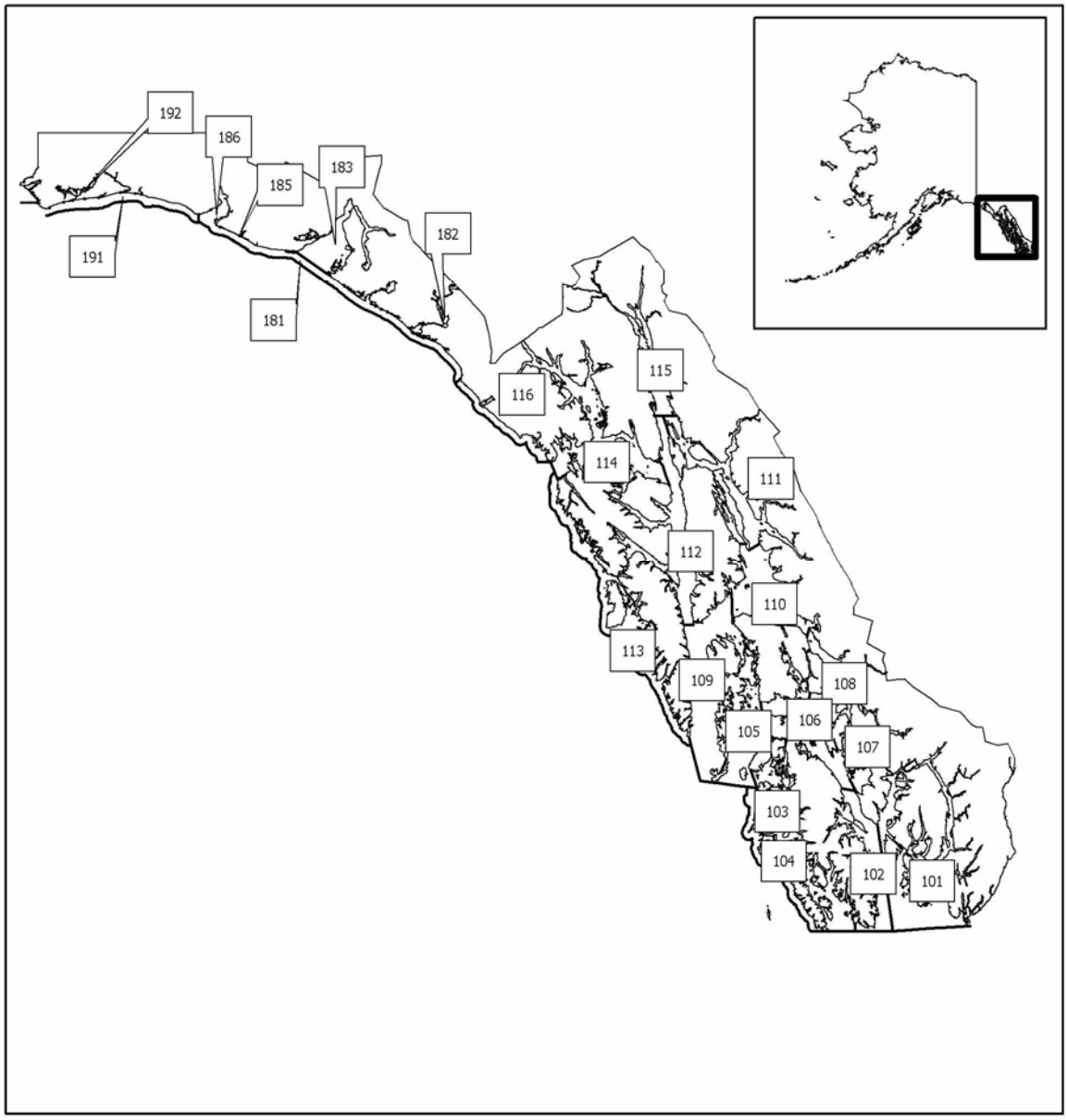

Figure 2.2–Fishing districts in Southeast Alaska and the Yakutat area.

and 108 fisheries are managed to abide by harvest-sharing agreements for transboundary Stikine River sockeye salmon; the current agreement specifies equal sharing of the total allowable catch[1] of Stikine River sockeye salmon in the two countries' fisheries. Harvest sharing of transboundary Taku River sockeye salmon is a major consideration in the District 111 fishery, with the U.S. entitled to 82% of the total allowable catch of wild Taku River sockeye salmon and 50% of the total allowable catch of sockeye salmon resulting from joint U.S./Canada enhancement programs on the river. The District 115 fishery, which targets sockeye salmon returns to the Chilkat and Chilkoot rivers, is the only drift gillnet fishery not directly affected by the Pacific Salmon Treaty.

[1] AAH (annual allowable harvest) and TAC (total allowable catch) are terms defined in the Pacific Salmon Treaty that represent the harvestable surplus in excess of the agreed upon escapement goal.

ADF&G operates intensive stock identification programs in order to effectively manage the stocks harvested in the fisheries and to abide by Pacific Salmon Treaty agreements. These programs have been operated since the early 1980s and are integral to the assessment of the region's sockeye salmon runs.

Although purse seine fisheries are frequently the largest harvester of sockeye salmon in the region, the primary targets of the seine fisheries are pink salmon and hatchery returns of chum salmon. The District 104 fishery, on the outer coast of southern Southeast Alaska, is where most sockeye salmon are taken by the purse seine fleet. Pacific Salmon Treaty provisions currently limit the District 104 harvest of sockeye salmon prior to Statistical Week 31 (near 31 July) to 2.45% of the annual allowable harvest of the combined Nass and Skeena River sockeye salmon runs. Directed purse seine fisheries on sockeye salmon occasionally occur in terminal areas when surpluses to spawning needs are identified; examples include Yes Bay (McDonald Lake run) in southern Southeast Alaska, and Redfish Bay and Necker Bay along the outside coast of northern Southeast Alaska near Sitka. Sockeye harvests in most other purse seine fisheries in the region are incidental to directed fishing on other species. To abide by Pacific Salmon Treaty agreements, contributions of Nass and Skeena sockeye salmon runs and a conglomerate of Alaska sockeye runs are estimated annually in southern Southeast Alaska purse seine fisheries. At present, these programs do not provide stock-specific information on harvests of individual Alaska sockeye runs in the region.

Set gillnet gear is allowed in the Yakutat area; there are no other commercial set gillnet fisheries in the rest of the region. Moreover, set gillnets are the only net gear allowed for commercial harvest of salmon in the Yakutat area. Sockeye salmon are the primary species targeted by Yakutat area fisheries during June through late August. The fisheries occur at or near the mouths of streams draining into the Gulf of Alaska, and thus are managed according to developing returns to each specific river. The exception to this is the Yakutat Bay fishery. This fishery harvests mixed stocks returning to all the systems in the area.

STOCK STATUS

This section provides a short summary of harvest and escapement assessment programs used to develop data series for monitoring stocks and establishing escapement goals. Status of the stocks is then reviewed by comparing measured escapements relative to established goals.

HARVEST ESTIMATION

Commercial harvest is recorded on a legal document called a *fish ticket*. The total weight of the harvest is the primary measure, and serves as the basis of payment on the part of the processors to the fishers. Fish tickets contain temporal and spatial information about the harvest, as well as information about the vessel making the catch and sale. Catch, in units of weight, is converted into units of fish numbers by the processors based on their own individual methods of determining the average weight of individual fish. By far, the largest removals are in the commercial fisheries, and the most accurate harvest estimates are for these fisheries.

Subsistence and personal use harvests have traditionally been estimated by means of returned permits. Since there are no important disincentives for non-reporting, harvests in these categories

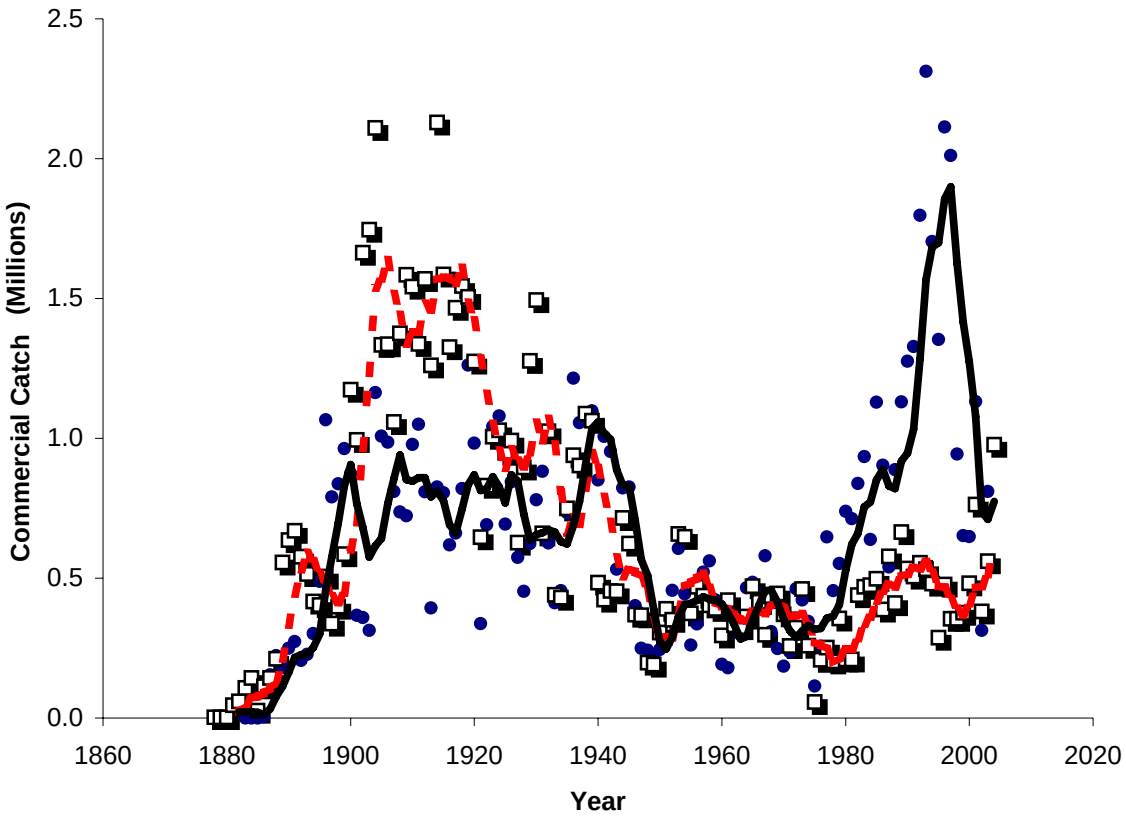

Figure 2.3–Commercial catch of sockeye salmon in Southeast Alaska (not including the Yakutat area) from 1878 to 2004. Open squares show catch of sockeye salmon in northern Southeast Alaska, and dots show catch of in southern Southeast Alaska. The curves show 5-year running averages. The solid curve is the estimated trend for southern Southeast Alaska, and the dashed curve is the estimated trend for northern Southeast Alaska.

are usually underreported and underestimated. Probability based surveys of subsistence harvest have been conducted for two years at Falls, Klag, Hetta, and Klawock lakes. These studies showed that the reported harvest was lower than the actual harvest (Conitz and Cartwright 2002a, 2002b, 2002c; Conitz et al. 2002; Lewis and Cartwright 2002a, 2002b, 2002c). Sport harvest is assessed by means of a household-based postal survey (e.g., Jennings et al. 2004).

Biological sampling is conducted in most commercial net fisheries that harvest sockeye salmon in Southeast Alaska and the Yakutat area. Age, sex and size data are collected, analyzed and summarized annually. ADF&G estimates stock compositions of sockeye harvests in most of the region's major mixed stock fisheries. A variety of techniques are used, including analyses of scale pattern, brain parasites, genetic stock identification, and thermal otolith marking of hatchery releases (Van Alen 2000; Jensen 2000). However, some fisheries directed at other species are not intensively sampled for sockeye stock composition (e.g. some purse seine fisheries in northern Southeast Alaska). Some of the stock-separation programs provide estimates for groups of stocks

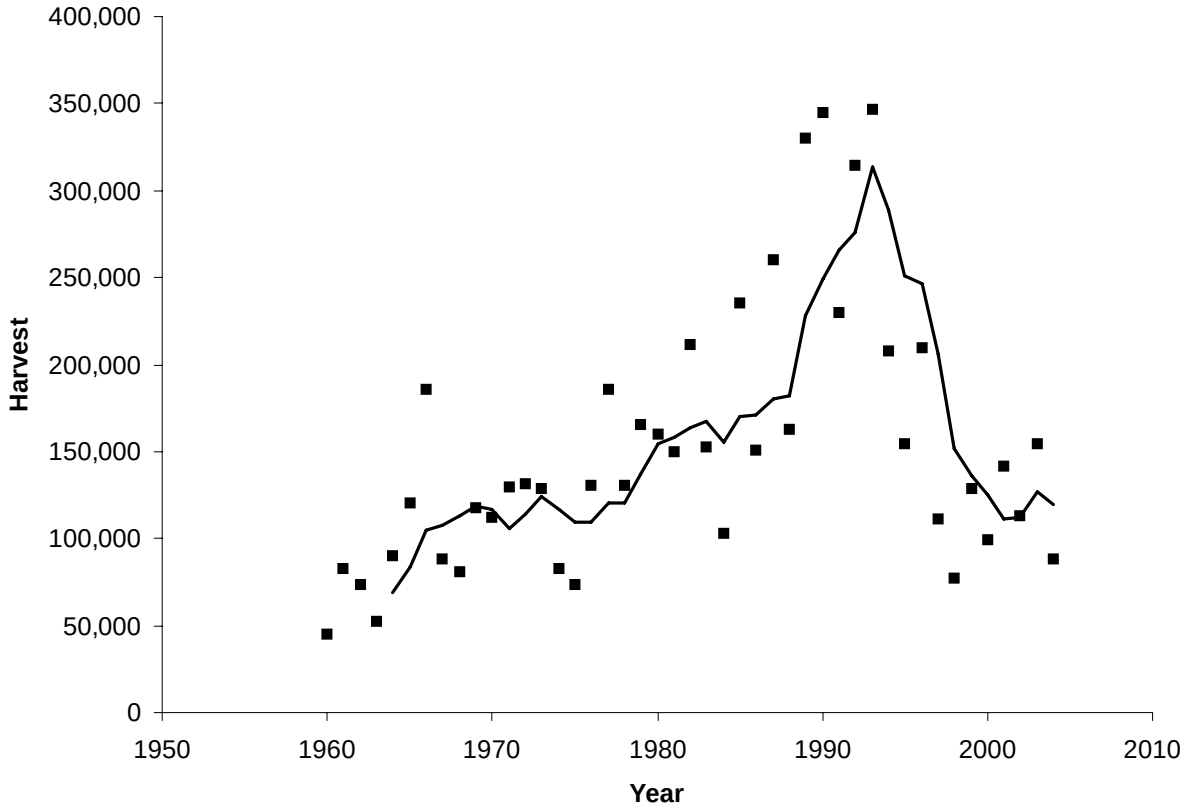

Figure 2.4–Commercial harvests of sockeye salmon in the Yakutat area from statehood to 2004. The curve represents the 5-year running average.

useful for management purposes, but do not provide a high degree of resolution for individual Southeast Alaska wild stocks (e.g. stock composition of fisheries in southern Southeast Alaska). This has limited the development of brood year tables necessary for stock-recruit analysis for some stocks, particularly for smaller stocks in the region that are harvested in mixed stock fisheries. Virtually all releases of sockeye salmon from hatchery programs have been otolith marked in recent years; very precise estimates of the contributions of hatchery sockeye are available for fisheries targeting these stocks (e.g. District 106, 108 and 111 drift gillnet fisheries, northern Chatham Strait purse seine fishery, etc).

