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Northern Chatham Strait Sockeye Salmon: Stock Status, Fishery Management, and Subsistence Fisheries

by

Harold Geiger

and

ADF&G Staff

September 2007

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

The staff of the Alaska Department of Fish and Game and the staff of the USDA Forest Service met and worked to assemble all available technical information related to sockeye salmon in Northern Chatham Strait. The work began with five questions about escapement levels and fishery status, four questions about fishery management process and decisions, and four questions of policy. In attempting to answer those questions detailed information regarding sockeye stocks in Kanalku Lake, Sitkoh Lake, Kook Lake, and Hasselborg River/Salt Lake—sockeye systems important for subsistence fisheries for the community of Angoon was developed. Although we found escapement estimates for Sitkoh Lake for six years before 2001, for Kook for two years before 2001, our core escapement time series started in 2001 (we have no escapement estimates for Hasselborg River in any year). We provided a detailed description of the State of Alaska's management of the subsistence fishery, together with estimates of subsistence harvest in Angoon. Additionally, we developed extensive information about the northern Chatham Strait commercial purse seine fisheries, including a description of the management, and time and area catch statistics. In the end, we were unable to provide clear answers to the 13 questions we posed, largely due to a lack of information. However, we were able to assemble all information on stock status, fishery management, harvest, and escapement into one document.

Key words: sockeye salmon, *Oncorhynchus nerka*, subsistence, fishery management, Chatham Strait, Kanalku Lake, Sitkoh Lake, Kook Lake, Angoon, escapement, stock status.

INTRODUCTION

Northern Chatham Strait sockeye salmon stock status has recently been the subject of discussions between the USDA Forest Service, the Alaska Department of Fish and Game (ADF&G), the Alaska Board of Fisheries (BOF), and the Southeast Regional Advisory Council (SERAC), and the community of Angoon. USDA Forest Service and ADF&G personnel met on October 2nd, 2006 to learn more about what facts are in dispute and to try and understand each agency's position on northern Chatham sockeye stock status. That meeting did not produce a consensus about facts in dispute, or even a consensus about the nature of the controversy. Agreement was reached between the agencies for staff to develop a report that outlines these concerns and clarifies what facts are in dispute.

Our first objective was to try and capture, in writing, a record of questions and facts surrounding the controversy. Below, we have tried to translate the specific points from the USDA Forest Service presentation into specific questions. These questions may or may not be answerable with the information that has already been assembled. It was not our intent to reach conclusions about each one of these questions in this document. Our first objective was simply to get a record of what the questions are.

Prior to the October 2, 2006 meeting, ADF&G staff concluded that some of the information that the USDA Forest Service received from ADF&G was incorrect, incomplete, or correct but incorrectly interpreted. Therefore, our second objective was to identify what information we have that can help answer questions about the harvest of sockeye salmon in northern Chatham Strait and also to answer questions about sockeye stock status. That is, our second objective was to assemble information relating to the controversy and ensure that it is correctly labeled and described.

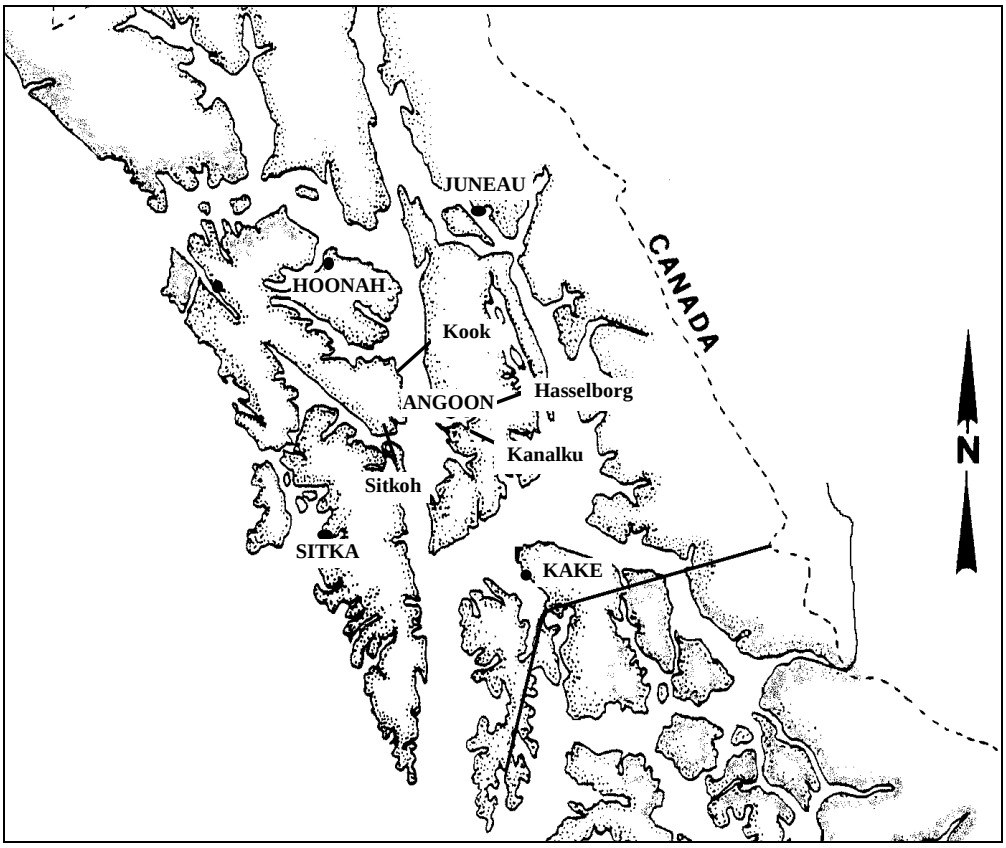


Figure 1.–Map of Southeast Alaska showing location of Kanalku, Kook, and Sitkoh Lakes, Hasselborg River, and the village of Angoon.

The USDA Forest Service has funded a series of studies directed at the sockeye resources important to the Village of Angoon on Admiralty Island since 2001. These sockeye resources primarily come from three sockeye-producing systems near Angoon. Kanalku Lake is closest to the village and is accessible to small skiffs via the sheltered waters of Mitchell Bay. The Hassleborg/Salt Lake system is also located within Mitchell Bay and has some history of subsistence salmon harvest. Kanalku Bay is the area most village residents prefer for subsistence harvest of sockeye salmon. Tradition and archaeology indicate that Angoon people have fished both the Kanalku and Hasselborg systems continuously for at least 1,000 years (de Laguna 1960; Moss 1989; Goldschmidt et al. 1998). Sitkoh Lake is across Chatham Strait from Angoon, and fished somewhat less intensively by most Angoon residents. Although Sitkoh Bay is within the traditional territory of the Angoon Tlingit people (Goldschmidt et al. 1998), it is farther and more difficult to access from Angoon than Kanalku Bay, and reportedly more difficult to fish (M. Kookesh, retired biologist, Div. of Subsistence, personal communication 2003). Kook Lake/Basket Bay is also on the opposite side of Chatham Strait from Angoon. Some Angoon residents prefer harvesting their subsistence sockeye salmon at Basket Bay, compared with other areas, in part due to traditional clan and family association with the area.