ESCAPEMENT MEASUREMENT

A variety of methods are used to estimate escapements throughout the region, including mark-recapture studies, counting weirs, and aerial and foot surveys. Weirs are operated on several clear-water streams, and mark-recapture studies are generally used to verify the weir counts in Southeast Alaska. Mark-recapture programs are operated on several large glacial systems where fish cannot be visually counted. A relationship between repeated foot surveys and weir counts was developed for McDonald Lake, and expansions of foot surveys have been used to estimate escapements to this system since the mid-1980s. When an incomplete or inaccurate counting of the salmon is used to monitor escapement trends, we call that measure an *escapement index* to distinguish that kind of measure from an estimate of total escapement. Aerial surveys are used to

index escapement trends throughout the region, and particularly in the small Yakutat area streams.

In the Yakutat area, sockeye escapement is assessed with a weir on the Situk River. Escapement is measured by means of a peak-count aerial index in the Italio, Akwe, East Alsek, and Doame rivers and peak foot or boat surveys in the Lost River; peak-count series for these systems go back to the 1970s. The CDFO has operated a counting weir since 1976 on the Klukshu River, a major tributary of the Alsek River, to index escapement to the Alsek drainage. The proportion of the Klukshu stock within the larger Alsek was evaluated with mark-recapture in 1983, and 2000 through 2004, in combination with several years of radio telemetry studies. Mark-recapture programs were operated in four Yakutat area systems from 2003 through 2005 to estimate total escapement and provide information on the relationship between ongoing index survey counts and total escapement; these included the East Alsek River (Waltemyer et al. 2005a, 2005b), Lost River and Akwe and Italio rivers.

In Upper Lynn Canal, a fish-wheel based mark-recovery study has provided information on run strength, run timing, and many other biological features of sockeye salmon returning to the Chilkat River (Bachman 2005). Mark-recapture estimates of escapement are available for Chilkat Lake and the mainstem Chilkat River (all other spawning areas combined) since 1994. Historically, ADF&G operated a weir at Chilkat Lake as the primary escapement assessment tool for the drainage, but (unpublished) mark-recapture studies and a radio tagging study showed that the weir was an unreliable escapement measure in this system because large and variable fractions of the escapement passed into Chilkat Lake undetected at the weir (Brian Elliot, University of Alaska Fairbanks, personal communication). The other major Upper Lynn Canal stock, Chilkoot Lake sockeye salmon, is monitored by means of a counting weir, which has been verified in recent years by a backup mark-recapture study (Sogge and Bachman *in prep*).

In the District 111 area, weekly inseason estimates of the sockeye salmon escapement to Canadian portions of the Taku River have been generated since 1984 through a joint U.S.-Canada fish wheel mark recapture project. Several weirs are operated by CDFO on systems within the Taku drainage, including Tatsamenie Lake (from 1985 to the present), Little Trapper Lake (1983 to the present) and Kuthai Lake (1992 to the present). ADF&G and CDFO have cooperated in operating a weir on the Nahlin River (most years between 1988 and 1998). ADF&G has also operated weirs on systems that produce fish that co-mingle with Taku stocks in District 111, including Crescent Lake (1982 to 1993), and Speel Lake (1982 to 1993, and 1995 to the present). Douglas Island Pink and Chum, Inc (DIPAC) has taken over operation of the Speel Lake weir in recent years. The National Marine Fisheries Service-Auke Bay Laboratory conducted extensive radio telemetry studies on Taku River sockeye in the 1980s that provided valuable information on spawning distribution in the drainage (Eiler et al. 1992). The Auke Bay Laboratory has also operated a weir to count the adult sockeye salmon escapement into Auke Creek, located just north of Juneau, since 1963 (Taylor and Lum *unpublished*); the weir has also been operated for much of this period to document outmigrating smolt abundance.

Escapement to the Stikine River is estimated by several methods, with assistance from CDFO. A weir has been operated annually since 1959 at Tahltan Lake, the largest spawning stock into the drainage, but counts are not available on a timely basis for inseason management. Total escapement to the drainage has been estimated by the Transboundary Technical Committee of the Pacific Salmon Commission, through an indirect method that relies on stock-composition data, catch-per-unit-effort data from Canadian inriver fisheries and the Tahltan Lake escapement. Methods were further refined in recent years, using the presence of otolith marked returns of

enhanced fish to Tahltan and Tuya lakes. An inseason management model has been used by ADF&G and CDFO to provide in-season estimates of escapement, but the model produced inaccurate estimates in some recent years. As a result, the two agencies began mark-recapture studies on the river in 2001 to provide an alternate method for estimating escapement.

Two long-term sockeye escapement monitoring programs are in place along the outside coast of northern Southeast Alaska. ADF&G has estimated escapement of sockeye salmon to Ford Arm using mark-recapture methods in combination with operation of a weir to count coho salmon since 1983 (Leon Shaul, ADF&G, Douglas, personal communication). The U.S. Forest Service has operated a weir since 1982 (with the exception of 1998) on Redoubt Lake, a large meromectic system about 11 km south of Sitka.

Because of the dispersed production of sockeye salmon in coastal lakes in southern Southeast Alaska, there are very few long-term monitoring projects, except at large systems associated with enhancement projects. Escapement into McDonald Lake has been assessed by a series of standardized foot surveys (Johnson et al. *in press*). Escapement into Hugh Smith Lake is assessed by means of a weir, which has been operated since 1980, and with mark-recapture studies since 1992 to verify the weir estimates.

Since 2001 ADF&G and federal and tribal cooperators launched short-term assessment projects on 19 sockeye producing lakes in Southeast Alaska. Most of these projects are still ongoing. These cooperators intended to measure or index adult sockeye salmon escapement and collect biological and lake-productivity measurements on sockeye salmon-producing lakes important to local subsistence users in the region. In some cases they directly estimate subsistence harvests. Initial results from 12 of these programs operated by ADF&G were briefly summarized in Geiger et al (2004). On Prince of Wales Island, projects were located at Klawock, Hetta, Eek, Luck, Salmon Bay lakes. On Baranof Island monitoring projects were located at Falls, Gut Bay, Salmon, and Redfish lakes. On Chichagof Island projects were located at Kook, Sitkoh, Pavlov, and Klag Bay lakes. On Admiralty Island a project was placed at Kanalku Lake. A Hoktaheen Lake project was launched on Yakobi Island and a Kutlaku Lake project was launched on Kuiu Island. On Wrangell Island a project was located at Thoms Lake. On the mainland projects were launched at Virginia Lake. A project was placed on the Chilkat Peninsula at Neva Lake.

STOCK ASSESSMENT OVERVIEW

Geiger et al. (2004) reported 14 systems in Southeast Alaska and the Yakutat area with escapement goals, and these goals form the basis of our review since the last stock assessment. The primary assessment tool for these stocks is the escapement goal performance. The goals are described in the Escapement Goal section that follows, and an overview of the analysis that supported each escapement goal is provided in an appendix (Appendix 2).

Yakutat Stocks

Escapements to the non-transboundary Yakutat sockeye systems have usually met or exceeded the current escapement goals every year since 2000, with the exception of the Akwe River, where conditions in recent years have not allowed escapement to be adequately assessed. As previously mentioned, sockeye harvests in the Yakutat area in the last decade have declined below levels seen in the mid-1980s through the mid-1990s (Figure 2.4). Recent reduction in the productivity of the East Alsek River, presumably due to hydrological changes in that watershed (Clark et al. 2003), is a contributing factor to lower catches in the Yakutat area, but yields to the Situk River have also declined. In all cases, recent yields in the Yakutat area were substantially

lower than predicted by the Ricker models (described in Geiger and McPherson 2004) that were used to set escapement goals. The combined Ricker-model prediction is for an average sustained yield for the five stocks with escapement goals in excess of 200,000 fish. However, the yield for all of the Yakutat area has averaged about 125,000 fish from 1996 to 2004. The combined yield for this area has not been above 155,000 since 1996. This discrepancy could be an indication that the environment in the Yakutat area has substantially changed, or it could indicate problem with the models that were used to set the escapement goals. In any event, the sockeye yields in the Yakutat area have fallen since the early 1990s (when they were typically near 300,000) to levels near what was observed in the 1970s (typically near 100,000, Figure 2.4).

Transboundary River Stocks

Transboundary river stocks are managed jointly with Canada. We have escapement goals for the Klukshu index tributary of the Alsek River, for the Taku River drainage as a whole, and for the Tahltan and Mainstem stocks in the Stikine River drainage. Sockeye escapements to the Taku and Klukshu rivers have been within or above goal ranges in most years since 2000. Harvests of sockeye salmon in the U.S. Alsek River fishery have averaged 20,000 fish over the last decade (1995–2004 average), very close to the historical average harvest for the fishery (1961–1994 average harvest was 21,000 fish). Harvests of Taku sockeye salmon in the terminal U.S. and Canadian inriver fisheries have been at high levels during the last decade, including record harvests in several years. Returns to Tahltan Lake, however, have been highly variable in the last decade. Tahltan Lake escapements were below the escapement goal range between 1997 and 2002. This was a major concern to Alaskan and Canadian managers. They developed coordinated management and assessment responses to improve escapements. As a result, exploitation rates were reduced and the escapement goal was missed by only several hundred fish in 2002. Escapements were above the upper end of the escapement goal range in 2003 through 2005.

Southeast Alaska Stocks

Escapement goals have been established for six additional systems in Southeast Alaska, including four systems in northern Southeast Alaska (Chilkat and Chilkoot lakes, Redoubt Lake, and Speel Lake), and two in southern Southeast Alaska (McDonald and Hugh Smith lakes).

ESCAPEMENT GOALS AND ESCAPEMENT PERFORMANCE

There are currently 13 escapement goals for sockeye stocks in Southeast Alaska and the Yakutat area (Table 2.1). During ADF&G's review of existing escapement goals in 2005, we updated goals for three large sockeye salmon stocks in the region (McDonald, Chilkat and Chilkoot lakes) and recommend eliminating the goal for the Akwe River. Geiger et al. (2004) provided an extensive record of statistics on escapement performance, stock-specific harvest, where available, and age-class distribution in the catch and escapement for the monitored systems, current up to the 2002 return year, which we have not repeated here. Table 2.2 includes escapement information since 2000 for systems with escapement goals, including information for 2005, where available. Figures 2.5 through 2.18 in this section show longer escapement histories for these stocks, and additional information on each system is presented in the Appendices 2.1 through 2.14.

Table 2.1–Escapement goals for sockeye salmon stocks or stock groups in Southeast Alaska and the Yakutat area.

System	Additional Material in Appendix	Escapement Goal	Year Established	If Recently Revised, Previous Goal
Situk River	2.1	30,000–70,000	1995[a]	
Lost River	2.2	1,000–2,300	1995	
Akwe River	2.3	Eliminated	1995	600–1500
Klukshu River	2.4	7,500–15,000	2000	
East Alsek-Doame River	2.5	13,000–26,000	2003	26,000–57,000
Chilkoot Lake	2.6	50,000–90,000	2005	50,500–91,500
Chilkat Lake	2.7	80,000–200,000[b]	2005	52,000–106,000
Redoubt Lake	2.8	10,000–25,000	2003	No previous goal
Taku River	2.9	71,000–80,000	1986	
Speel Lake	2.10	4,000 –13,000	2003	5,000
Tahltan Lake	2.11	18,000–30,000	1993	20,000–40,000
Mainstem Stikine River	2.12	20,000–40,000	1987	
Hugh Smith	2.13	8,000–18,000	2003	15,000–35,000
McDonald Lake	2.14	70,000–100,000	2005	65,000–85,000

[a] An analysis in 2002 produced the same goal.

[b] The previous escapement goal was based on weir counts. The new goal is based on mark-recapture estimates of escapement, and the intent is to keep the number of fish entering the lake essentially unchanged.