Biologists from both federal and state agencies were surprised by the low measures of escapement into Kanalku Lake in two years: less than 250 fish in 2001 (Conitz and Cartwright 2002) and only about 270 fish in 2003 (Conitz and Cartwright 2005a). Even though prior to this time there was no escapement history for this system, and no way to judge these escapement levels in any kind of historical context, these low numbers certainly seemed at the time to be

inconsistent with the physical size of Kanalku Lake and inconsistent with the presumed level of subsistence take out of that system in recent years. In response, the Kanalku system was closed to subsistence fishing starting in 2002 by a voluntary agreement between the Angoon community and ADF&G. Additionally, the USDA Forest Service prohibited outfitter-guides from using Kanalku Creek in 2002, and that restriction has remained in effect. In 2002, the first year of the voluntary fishing closure in Kanalku Bay, the estimated sockeye escapement into Kanalku Lake was about 1,600 fish, and ADF&G biologists and Angoon residents were encouraged that the closure was effective. However in 2003, due to personnel changes in both the ADF&G area management team and leadership positions in Angoon, the voluntary closure was not well publicized and Angoon residents began to disagree about whether the bay should be closed. Most Angoon residents upheld the fishing closure despite the confusion in 2003, but some residents and community leaders disagreed sharply over the extent of actual harvest (M. Kookesh, retired biologist, Division of Subsistence, personal communication 2004). In contrast to the confusion about the subsistence catch level during this period, we now have sockeye salmon escapement estimates for six years from Kanalku Lake, starting in 2001.

The Sitkoh Lake system, where subsistence fishing has been far less intense, supported estimated annual sockeye escapements of 6,000 to 17,000 fish from 1996 to 2003 (Conitz and Cartwright 2005a). The reported subsistence sockeye harvests from Sitkoh Bay, which may be much lower than the actual harvests, averaged less than 150 fish annually throughout this period (Conitz and Cartwright 2005a). Perhaps in response to the voluntary fishing closure in Kanalku Bay, the number of Angoon residents who reported fishing for sockeye salmon in Sitkoh Bay increased from under 10 permits annually from 1991 to 2000 to 20 permits in 2003 (Conitz and Cartwright 2005a).

From 2001 to 2003, ADF&G and its cooperators, under contract to USDA Forest Service, attempted to estimate sockeye escapement into Kook Lake. Although this project was not entirely successful, the project produced rough estimates of escapement of 380 fish in 2001 and 3,600 fish in 2002 (Conitz and Cartwright 2005a). Sampling in 2003 was inadequate to produce an escapement estimate. The USDA Forest Service has estimated sockeye escapements into Kook Lake using a weir since 2005. Total sockeye salmon counts through the weir were 1,994 fish in 2005 and 9,838 fish in 2006 (B. Van Alen, USDA Forest Service, unpublished data, 2006). Additional stock assessment and lake productivity data were collected in a cooperative project between ADF&G and the USDA Forest Service in the 1990s. An adult weir was operated in 1994 and 1995 with counts of 1,800 and 5,800 sockeye salmon, respectively. Populations of juvenile sockeye salmon and zooplankton were estimated, and other limnological variables were measured in the 1990s as well as the 2001–2002 period (Conitz and Cartwright 2003; Barto and Cook 1995, 1997). Fishery managers and biologists at ADF&G and the USDA Forest Service were both concerned because no sockeye salmon were observed in aerial or ground surveys of Kook Lake during July of 2001. In response, a USDA Forest Service crew and Angoon Community Association employees cleared the Kook Lake outlet stream of large deadfall and other debris obstructing the entrances of the caves through which it passes (B. VanAlen, ADF&G, personal communication, 2001). Reported annual sockeye salmon harvests from Basket Bay averaged about 400 fish in the decade 1994–2003, down from an annual average of about 650 fish in the preceding decade. The number of permit-holders also declined from an average of 40 each year in 1985–1993 to 24 per year in 1994–2003 (Conitz and Cartwright 2005a).