SITUK RIVER

ADF&G has managed the Situk-Ahrnklin Inlet and inriver fisheries to achieve an escapement goal of over 100,000 spawners in the early 1980s, then 45,000 to 55,000 sockeye salmon past the Situk River weir for several years prior to 1995. In 1995, ADF&G adopted an escapement goal of 30,000 to 70,000 sockeye salmon (weir count minus upstream sport harvest; Clark et al. 1995a). At that time the authors of the escapement goal report recommended the goal be reviewed in five years. A Situk River stock-recruit analysis using data from the 1976 through 1997 brood years is the basis for the current goal range (Clark et al. 2002; Appendix 2.1). Escapements have been within or above the goal range (Figure 2.5).

LOST RIVER

In 1995, ADF&G established a *biological escapement goal* for the Lost River of 1,000 to 2,300 peak survey counts, based on a stock-recruit analysis using data from the 1972 to 1983, 1986, and 1988 brood years (Clark et al. 1995b; Appendix 2.2). This goal has not been updated since 1995. Escapements have been within the goal range four of the last five years, with escapement above the range in 2003 (Figure 2.6).

Table 2.2–Escapement measures for 13 sockeye systems with escapement goals in Southeast Alaska and the Yakutat area for the years 2000 to 2005.

System	Units	Previous Goals	2000	2001	2002	2003	2004	2005
Hugh Smith Lake[a]	Total Fish	8,000–18,000	4,300	3,800	6,200	19,600	19,700	23,800
McDonald Lake	Total Fish	65,000–85,000	90,600	42,800	25,800	89,200	21,300	n.a.
Mainstem Stikine River	Total Fish	20,000–40,000	10,100	40,900	31,400	62,300	38,000	30,000
Tahltan Lake	Total Fish	18,000–30,000	5,700	14,700	17,300	49,600	63,300	42,000
Speel Lake	Total Fish	4,000–13,000	9,400	12,700	5,000	7,000	7,900	7,500
Taku River	Total Fish	71,000–80,000	75,500	144,300	103,300	160,400	108,000	130,000
Redoubt Lake	Total Fish	7,000–25,000	3,000	3,700	23,900	69,900	77,300	64,500
Chilkat Lake[b]	Weir counts	52,000–106,000	131,000	132,000	134,000	117,000	119,000	n.a.
Chilkoot Lake	Total Fish	50,500–91,500	43,600	76,300	58,400	74,500	75,600	51,200
East Alsek-Doame River	Index units	13,000–26,000	23,200	18,500	14,200	36,400	33,300	50,000
Klukshu River	Total Fish	7,500–15,000	5,400	9,200	23,600	32,100	13,700	3,400
Lost River	Index units	1,000–2,300	2,200	1,400	1,800	3,000	1,100	1,500
Situk River	Total Fish	30,000–70,000	36,300	57,700	65,400	89,700	42,500	66,500

[a] Includes hatchery fish.

[b] The previous Chilkat Lake escapement goal was based on weir-count observations, although these escapement measures are in mark-recapture units.

AKWE RIVER

Although ADF&G adopted a *biological escapement goal* of 600 to 1,500 peak aerial survey (Appendix 2.3) counts for this system in 1995, we have no peak counts on this system after 2001. The escapement goal has not been updated and ADF&G recommends deleting this escapement goal.

KLUKSHU RIVER (IN THE ALSEK RIVER SYSTEM)

The Klukshu River is a major sockeye salmon producing tributary of the transboundary Alsek River system. A *biological escapement goal* of 7,500 to 15,000 sockeye salmon spawning upstream of the Klukshu River weir was established in 2000, based on a stock-recruit analysis of data from the 1976 through 1992 brood years (Clark and Etherton 2000; Appendix 2.4). This goal was adopted later by the ADF&G, CDFO, and Transboundary Technical Committee. Expanded stock assessment work is being conducted to improve estimates of total escapement to the entire Alsek River drainage. Escapements were above the upper end of the goal range two out of the last five years, within the goal range in two years and below the lower end of the goal one out of the last five years (Figure 2.7).

EAST ALSEK-DOAME RIVERS

A *biological escapement goal* of 26,000 to 57,000 peak aerial survey counts was established for the East Alsek-Doame River in 1995 (Clark et al. 1995b). The escapement goal was derived from stock–recruit data collected in the 1970s and 1980s, when spawning habitat was in excellent condition. The *biological escapement goal* was recently revised downward to 13,000 to 26,000 peak aerial survey counts as a result of deteriorated spawning habitat since about 1990 (Clark et al. 2003; Appendix 2.5). Escapements have been above the upper end of the goal range three of the last five years and above the lower end of the goal range five of the last five years (Figure 2.8).

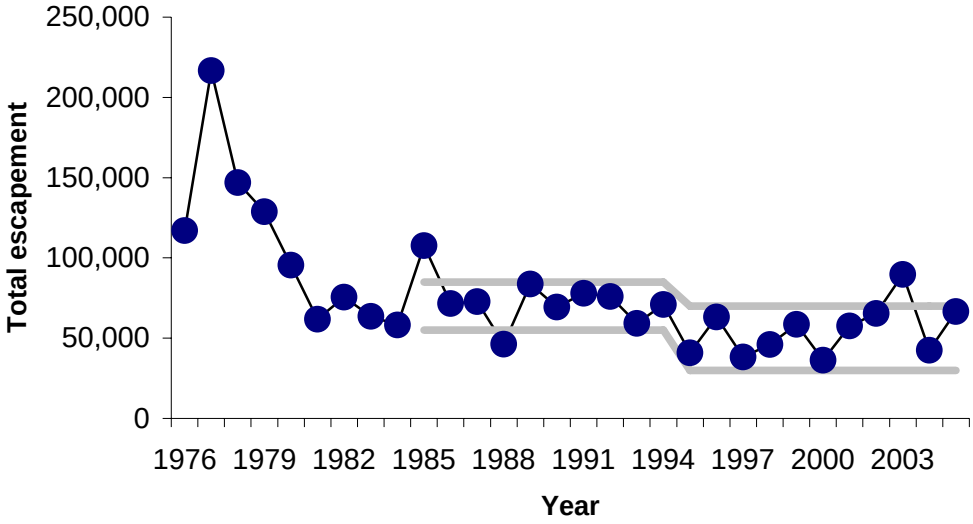

Figure 2.5–Escapement measures (weir count) for Situk River sockeye salmon. The two gray horizontal lines show the current escapement goals, beginning the year that the goals were established.

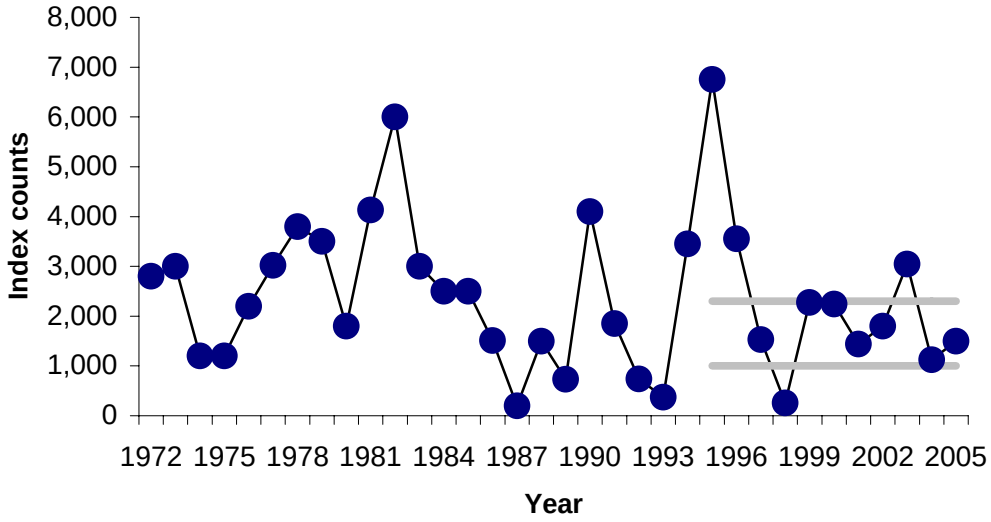

Figure 2.6–Escapement index (peak survey counts) for Lost River sockeye salmon. The two gray horizontal lines show the current escapement goals, beginning the year that the goals were established.

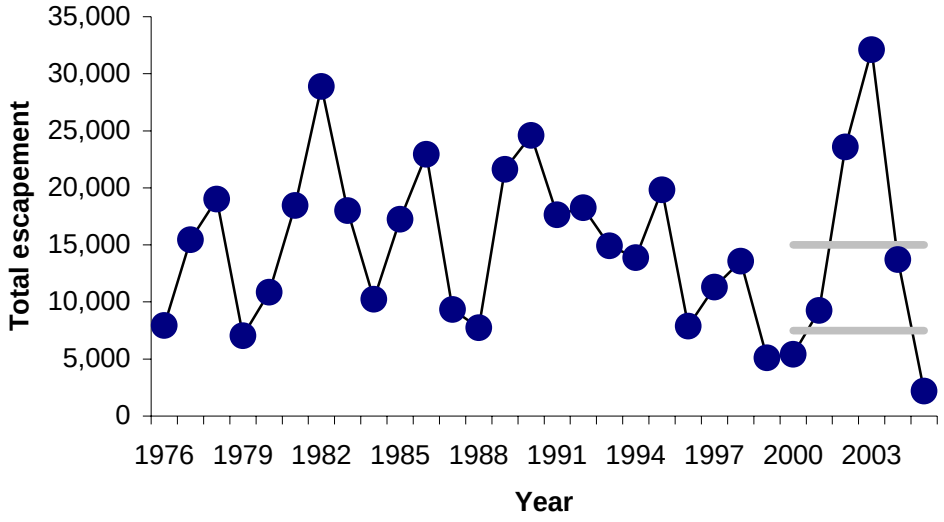

Figure 2.7–Escapement measures (weir counts) for Klukshu River sockeye salmon. The two gray horizontal lines show the current escapement goals, beginning the year that the goals were established.

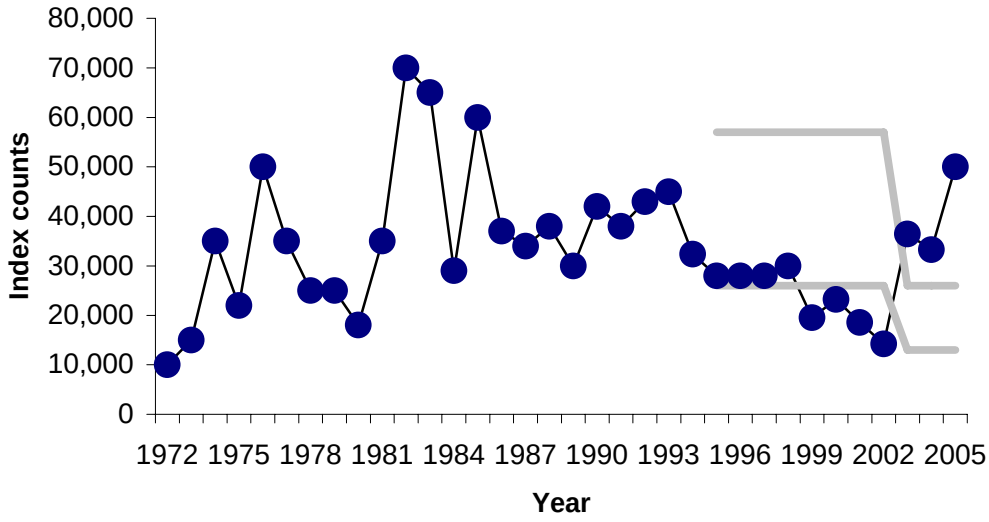

Figure 2.8–Escapement index (peak aerial counts) for East Alsek-Doame River sockeye salmon. The two gray horizontal lines show the current escapement goals, beginning the year that the goals were established.

CHILKOOT LAKE

ADF&G has operated an adult weir at the Chilkoot Lake outlet since 1976. An escapement goal range was established in 1990 on the basis of a stock-recruit analysis of catches and weir counts from the 1976 to 1984 brood years (McPherson 1990). An extremely low weir count in 1995 prompted ADF&G to check the weir counts with mark-recapture estimates. Mark-recapture estimates have been considerably higher than the weir counts at times. Chilkoot Lake underwent an extended downturn in production in the 1990s. The commercial catch of Chilkoot Lake sockeye salmon averaged 149 thousand fish from 1976 to 1989, but the recent ten-year average harvest is only 26 thousand fish. An extensive stock-recruit analysis in 2005 failed to produce a statistically reliable stock-recruit relationship because of rapid changes in this stock's productivity. ADF&G recommends essentially the same escapement goal range, of 50,000 to 90,000, although we are now classifying this as a *sustainable escapement goal* (Appendix 2.6). We further recommend weekly escapement targets, based on historical run timing (Appendix Table 2.6.1). Our rationale is that even though production is now too unstable to develop a statistically reliable stock-recruit model, the previous escapement goal was based on a substantial analysis, and escapements in the current goal range resulted in high yields in the past. We are operating on the assumption that the lake will return to a more stable production regime in the near future. The escapement has been within the previous escapement goal range five out of the last five years, with the escapement below the lower end of the range in 2000 (Figure 2.9).

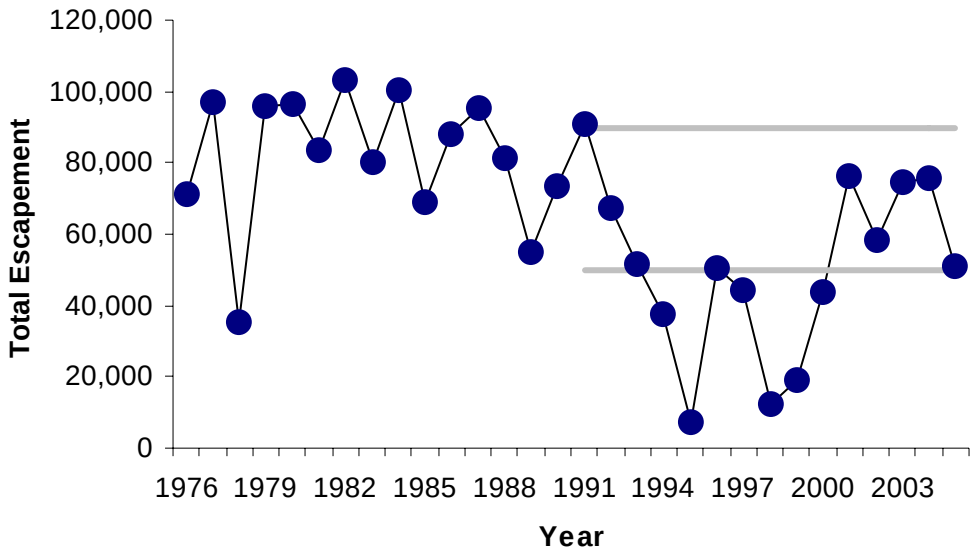

Figure 2.9–Escapement measures (weir counts) for Chilkoot Lake sockeye salmon. The two gray horizontal lines show the current escapement goals, beginning the year that the goals were established.

CHILKAT LAKE

Like the Chilkoot system, the escapement goal in this system was established in 1990 based on a stock-recruit analysis of data from the 1976 to 1984 brood years (McPherson 1990). Mark-recapture methods are now used to measure escapement into Chilkat Lake, although the previous goal was based on weir-count observations of escapement. There are two main challenges in updating the escapement goal for this system. First, like the Chilkoot system, recent mark-recapture studies have shown that the historic weir counts are biased low, but not consistently biased. The problem seems to be far worse with the Chilkat Lake escapement measures. Although it was possible to develop an apparent statistical relationship between the weir counts and the far more reliable mark-recapture estimates, this relationship is largely based on a single outlier (Figure 2.10). Even so, the weir counts seem to typically be about half of the mark-recapture estimates. The second problem with updating the goal is that the stock's productivity has been influenced by lake stocking. Based on the euphotic volume of the lake, ADF&G recommended that Chilkat Lake be used as a site for lake stocking in the 1980s. Eggs and milt were harvested from the lake, and fry were stocked in the lake from the 1993 to 1995 brood years. The first fry plants occurred in June of 1994 with 4.4 million juvenile salmon. The mean smolt size dropped in 1995 and again in 1996. By 1997 the zooplankton showed alarming declines, and the project initiators were rethinking their initial assumptions about this lake's capacity to support additional sockeye fry. Clearly, this stocking decreased the productivity of Chilkat Lake. In 2000, Alaska Department of Fish and Game tied future lake stocking in the system to zooplankton abundance and sockeye salmon smolt size. Because of the stocking, the stock-recruit observations for the 1993–1997 brood years are not suitable for use in setting future escapement goals. Escapements have been measured on two different scales at Chilkat Lake. The escapement goals are in weir-count units, and the generally higher recent mark-recapture estimates are not directly comparable. Even so, we believe that the most recent five escapements are consistent with the intent of the previous escapement goals (Figure 2.11).

We recommend revising this goal so the goal is in the units of the mark-recapture estimates. Because we do not have a reliable means of converting between the weir-count estimates and the mark-recapture estimates, we relied on professional judgment to determine that an escapement level of 80,000 to 200,000 in mark-recapture units is approximately the same as the previous weir-count escapement goal (Appendix 2.7). Although this goal is intended as a *sustainable escapement goal*, this goal range is consistent with two independent, unpublished attempts at a Ricker analysis of the pre-1993 brood year stock-recruit observations.

REDOUBT LAKE

A *biological escapement goal* of 10,000 to 25,000 spawners was recently established for Redoubt Lake based on stock-recruit analysis of data from the 1982 to 1996 brood years (Geiger 2003; Appendix 2.8). In 2003 the BOF established an *optimal escapement goal* of 7,000 to 25,000 spawners. Escapements have been below the lower end of this goal range one of the last five years, within the range in one year and above the upper end of the goal range three of the last five years (Figure 2.12).

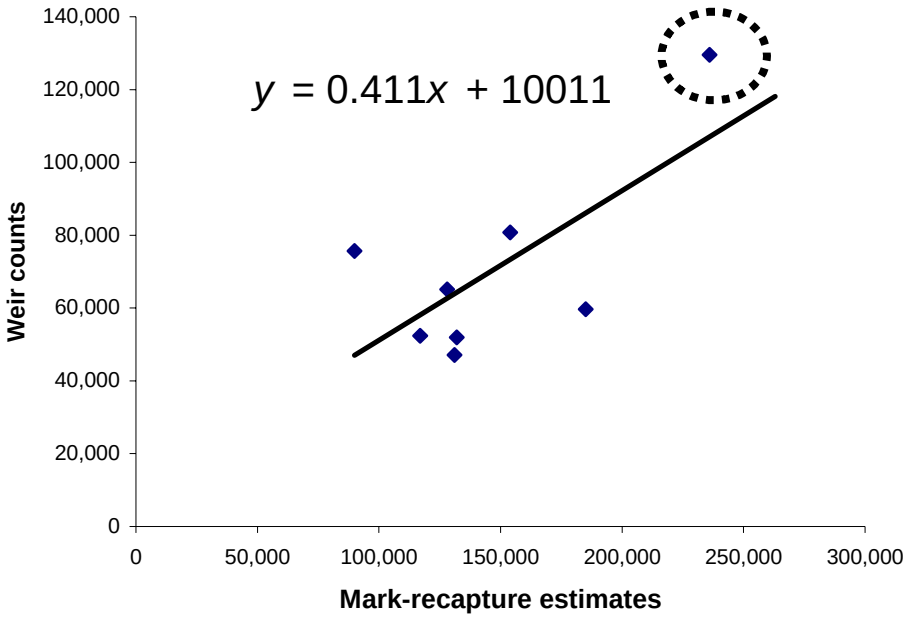

Figure 2.10–A regression relationship between Chilkat Lake weir counts and mark-recapture estimates using paired 1994 to 2004 observations. The false appearance of a statistical relationship is controlled by a single outlier, denoted by the dotted circle. The deletion of this point results in an entirely different relation with a drop in the R^2 statistic from 50% to less than 1%.

TAKU RIVER

An escapement goal of 71,000 to 80,000 sockeye salmon into Canadian spawning areas of the transboundary Taku River was established by the Transboundary Technical Committee (TTC 1986) in 1985 (Appendix 2.9). The escapement goal was established based on professional judgment and the technical committee considers it an interim goal until a formal scientifically based goal is developed. ADF&G considers this goal to be a *sustainable escapement goal*. Escapements have been above the upper end of the escapement goal range five of the last five years, and within the escapement goal range in 2000 (Figure 2.13).

SPEEL LAKE

The Speel Lake sockeye escapement has been monitored with a weir in all but two years since 1983. The stock has been managed for an escapement goal of 5,000 fish until 2003. Riffe and Clark (2003) recommended a goal of 4,000 to 13,000 spawners (Appendix 2.10). Estimated escapements have been within this range for five of the last five years (Figure 2.14).

TAHLTAN LAKE SOCKEYE SALMON

Tahltan Lake is a major sockeye producing tributary of the transboundary Stikine River. The Transboundary Technical Committee of the Pacific Salmon Commission adopted the current escapement goal of 18,000 to 30,000 spawners for Tahltan Lake in 1993, based on a stock-recruit analysis conducted by CDFO staff (Humphreys et al. 1994). We consider this goal to

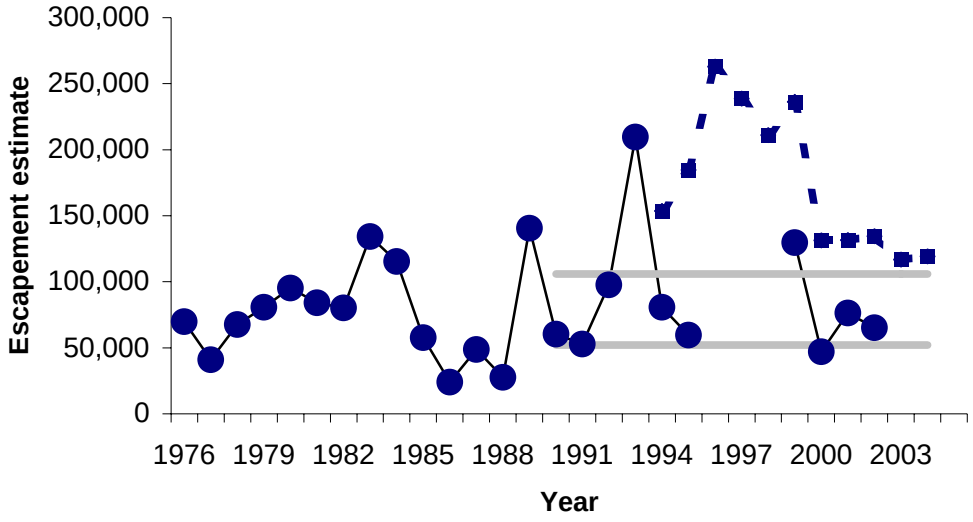

Figure 2.11–Two escapement measures for Chilkat Lake sockeye salmon (1976–2004, the 2005 statistic is not yet available). The dots connected by a solid line are the weir counts, which have been shown to be inaccurate. The squares connected by the dashed lines are the mark-recapture estimates. The two horizontal lines show the previous escapement goals, in weir-count units, beginning the year that the goals were established.

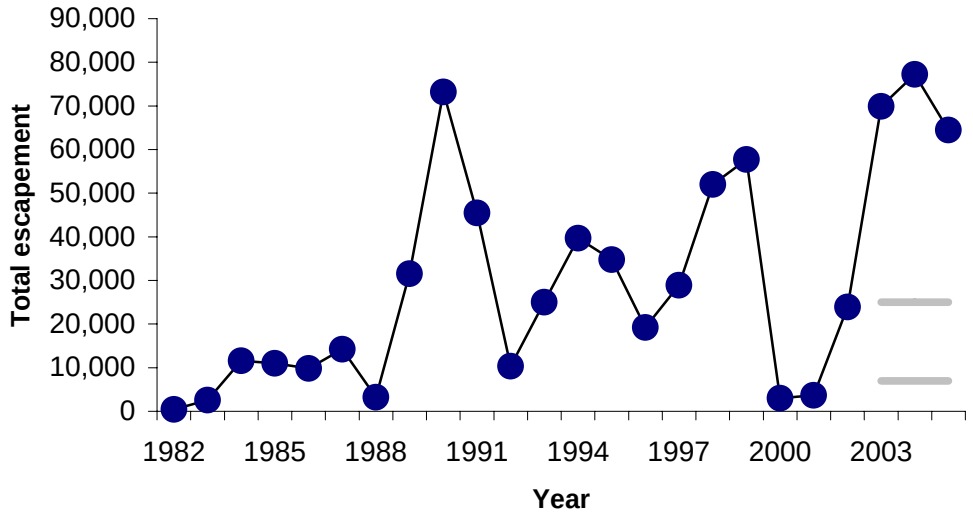

Figure 2.12–Escapement measures (weir counts) for Redoubt Lake sockeye salmon. The two gray horizontal lines show the current escapement goals, beginning the year that the goals were established.

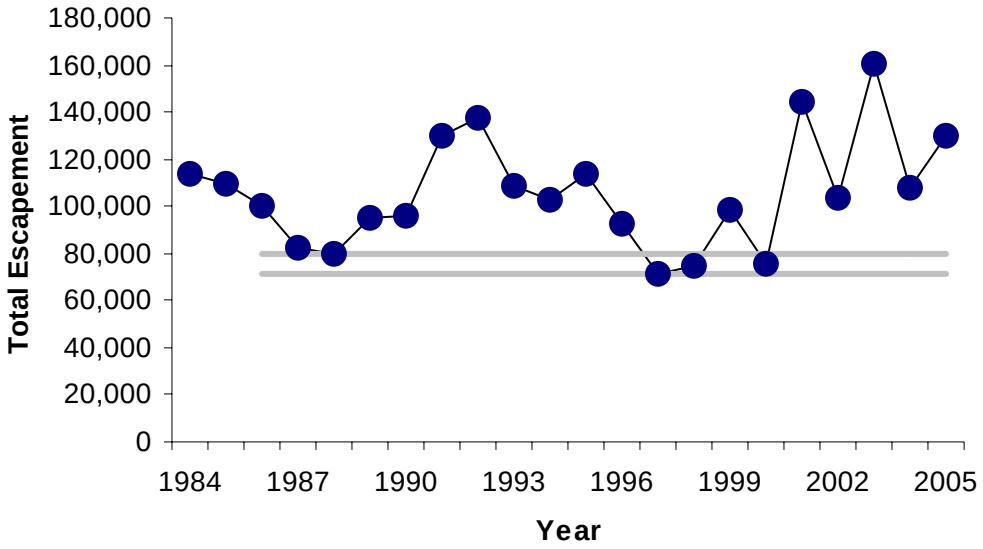

Figure 2.13–Escapement measures (mark-recapture estimates) for Taku River sockeye salmon. The horizontal lines show the current escapement goals, beginning the year that the goals were established**.**

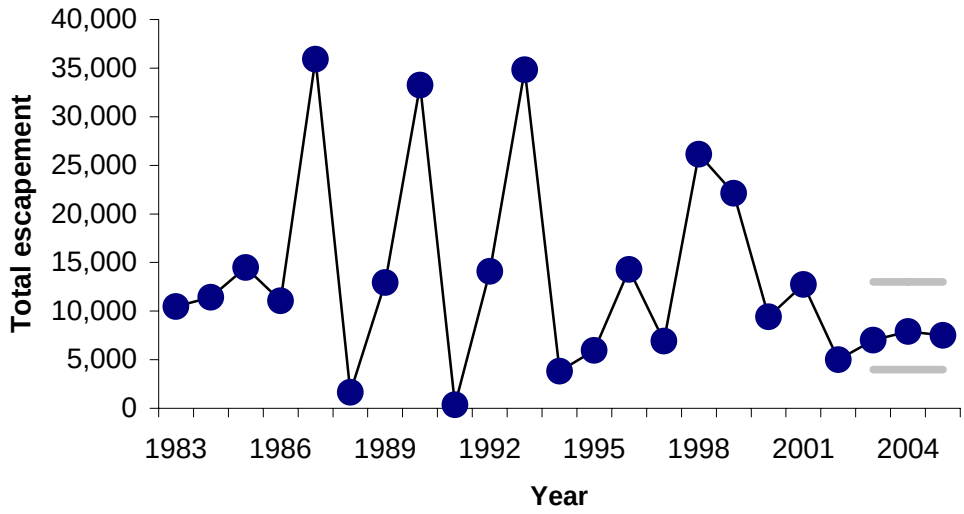

Figure 2.14–Escapement measures (expanded weir counts) for Speel Lake sockeye salmon. The two gray horizontal lines show the current escapement goals, beginning the year that the goals were established.