The only escapement information available for Hasselborg River/Salt Lake is a series of visual surveys, conducted in various years by boat, airplane, helicopter, and on foot. Sockeye and coho salmon were usually present in the survey area together, and surveyors frequently commented about the difficulty of distinguishing between the two species. Sockeye counts ranged from 2 to 9,000 fish (Appendix B.2 in Conitz and Cartwright 2002). Hasselborg River was included in a subsistence sockeye stock assessment project led by ADF&G in 2001, but field crews were unable to effectively sample fish in this system. However, a visual survey count of about 2,500 sockeye salmon in August 2001 convinced federal and state fishery managers that this stock was probably healthy and further attempts at study were unnecessary. Salt Lake was designated as one of only two subsistence coho salmon fisheries in Southeast Alaska in 1981 (George and Kookesh 1982), until the Alaska Board of Fisheries expanded subsistence coho fishing in Southeast Alaska in 2003. Reported annual subsistence harvests averaged about 40 sockeye and 200 coho salmon during the 1985–2000 period (Conitz and Cartwright 2002).

In addition to the somewhat sketchy lake-specific escapement and subsistence harvest information, we have excellent commercial catch information. ADF&G has reliable and detailed records of commercial harvest, with some of these statistics extending back to the 19th Century. Because commercial transactions are used for tax records, bank records, and many other business purposes, the commercial catch statistics are a good record of the actual catch level. In modern times, failure to report commercial catches involves criminal penalties. ADF&G maintains a commercial catch database of catch records going back to 1960, containing detailed statistics on time and area of harvest, time and areas of fishery openings.

Similarly, ADF&G has escapement and timing statistics for some of the larger stocks that are likely contributing to the Chatham Strait commercial sockeye harvest. Escapements for some large stocks, such as Chilkoot and Chilkat lakes in Upper Lynn Canal and the Taku River, have been measured going back in some cases to the 1970s, and ADF&G has published these escapement statistics in several places (e.g., Geiger et al. 2005).

So, although there may be many questions that cannot be answered with the information we currently have, we do have some information, much of it reliable, consistent, and relevant.

QUESTIONS THAT DEFINE THE CONTROVERSY

Our agencies developed the following specific research questions as a guide to understanding the nature of the controversy about the Chatham Strait fisheries. These questions were then organized into one of three categories: questions of fact about escapement or fishery status, questions about management process and decisions, and questions of policy about escapement level. We tried to include all questions for the sake of completeness, noting that some of these questions may not be answerable and some of these questions are matters of policy and cannot be answered by an analysis of any data.

Specific questions of fact about escapement levels or fishery status

1. Is the harvestable portion of the stocks at Kanalku, Kook, and Sitkoh lakes sufficient to provide for subsistence uses?
2. Are escapements to Kanalku, Kook, and Sitkoh lakes within ranges necessary to conserve and sustain potential sockeye salmon production?
3. Do we know of habitat alterations that may impact sockeye production from the lakes?

4. Are amounts reasonably necessary for subsistence being provided for residents of Angoon?
5. Have escapements to Kanalku, Kook, and Sitkoh lakes meaningfully declined (since 1985)?

We can anticipate that we will have inadequate escapement information to unequivocally answer the first question. Regarding the fifth question, the word "meaningfully" gives away the problem that this question cannot be answered without some measure of judgment or interpretation. Because of natural variability and natural processes, Geiger and Zhang (2002) pointed out all stocks are either undergoing some kind of underlying increase or decrease. They further pointed out that the magnitude of change could be represented as a statistically significant decline in a long series, even though this decline may have no fisheries or biological importance. Similarly a non-statistically significant decline in a short series could be a very important decline from a fisheries perspective. Geiger and Zhang suggest that a "meaningful decline" is one that will cause the *underlying escapement level* to decline by 50% or more over a 10-year period.

Questions about fishery management process and decisions:

1. What is known about migratory patterns of sockeye salmon returning to Kanalku, Kook, and Sitkoh lakes?
2. What has been the pattern, temporally and spatially, of effort and harvest in commercial, sport, and subsistence fisheries in northern Chatham Strait?
3. What stocks are contributing to the stock mixture in the harvest and how might the stock composition changed over time?
4. What actions have management agencies taken to maintain a continuation of subsistence uses for Kanalku, Kook, and Sitkoh lakes sockeye salmon?