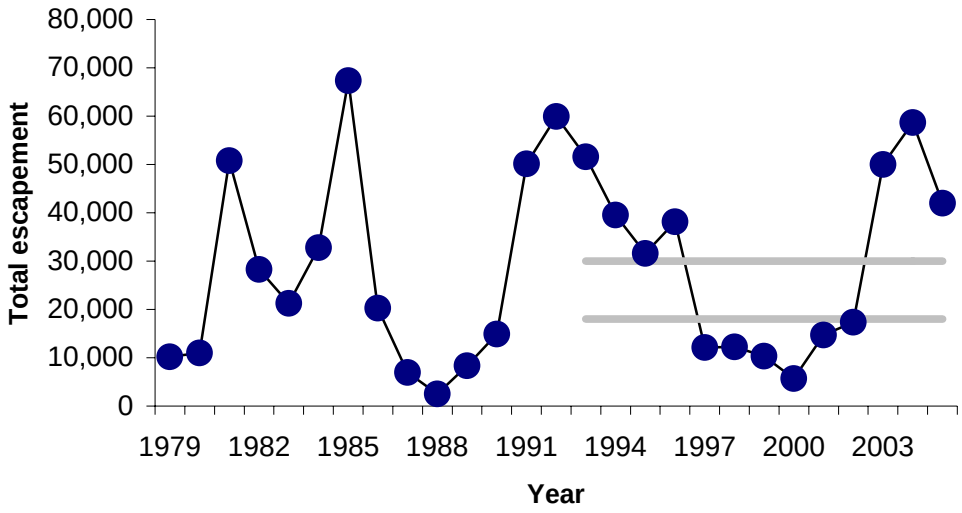

Figure 2.15–Escapement measures (weir counts) for Tahltan Lake sockeye salmon. The two horizontal lines show the current escapement goals, beginning the year that the goals were established.

be a *biological escapement goal*. It represents a mix of naturally spawning fish and a maximum of approximately 4,000 fish used for hatchery broodstock for stocking into Tahltan and Tuya lakes. Further review of this goal is scheduled to occur in the near future within the Transboundary Technical Committee (Appendix 2.11). The escapement was above the upper end of the goal range in 2003 through 2005, and below the lower end of the goal range in two of the last five years (Figure 2.15).

MAINSTEM STIKINE RIVER

The Transboundary Technical Committee established an escapement goal of 20,000 to 40,000 in 1987, based on professional judgment "of the quantity and quality of available spawning and rearing habitat, observed patterns in the distribution and abundance of spawners, and historical patterns of the near terminal area gill net harvest" (TTC 1990). We consider the goal to be a *sustainable escapement goal* (Appendix 2.12). Escapements have been within the goal range three of the last five years, and above the goal range in two of those years (Figure 2.16).

HUGH SMITH SOCKEYE SALMON

An escapement goal of 15,000 to 35,000 spawners was established for Hugh Smith Lake in the 1990s, largely based on professional judgment. In 2003 the Board of Fisheries set an *optimum escapement goal* of 8,000 to 18,000 based on the analysis outlined in Geiger et al. (2003; Appendix 2.13). This goal includes both naturally produced and hatchery stocked fish. The escapement has been above the upper end of the new escapement goal range three of the last five years, and below the lower end of the previous goal range two of the last five years (Figure 2.17). This stock was adopted as a *stock of management concern* in 2003 (see below).

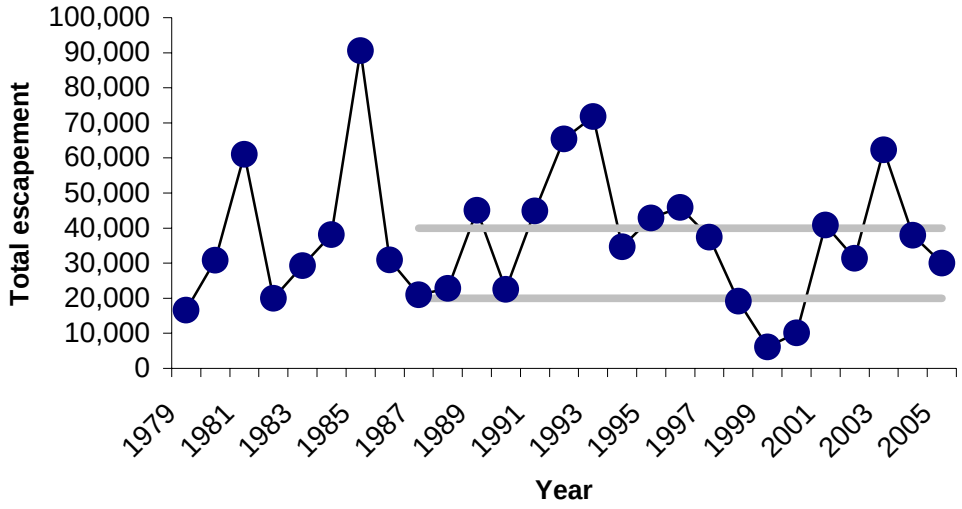

Figure 2.16–Escapement measures (estimated total escapement) for Mainstem Stikine River sockeye salmon. The two gray horizontal lines show the current escapement goals, beginning the year that the goals were established.

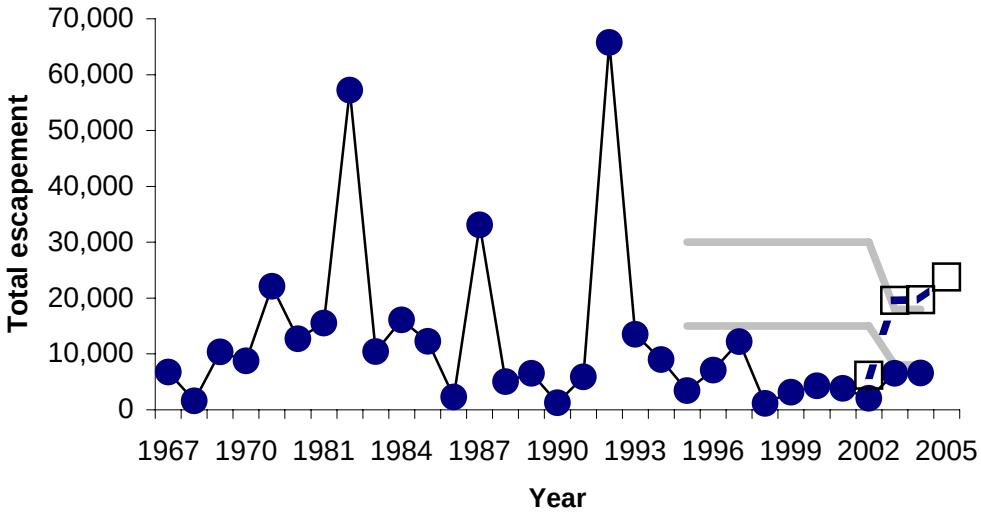

Figure 2.17–Escapement measures (weir counts) for Hugh Smith Lake sockeye salmon. The two gray horizontal lines show the escapement goals, by year. The dots connected by the solid line shows the estimated escapement of naturally spawned sockeye salmon. The open squares connected by the dashed line shows the escapement of both naturally spawned and hatchery stocked fish; the current escapement goal includes both naturally produced and stocked fish. Note that no data is available from 1972 through 1979.

McDonald Lake Sockeye Salmon

The ADF&G monitors escapements in McDonald Lake by means of a calibrated series of foot surveys. The escapement goal for McDonald Lake was lowered in 1993 to the previous range of 65,000 to 85,000 sockeye salmon. ADF&G now is recommending a new goal range of 70,000 to 100,000 as a *sustainable escapement goal* (Appendix 2.14) based on the analysis of Johnson et al. (*in press*). Johnson et al. provided a detailed description of stock assessment measures for the system, a description and listing of enhancement activities, including fish stocking, lake fertilization, and fish transport. The escapement was below the lower end of both the previous and the new escapement goal range four of the last five years (Figure 2.18). The escapement goal was not met in 2001 because of management error combined with below-average recruitment; the run came in under a pre-season forecast, and a directed fishery in west Behm Canal harvested the stock below the escapement goal. No directed fisheries have taken place since 2001, and low escapements in 2002 and 2004 resulted from very low adult recruitment in those years. The preliminary escapement estimate for 2005 also appears below the escapement goal range.

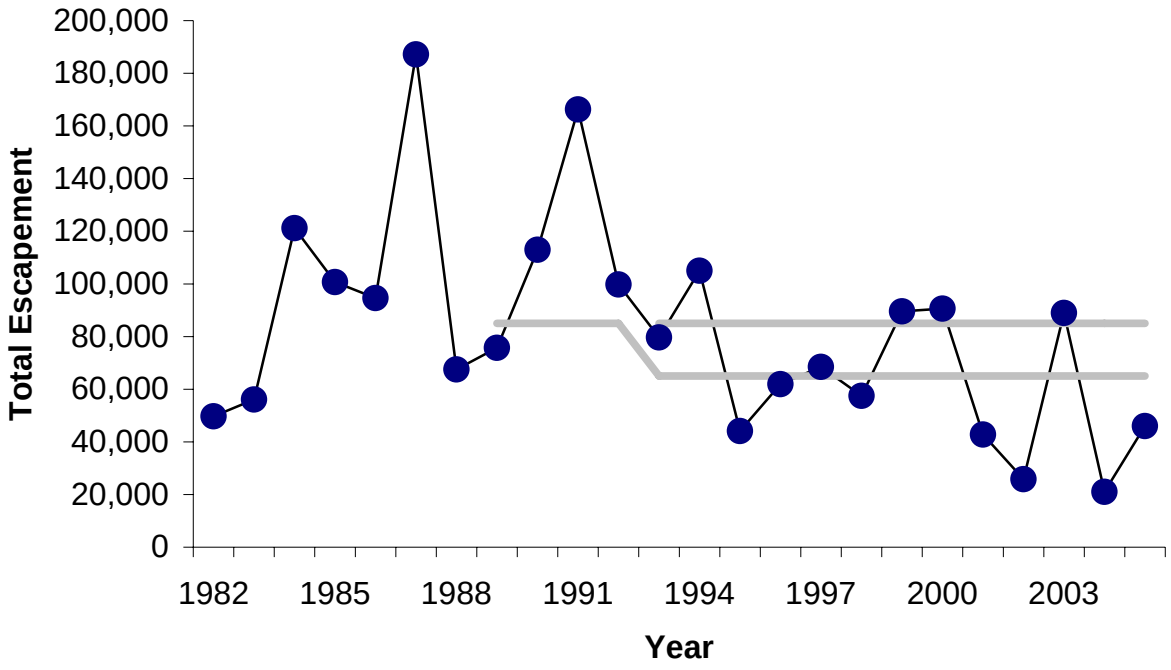

Figure 2.18–Escapement measures (expanded foot counts) for McDonald Lake, 1982–2005. The two horizontal lines show the current escapement goals, beginning the year that the goals were established. The 1989 goal was not expressed as a range.

STOCKS OF CONCERN

In 2003, the Alaska Board of Fisheries formally classified Hugh Smith Lake sockeye salmon as *a stock of management concern*, and adopted an action plan (ADF&G 2003) to rebuild this sockeye run. The plan outlined specific management actions to be implemented in District 101 purse seine and drift gillnet fisheries should the escapement be projected to fall below the lower bound of the *optimal escapement goal* range. Management actions were taken per the action plan in 2003 and 2005.

The action plan also included provisions for lake stocking. Early attempts by ADF&G and Southern Southeast Regional Aquaculture Association (SSRAA) to enhance and rehabilitate the sockeye salmon run at Hugh Smith Lake were unsuccessful, but the most recent method of pen-rearing fry in the lake prior to release has boosted survival rates of stocked fish, resulting in adult escapements counted past the weir over the upper end of the escapement goal range, from 2003 to 2005.

However, unusual behavior of adult sockeye salmon during each of the past three years, a dearth of stocked fish in the actual breeding population in Buschmann Creek, and the observation that large numbers of stocked fish died outside of suitable spawning habitat, all point to the conclusion that these stocked fish did not breed successfully and boost long-term production at Hugh Smith Lake. The first evidence of a problem was the observations of large numbers of sexually mature sockeye salmon milling near the weir in September, at a time when they would normally be spawning in the inlet streams at the head of the lake—something that had not be seen before the return of the stocked fish. Many of these fish appeared to be attempting to spawn at the outlet of the lake. An analysis of a sample of otoliths from these fish from 2002 to 2004 showed that almost all of these sockeye salmon that exhibited abnormal spawning behavior were stocked fish from pre-smolt releases (Table 2.3). To determine the percentage of otolith-marked adult sockeye salmon in the 2004 escapement, a systematic sample of fish was collected from approximately every 100th adult sockeye salmon that was passed through the weir. Out of 192 adult otoliths collected at the weir, 118 (65%) were thermally marked, 67 (35%) were unmarked, and 7 non-readable, yielding estimates of 65% (or 13,000, SE=500) fish in the escapement originating from the lake stocking. As only 16% of the fish in Buschmann Creek (the site of the egg collections for the stocking) had marks, the dearth of fish in Buschmann appears to correspond to the large numbers of fish with abnormal spawning behavior at the weir in 2004.

A relatively low smolt count of 77,000 in 2005 reinforces the idea that the large numbers of stocked fish returning to Hugh Smith Lake in 2003 had poor spawning success. This smolt count ranks 13th out of 25 smolt-count observations, even though there were only three measured escapements higher than what was observed in 2003, going back to 1992. Based on hydroacoustic surveys conducted in summer and fall 2005, it appears that the large 2004 adult escapement also failed to produce many juvenile sockeye salmon. Fish spawning in poor substrate near the weir, or along the lake shore near the release site, probably added little or nothing to the overall production, and it seems this was the fate of many of the stocked sockeye salmon.

Table 2.3–Proportion of marked and unmarked otoliths from adult sockeye salmon carcass samples, by recovery location, Hugh Smith Lake, 2002–2004.

		Year		
Sample Location	Otolith Status	2002	2003	2004
Buschmann Creek	Unmarked	187	36	96
	%	83%	67%	84%
	Marked	37	18	18
	%	17%	33%	16%
				96
Cobb Creek	Unmarked	19	41	30
	%	17%	32%	36%
	Marked	90	87	53
	%	83%	68%	64%
Weir (opportunistic)	Unmarked	4	19	7
	%	6%	9%	5%
	Marked	64	190	144
	%	94%	91%	95%

If stocking is ever resumed we will attempt to better distinguish between what we call the *accounted escapement*, which is the number fish that are simply counted through the weir, and the *effective escapement*, which is the number of adult breeders that effectively contribute to future production of the stock. Currently the *optimum escapement goal* is for the accounted fish, and it includes both the effective spawners and the fish not successfully contributing to production from the lake.

The system of fisheries closures, outlined in the action plan, appears to have been effective. Coded wire tagging studies in the 1980s and 1990s showed that Hugh Smith Lake sockeye salmon were harvested primarily in the District 101 fisheries (Geiger et al. 2003). The District 101 sampling indicated that the system of fisheries closures around the mouth of Boca de Quadra, closures that the action plan calls for when the escapement through the weir is projected to be less than 8,000 adult sockeye salmon, should be effective at reducing harvest of this stock. In 2004, stocked Hugh Smith Lake sockeye salmon accounted for an average 22% (weekly range: 8–31%) of the sockeye salmon harvested in the District 101 "inside" area purse seine fishery (subdistricts 101-23 and 101-41), and 7.1% of the total sockeye salmon harvest in the District 101-11 drift gillnet fishery, from Statistical Week 26 (20 June–26 June) to week 36 (29 August–4 September; weighted by week). The estimated minimum harvest rate in District 101 fisheries that we sampled was 63%. The peak catches of Hugh Smith Lake sockeye salmon in District 101 took place in Statistical Weeks 29 to 35 (11 July–28 August), which corresponds well with the timing of potential fisheries closures as outlined in the Hugh Smith Lake Action

Plan. Looking at past sockeye salmon escapements into Hugh Smith Lake, it appears that there is minimal risk of implementing a closure unnecessarily, and conversely, little risk of not putting closures into effect when escapements are going to be below 8,000 adult sockeye salmon. In the past 11 occurrences of final escapements less than 8,000 adults, fisheries closures would have occurred in 53 of 55 weeks covered by the action plan, had it been in effect. In the past 11 occurrences where the final escapement was more than 8,000 adults, fisheries closures would have occurred unnecessarily in just 13 of 55 weeks covered by the action plan.

Because the accounted escapements to the system were over the *optimal escapement goal* range for three consecutive years (Figure 2.17), which was a stated objective of the Board of Fisheries-approved action plan, ADF&G has concluded that this system no longer meets the definition of a *management concern*, as described in 5 AAC 39.222. In making this recommendation, we also noted an increase in our estimated effective escapement (Figure 2.17) and the presumed recent reduction in harvest rates on this stock.

This fall, ADF&G conducted a review of the Hugh Smith Lake sockeye stock and the effectiveness of the action plan. The review team reached several conclusions, including a consensus that the management actions outlined in the action plan are well timed and effectively located, the principal reasons for the stock decline in the past was high harvest rates, the stocking efforts were ineffective at boosting long-term production, and the past stocking efforts were not benign and likely resulted in some genetic consequences for the stock. The review team recommended suspending the lake stocking. As a result, ADF&G has decided to halt stocking of fry into the lake for one life cycle in order to more fully assess the benefits, risks, and potential consequences of continuing or not continuing stocking thereafter.

We have not identified any new sockeye stocks that would meet the criteria of stocks of concern, as defined by the Sustainable Salmon Fishery Policy. The McDonald Lake sockeye salmon stock has recently undergone a reduction in recruitment, although we are not recommending this stock for *stock of concern status*. The escapement goal was not met in four of five years between 2001 and 2005 at McDonald Lake (Johnson et al. *in press*). These four low escapements do not yet meet the definition of "chronic" in the Sustainable Fishery Policy. The escapement goal was not met in 2001 because of management error combined with below-average recruitment. Low escapements and low catches in 2002 and 2004 resulted from very low adult recruitment in those years. Those low recruitments followed low zooplankton measurements in the lake in the late 1990s. Zooplankton levels have increased in recent years. If zooplankton reductions were responsible for the recruitment downturn, then we expect recruitment to increase. If zooplankton levels were not involved in this reduction, but some unusual ocean event was, there is no reason, at this time, to think that these unusual conditions will persist.

DISCUSSION

The overall situation in the sockeye salmon fisheries in Southeast Alaska looks to be similar to the one described by Geiger et al. (2004) before the 2003 Board of Fisheries meeting. Over the last five years the escapements in the monitored systems have been generally within, or even slightly above the escapement goal ranges, although we noted several exceptions. Along with escapements, sockeye yields have generally been maintained in Southeast Alaska over two decades. Although yields have fallen somewhat in McDonald Lake southern Southeast Alaska, yields have improved in Lynn Canal since the 1990s, and these ups and downs appear to us to be normal stock fluctuations. Overall, yields are probably fairly high for these sockeye stocks, under the current management regime. However, yields are not high in either Southeast Alaska or the

Yakutat area, when compared to historical benchmarks. As was previously mentioned, the last two or three decades have been a period of high marine survival for Pacific salmon stocks migrating into the Gulf of Alaska.

The average yields of pink, and coho salmon, in both the southern and northern Southeast Alaska ends of the region, increased by a factor between 3 to 9 from the 1970s to the 1990s. In the southern end of the Southeast Region, the sockeye yield increased by about a factor of 4—largely because of increased stock sizes of Canadian sockeye stocks. In the northern end, the sockeye yield increased by a factor of about 2, to some extent due to the increased catches of hatchery produced fish from the Snettisham Hatchery in the past few years. Yields in the Yakutat area have declined since the early 1990s. Yields from this area are now similar to what they were in the 1970s. In summary, the sockeye stocks are stable, fisheries are being sustained; yet, for reasons that we don't fully understand, the sockeye stocks in Southeast Alaska and Yakutat have not responded to the favorable marine conditions the way pink and coho salmon have in Southeast Alaska, and the way sockeye stocks have in the Kodiak area and Cook Inlet.

As an appropriate part of this stock status review the salmon research staff in the Southeast Region considered our stock assessment program and developed the following four recommendations.

First, considering the size and the importance of McDonald Lake in southern Southeast Alaska, this system should have a better escapement-monitoring program. ADF&G received funding from the Southeast Sustainable Salmon Fund to assess the effectiveness of the current program by conducting concurrent mark-recapture studies in 2005 and 2006. We suggest that this study be used to develop recommendations for a cost effective and accurate long-term monitoring project.

Second, although extensive sockeye salmon stock identification programs are operated though most of the region, the programs do not provide fine-scale harvest estimates for most of the region's stocks. At this time, genetic stock identification appears to be the most cost-effective and technically manageable means of providing such information. The technique also offers the potential advantage of in-season applicability that could aid fisheries management. Substantial funding has been secured from the Southeast Sustainable Salmon Fund to begin development of a genetic stock identification program for Southeast Alaska sockeye salmon. We recommend that ADF&G continue to move towards a genetic stock identification program for sockeye salmon in Southeast Alaska, and put this in place as soon as possible.

Third, we recommend a complete review of the Yakutat area escapement goals, including a careful look at the statistical strategies and the use of peak aerial counts in setting these goals. A complete review before 2007 would be well timed, as we will have the results of escapement estimation studies being conducted from 2003 through 2005 for Yakutat forelands systems (East Alsek, Lost, Akwe and Italio rivers).

Fourth, we recommend continuing assessment of juvenile and adult production of sockeye salmon at Hugh Smith Lake, at least for several years, to gain a better understanding of the stock dynamics at this system.

ACKNOWLEDGMENTS

ADF&G was assisted by a large number of other organizations in monitoring escapements in the region. The Canadian Department of Fisheries and Oceans, the Taku River Tlingit First Nation, and the Tahltan First Nation helped with monitoring escapements into the transboundary rivers. The Douglas Island Pink and Chum Corporation, Northern and Southern Southeast Regional Aquaculture Associations, U.S. Forest Service, U.S. Fish and Wildlife Service, Sitka Tribe of Alaska, and others each provided support for projects operated in the region. We thank Andy McGregor and Bob Clark for careful reviews of an earlier draft, and for their many suggestions that substantially improved our presentation.

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APPENDICES

Appendix 2.1–Situk River Sockeye Salmon

System:	Situk River
Species:	Sockeye Salmon
Stock Unit:	Situk River sockeye salmon
Management Jurisdiction:	Alaska Department of Fish and Game
Area Office:	Yakutat
Primary Fishery:	Set gillnet commercial fishery
Secondary Fisheries:	Sport, and set gillnet subsistence fishery
Escapement Goal Type:	*Biological Escapement Goal*
Basis for Goal:	Stock-recruit analysis using brood years 1976 to 1997
Documentation:	Clark, J. H., S. A. McPherson, and G. Woods. 2002. Biological escapement goal for sockeye salmon in the Situk River, Yakutat, Alaska. Alaska Department of Fish and Game, Division of Sport Fish, Special Publication 02-03. Anchorage. Clark, J. H., S. A. McPherson, and A. Burkholder. 1995. Biological escapement goal for Situk River sockeye salmon. Alaska Department of Fish and Game, Commercial Fisheries Management and Development Division, Regional Information Report 1J95-22. Douglas.
Inriver Goal:	None
Action Points:	None
Escapement Goal:	30,000 to 70,000 fish
Escapement Measures:	Weir counts minus upstream sport catch, 1976 to present

Stock-Recruit Analysis Summary

Model: Ricker

Number of years in model: 22

Ratio of highest escapement to lowest escapement: 5.7

Parameter estimates: α-parameter = 4.04 (adjusted), $1/\beta \approx 92{,}000$,

(β-parameter =$1.09\ 10^{-5}$)

Basis of range of escapement goal: Escapement level is 0.8 to 1.6 times the escapement that forecasts the *maximum sustainable catch*

Appendix 2.2.–Lost River Sockeye Salmon**.**

System:	Lost River
Species:	Sockeye Salmon
Stock Unit:	Lost River sockeye salmon
Management Jurisdiction:	Alaska Department of Fish and Game
Area Office:	Yakutat
Primary Fishery:	Set gillnet commercial fishery
Secondary Fisheries:	Sport, and subsistence fisheries
Escapement Goal Type:	*Biological Escapement Goal*
Basis for Goal:	Stock-recruit analysis using brood years 1972 to 1983, 1986, and 1988
Documentation:	Clark, J. H., A. Burkholder, and J. E. Clark. 1995. Biological escapement goals for five sockeye salmon stocks returning to streams in the Yakutat area of Alaska. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report Number 1J95-16. Douglas.
Inriver Goal:	None
Action Points:	None
Escapement Goal:	1,000 to 2,300 peak counts
Escapement Measures:	Foot and boat surveys from 1972 to present

Stock-Recruit Analysis Summary

Model: Ricker

Number of years in model: 14

Ratio of highest escapement to lowest escapement: 5.0

Parameter estimates: α-parameter = 6.34 (adjusted), 1/ β ≈3,600 (β-parameter = 0.000279)

Basis of range of escapement goal: Expected yield is at least 90% of maximum sustainable catch

Appendix 2.3–Akwe River Sockeye Salmon

System:	Akwe River
Species:	Sockeye salmon
Stock Unit:	Akwe River sockeye salmon
Management Jurisdictions:	Alaska Department of Fish and Game
Area Office:	Yakutat
Primary Fishery:	Set gillnet commercial
Secondary Fishery:	Subsistence fishery
Escapement Goal Type:	*Biological Escapement Goal*
Basis for the Goal:	Stock-recruit analysis using brood years 1973 to 1987, not including 1975 and 1981
Documentation:	Clark, J. H., A. Burkholder, and J. E. Clark. 1995. Biological escapement goals for five sockeye salmon stocks returning to streams in the Yakutat area of Alaska. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report Number 1J95-16. Douglas.
Inriver Goal:	None
Action Points:	None
Escapement Goal:	Deleted (previously 600 to 1,500 peak counts)
Escapement Measures:	Peak aerial count of sockeye in Akwe River system, 1973 to 2001

Stock-Recruit Analysis Summary

Model: Ricker

Number of years in model: 13

Ratio of highest escapement to lowest escapement: 20

Parameter estimates: α-parameter = 4.31 (adjusted), $1/\beta \approx 20{,}200$ (β-parameter = $4.96\ 10^{-5}$)

Basis of range of escapement goal: Expected yield is at least 90% of *maximum sustainable catch*

Appendix 2.4–Klukshu River Sockeye Salmon

System:	Alsek River
Species:	Sockeye salmon
Stock Unit:	Klukshu River sockeye salmon
Management Jurisdictions:	Alaska Department of Fish and Game, Department of Fisheries and Oceans, Canada (CDFO): joint management through the Pacific Salmon Commission
Area Office:	Yakutat (ADF&G), Whitehorse, Y.T. (CDFO)
Primary Fisheries:	U.S. set gillnet commercial and Canadian aboriginal fishery
Secondary Fisheries:	U.S. subsistence and Canadian sport
Escapement Goal Type:	*Biological Escapement Goal*
Basis for the Goal:	Stock-recruit analysis, using brood years 1976 to 1992
Documentation:	Clark, J. H. and P. Etherton. 2000. Biological escapement goal for Klukshu River system sockeye salmon. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report Number 1J00-24. Douglas.
Inriver Goal:	None
Action Points:	None
Escapement Goal:	7,500 to 15,000 fish
Escapement Measures:	Klukshu weir counts minus upstream removals, 1976 to present

Stock-Recruit Analysis Summary

Model: Ricker

Number of years in model: 17

Ratio of highest escapement to lowest escapement: 4.1

Parameter estimates: α-parameter = 4.586, $1/\beta \approx 15{,}800$ (β-parameter = $6.332 \cdot 10^{-5}$)

Basis of range of escapement goal: Escapement goal range is 0.8 to 1.6 times the escapement that forecasts the *maximum sustainable catch*

Appendix 2.5–East Alsek-Doame River system sockeye salmon stock.

System:	East Alsek-Doame River
Species:	Sockeye salmon
Stock Unit:	East Alsek-Doame River system sockeye salmon
Management Jurisdiction:	Alaska Department of Fish and Game
Area Office:	Yakutat
Primary Fisheries:	Set gillnet commercial
Secondary Fisheries:	Subsistence and sport
Escapement Goal Type:	*Biological Escapement Goal*
Basis for Goal:	Stock-recruit analysis for brood years 1972 to 1990; separate stock-recruit analysis for brood years 1991 to 1997.
Documentation:	Flushed Habitat: Clark, J. H., A. Burkholder, J. E. Clark. 1995. Biological escapement goals for five sockeye salmon stocks returning to streams in the Yakutat area of Alaska. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report Number 1J95-16. Douglas. Clark, J. H., S. Fleischman, and G. Woods. 2003. Revised biological escapement goal for the sockeye salmon stock returning to the East Alsek-Doame River system of Yakutat, Alaska. Special Publication 03-04. Sport Fish Division, Anchorage.
Inriver Goal:	None
Action Points:	None
Escapement Goal:	Flushed Habitat, 26,000 to 57,000 index units Unflushed Habitat, 13,000 to 26,000 index units
Escapement Measures:	Sum of peak aerial counts in East Alsek & Doame (1972-present)

Stock-Recruit Analysis Summary

Model: Ricker for brood years 1972 to 1990 (0.43 times estimate of replacement for brood years 1991 to 1997)

Number of years in model: 19 for brood years 1972 to 1990, 7 for 1991 to 1997

Ratio of highest escapement to lowest escapement: 6.6 for brood years 1972 to 1990, 1.7 for 1991 to 1997

Parameter estimates: α-parameter = 5.72 (adjusted), $1/\beta \approx 85{,}500$, (β-parameter = $4.96 \cdot 10^{-5}$)

Basis of range of escapement goal:

For brood years 1972 to 1990, expected yield is at least 90% of maximum sustainable catch

For 1991–1997, escapement levels that range from 0.8 to 1.6 times escapement producing the maximum sustainable catch

Appendix 2.6–Chilkoot Lake Sockeye Salmon stocks.

System:	Chilkoot Lake
Species:	Sockeye salmon
Stock Unit:	Early and late runs
Management Jurisdiction:	Alaska Department of Fish and Game
Area Office:	Haines
Primary Fisheries:	Drift gillnet commercial, subsistence, and sport
Escapement Goal Type:	*Sustainable Escapement Goal*
Basis for the Goal:	Stock-recruit analysis using brood years 1976 to 1984
Documentation:	Zhang, X., R.L. Bachman, M.M. Sogge, and H.J. Geiger. *in prep.* Sockeye salmon stock status and escapement goals for Chilkoot Lake in Southeast Alaska. Alaska Department of Fish and Game, Divisions of Sport and Commercial Fisheries Special Publication, Anchorage. Previous goal documented in McPherson, S. A. 1990. An inseason management system for sockeye salmon returns to Lynn Canal, Southeast Alaska. M. S. Thesis, University of Alaska Fairbanks.
Inriver Goal:	None
Action Points:	If the Chilkoot River weir count is less than 4,500 sockeye salmon through June 13, the eastern side of Section 15-C will be closed north of the latitude of Bridget Point and 6-inch mesh size gear restrictions will be in effect for Section 15-C. The eastern shoreline of Section 15-A will be closed if there are less than 4,500 sockeye salmon through the weir by June 13. This date was picked, so as to occur prior to the first news release announcing the general opening of the SE drift gillnet fishery.
Escapement Goal:	Overall escapement goal is 50,000 to 90,000 sockeye salmon, with weekly cumulative catch goals in Appendix Table 2.6.1.
Escapement Measures:	Weir counts and mark-recapture estimates, 1976 to present

Table 2.6.1–Weekly cumulative escapement goals for Chilkoot Lake.

Statistical Week	Weekly Goal	Cumulative Goal	Cumulative Lower Bound	Cumulative Upper Bound
23	697	697	498	896
24	2,847	3,544	2,532	4,557
25	4,918	8,462	6,045	10,880
26	4,161	12,624	9,017	16,230
27	2,727	15,350	10,964	19,736
28	3,260	18,610	13,293	23,928
29	5,865	24,475	17,482	31,468
30	8,110	32,585	23,275	41,894
31	10,219	42,804	30,574	55,033
32	9,268	52,071	37,194	66,949
33	6,075	58,147	41,533	74,760
34	5,168	63,315	45,225	81,405
35	3,508	66,823	47,730	85,915
36	2,301	69,123	49,374	88,873
37	877	70,000	50,000	90,000

Appendix 2.7–Chilkat Lake sockeye salmon stocks.

System:	Chilkat Lake
Species:	Sockeye salmon
Stock Unit:	Early and late runs
Management Jurisdiction:	Alaska Department of Fish and Game
Area Office:	Haines
Primary Fisheries:	Drift gillnet commercial, subsistence, and sport
Escapement Goal Type:	*Sustainable Escapement Goal*
Basis for the Goal:	Based on assumptions about past escapement levels, converted to the units of the mark-recapture estimates of escapement
Documentation:	The proposed goal will be documented in a report that is still in process. The previous goal was documented in, McPherson, S. A. 1990. An inseason management system for sockeye salmon returns to Lynn Canal, Southeast Alaska. M. S. Thesis, University of Alaska Fairbanks.
Inriver Goal:	None
Action Points:	None
Escapement Goal:	An overall escapement goal is 80,000 to 200,000 adult sockeye salmon, measured with mark-recapture methods.
Escapement Measures:	Fish wheel-based mark-recapture estimates

Stock-Recruit Analysis Summary

Not applicable

Appendix 2.8–Redoubt Lake sockeye salmon.

System:	Redoubt Lake
Species:	Sockeye salmon
Stock Unit:	Redoubt Lake
Management Jurisdiction:	Alaska Department of Fish and Game, U.S. Forest Service
Area Office:	Sitka
Primary Fishery:	Subsistence and sport
Escapement Goal Type:	*Biological Escapement Goal, Optimal Escapement Goal*
Basis for Goal:	Stock-recruit model using brood years 1982 to 1996 Modified by Board of Fisheries action.
Documentation:	Geiger, H. J. 2003. Sockeye salmon stock status and escapement goals for Redoubt Lake in Southeast Alaska. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 1J03-01. Juneau, Alaska.
Inriver Goal:	None
Action Points:	Numerous (described in new Redoubt Lake Management Plan passed by the Board of Fisheries in January 2003)
Escapement Goal:	*7,000 to 25,000 fish (Optimal Escapement Goal)*
Escapement Measures:	Weir counts, 1982 to 1997, 1999 to present

Stock-Recruit Analysis Summary

Model: Ricker

Number of years in model: 15

Ratio of highest escapement to lowest escapement: 160

Parameter estimates: α-parameter = 4.30 ("bias adjusted" value is 8.55), $1/\beta \approx 23{,}000$ (β-parameter = $4.30\ 10^{-5}$), σ^2-parameter = 1.294

Basis of range of escapement goal: Range of sustained escapements expected to produce at least 90% of *maximum sustained catch*, rounded to the nearest whole 2,500 spawners.

Appendix 2.9–Taku River sockeye salmon stock

System:	Taku River
Species:	Sockeye Salmon
Stock Units:	Kuthai Lake, Little Trapper Lake, Tatsamenie Lake, Mainstem Taku River
Management Jurisdiction:	ADF&G, CDFO: Joint management through the Pacific Salmon Commission
Area Office:	Douglas (ADF&G), Whitehorse Y. T. (CDFO)
Primary Fisheries:	Drift Gillnet, U.S. Commercial, Canadian Commercial
Secondary Fisheries:	Personal Use, Canadian Aboriginal, Recreational
Escapement Goal Type:	*Sustainable Escapement Goal*
Basis for Goal:	Best professional judgment. Goal set by Transboundary Technical Committee in 1985.
Documentation:	Transboundary Technical Committee. 1986. Report of the Canada/United States Transboundary Technical Committee. Transboundary Technical Committee Report (86). Final Report. February 5, 1986.
Inriver Goal:	None
Action Points:	None
Escapement Goal:	System-wide escapement goal of 71,000 to 80,000 fish
Escapement Measures:	Darroch Mark-Recapture Estimate, 1984–2002, Canyon Island Fish Wheel project, ADF&G; Canadian Dept. Fisheries and Oceans weir sites on Kuthai, Little Trapper, and Tatsamenie lakes.

Stock-Recruit Analysis Summary

Not applicable

Appendix 2.10–Speel Lake sockeye salmon stocks

System:	Speel River
Species:	Sockeye salmon
Stock Unit:	Speel Lake
Management Jurisdiction:	Alaska Department of Fish and Game (ADF&G)
Area Office:	Douglas
Primary Fisheries:	Commercial drift gillnet
Escapement Goal Type:	*Biological Escapement Goal*
Basis for the Goal:	Stock-recruit analysis using brood years 1983 to 1996
Documentation:	Riffe, R. R. and J. H. Clark. 2003. Biological escapement goal for Speel Lake sockeye salmon. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report, 03-34. Juneau, Alaska.
Inriver Goal:	None
Action Points:	None
Escapement Goal:	4,000 to 13,000 fish
Escapement Measures:	Weir counts, 1983 to 1992 and 1995 to present

Stock-Recruit Analysis Summary

Model: Ricker

Number of years in model: 13

Ratio of highest escapement to lowest escapement:

Parameter values: α-parameter = 17.22 (adjusted), $1/\beta \approx 9{,}100$, (β-parameter = .00011)

Basis of range of escapement goal: Escapement range predicted to provide for 80% or more of estimated *maximum sustainable yield*

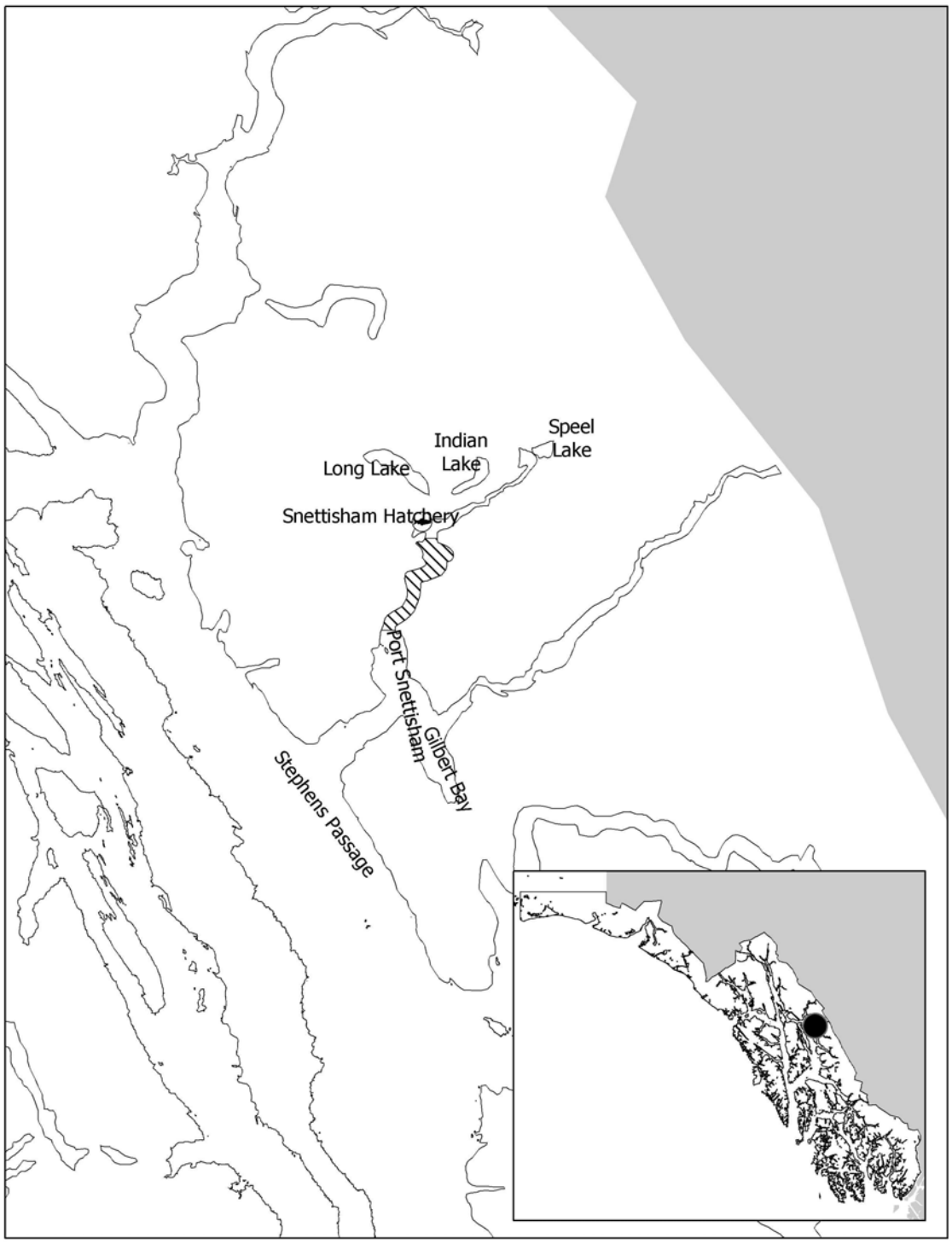

Figure 2.10.1–Speel Lake and surrounding area. Striped area denotes the hatchery Special Harvest Area (SHA).

Appendix 2.11–Tahltan Lake sockeye salmon stocks

System:	Stikine River
Species:	Sockeye salmon
Stock Unit:	Tahltan Lake sockeye salmon
Management Jurisdictions:	Alaska Department of Fish and Game, Department of Fisheries and Oceans, Canada (CDFO): joint management through the Pacific Salmon Commission
Area Office:	Petersburg/Wrangell (ADF&G), Whitehorse, Y. T. (CDFO)
Primary Fisheries:	District 106 and 108 commercial gillnet, Canadian inriver commercial and aboriginal gillnet
Secondary Fisheries:	U.S. and Canadian sport and subsistence fisheries
Escapement Goal Type:	*Biological Escapement Goal*
Basis for Goal:	Stock-recruit analysis, using data from brood years 1975 to 1987
Documentation:	Humphreys, R. D., S. M. McKinnel, D. Welch, M. Stocker, B. Turris, F. Dickson, and D. Ware (*editors*). 1994. Pacific Stock Assessment Review Committee (PSARC) Annual Report for 1993. Canadian. Manuscript. Report of Fisheries and Aquatic Sciences, Number 2227.
Inriver Goal:	None
Action Points:	Based on inseason assessment and agreement between managers if the run size projection has a very small allowable catch District 108 may be closed and the Canadian commercial fishery in the lower river may be limited. This is not a formal set action but rather a negotiation.
Escapement Goal:	18,000 to 30,000 fish (of which 4,000 are for hatchery supplementation broodstock)
Escapement Measures:	Weir counts since 1959; brood stock removal documented since inception in 1989 and apportionment between natural wild fish and hatchery plants available since 1993 (return in 1992 likely had a small number of planted fish).

Stock-Recruit Analysis Summary

Model: Ricker

Number of years in model: 12

Ratio of highest escapement to lowest escapement: 8.2

Parameter estimates: α-parameter = 1.44, $1/\beta \approx 33{,}300$ (β-parameter = $3.0 \cdot 10^{-5}$)

Basis of range of escapement goal: Best professional judgment

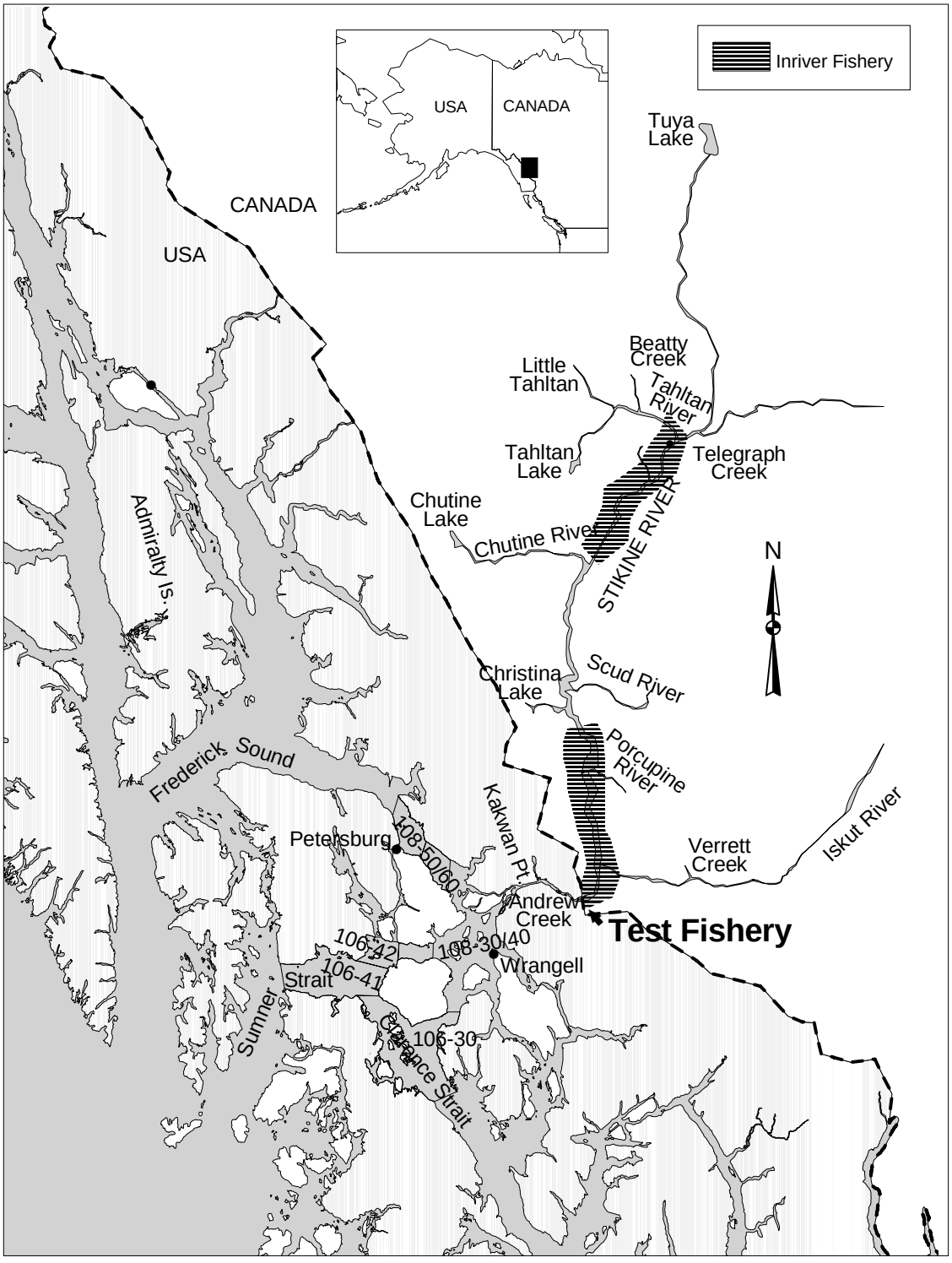

Figure 2.11.1–Stikine River drainage and surroundings, showing location of commercial, subsistence, and recreational fisheries.

Appendix 2.12–Mainstem Stikine sockeye salmon stock

System:	Stikine River
Species:	Sockeye Salmon
Stock Unit:	Mainstem Stikine River
Management Jurisdiction:	Alaska Department of Fish and Game, (ADF&G), Department. of Fisheries and Oceans Canada (CDFO)): joint management through the Pacific Salmon Commission
Area Office:	Petersburg/Wrangell (ADF&G), Whitehorse, Yukon Territory (CDFO)
Primary Fisheries:	District 106 and 108 commercial gillnet fisheries, Canadian commercial gillnet fisheries in the lower and upper Stikine River
Secondary Fisheries:	Canadian aboriginal, recreational, mixed stock seine fisheries in Southeast Alaska
Escapement Goal Type:	*Sustainable Escapement Goal*
Basis for Goal:	Best professional judgment. Set in 1987 by the Transboundary Technical Committee.
Documentation:	Transboundary Technical Committee. 1987. Report of the U.S./Canada Transboundary Technical Committee to the Pacific Salmon Commission, February 8, 1987, Vancouver, British Columbia.
Inriver Goal:	None
Action Points:	None
Escapement Goal:	20,000 to 40,000 estimated mainstem spawners
Escapement Measures:	Estimated harvest rates, based on returns of Tahltan Lake stocks. Tahltan adult weir operated from 1959 to present. Scale pattern analysis in use since 1984.

Stock-Recruit Analysis Summary

Not applicable

Appendix 2.13–Hugh Smith sockeye salmon stock

System:	Hugh Smith
Species:	Sockeye Salmon
Stock Unit:	Hugh Smith Lake
Management Jurisdiction:	Alaska Department of Fish and Game
Area Office:	Ketchikan
Primary Fisheries:	Gillnet and seine commercial fisheries
Escapement Goal Type:	*Biological Escapement Goal*
Basis for Goal:	Three unconventional methods
Documentation:	Geiger, H. J., T. P. Zadina, and S C. Heinl. 2003. Sockeye salmon stock status and escapement goal for Hugh Smith Lake in Southeast Alaska. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report Number 1J03-05. Douglas.
Inriver Goal:	None
Action Points:	None
Escapement Goal:	8,000 to 18,000 fish
Escapement Measures:	Weir counts minus hatchery removals

Stock-Recruit Analysis Summary

Not applicable

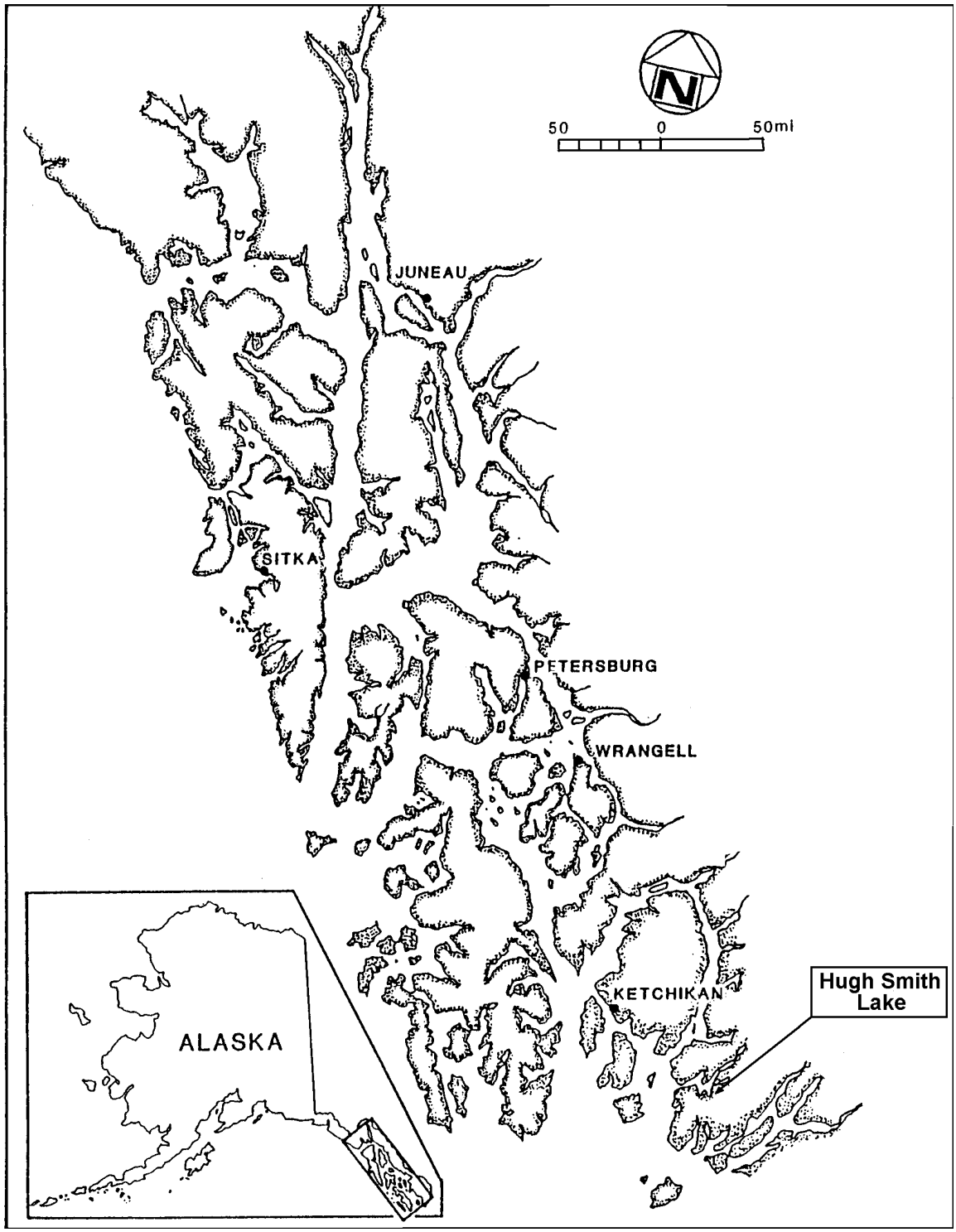

Figure 2.13.1–The location of Hugh Smith Lake in Southeast Alaska.

Appendix 2.14–McDonald Lake sockeye salmon stock

System:	McDonald Lake
Species:	Sockeye salmon
Stock Unit:	McDonald Lake sockeye salmon
Management Jurisdiction:	Alaska Department of Fish and Game, (ADF&G)
Area Office:	Ketchikan (ADF&G)
Primary Fisheries:	Mixed stock commercial fisheries in Southeast Alaska
Secondary Fisheries:	Directed commercial purse seine fishery in upper west Behm Canal in Southeast Alaska
Escapement Goal Type:	*Sustainable Escapement Goal*
Basis for Goal:	The third of ranked escapement estimates with highest median harvests
Documentation:	Johnson, T.A., S.C. Heinl, and H.J. Geiger. *in press.* Stock status and escapement goals for McDonald Lake, in Southeast Alaska. Alaska Department of Fish and Game, Divisions of Sport and Commercial Fisheries Special Publication.
Inriver Goal:	None
Action Points:	None
Escapement Goal:	70,000 to 100,000 fish
Escapement Measures:	A series of standard foot surveys, expanded to an estimate of total escapement by historic ratio of weir to foot-survey estimate

Stock-Recruit Analysis Summary

Not applicable