These questions might best be answered by a simple narrative outlining how management approaches the fishery, what management is trying to achieve, and management's interpretation of recent fishery events.

Questions of policy about escapement levels and subsistence opportunity:

1. If we were to set escapement goals for these systems, what would be the intent of those goals?
2. What should the escapement level be in these systems in order to meet this intent?
3. What level of subsistence harvest is expected from these three stocks?
4. What level of harvest is reasonably necessary to provide for the subsistence uses of the Angoon community?

Questions in this last category are included for completeness; however, questions in the third category relate to academic points or questions about embellishments to management. These are questions of policy, and as such, cannot be answered as "yes" or "no" based on statistical information or an analysis of data.

ANGOON-AREA SOCKEYE STOCKS

CULTURAL AND SUBSISTENCE FISHING HISTORY

Kanalku Lake, Hasselborg River/Salt Lake, Kook Lake, and Sitkoh Lake have been part of the traditional territories of the Angoon clans for as long as they have lived in the area (Goldschmidt and Haas 1998). These streams have supplied salmon to the people of Angoon and nearby villages as far back as the oldest traditions recount, and continue to be important subsistence resources for the people of Angoon. Boundaries of the traditional territories around Angoon have remained constant from pre-Euro-American contact through the present, and the people have maintained continuous harvesting cycles of the subsistence resources within these boundaries. However, harvest patterns were subject to periodic changes in response to socioeconomic and environmental changes. A physically and biologically diverse land base has allowed harvesters to choose from among different areas as circumstances changed (George and Bosworth 1988). In recent years, some Angoon residents have expressed concern about declining sockeye salmon returns and harvest opportunities in these traditional subsistence areas (Matt Kookesh ADF&G retired, personal communication 2001).

Kanalku Bay and Kanalku Lake are part of the Kootznahoo Inlet and Mitchell Bay territory that were traditionally owned by the Deisheetan clan (Goldschmidt and Haas 1998). Remains of a weir, and artifacts dated to at least 1,000 years ago have been found at the head of Kanalku Bay, showing a long continuity of subsistence activity and technology in this area (Moss 1989). From historic times to the present, this area is the one most frequently used by the people of Angoon for subsistence fishing and hunting; between 60–90% of Angoon households fished and hunted there each year from 1955–1984. Nearly all marine, freshwater, and terrestrial species utilized for subsistence can be found in this area. Kanalku Lake is the primary source of sockeye salmon in the Mitchell Bay area, and contributed 56% of the subsistence sockeye salmon harvest reported by Angoon residents from 1981–1986 (George and Bosworth 1988).

Salt Lake, like Kanalku Lake and Kanalku Bay and other parts of Kootznahoo Inlet and Mitchell Bay, belonged to the Deisheetan clan from the time Tlingit people first occupied the Angoon area until the late 19th century, when rights to it and the head of Mitchell Bay were given to the Teikweidi clan (Goldschmidt and Haas 1998). There was a summer settlement on the shores of Hasselborg River throughout the 19th century, where salmon were harvested and processed for winter use, and there were at least four large smokehouses on the banks of the river. Shellfish remains found near the site of the historic smokehouses provide evidence of use by people from the Angoon area for over 1,000 years (Moss 1989). The summer camp and smokehouses were moved into Mitchell Bay in the 20th century, but Salt Lake is still used by the Teikweidi clan and recognized in their oral tradition. Fishing methods commonly used in the early 20th century were traps and gaff hooks. A trap was located in a natural hole under the first upstream falls and caught salmon as they fell back after unsuccessful attempts to jump the falls. Hasselborg River/Salt Lake was designated as a permitted coho subsistence fishery for Angoon residents in 1981. A household survey the following year found that permit holders had lived on average for three decades in Angoon, and learned to fish in Salt Lake as a child or teenager from family members. Most people fished beach seines with a crew of two to six members and one or two skiffs. The majority of permit holders participated in other subsistence fisheries and also held commercial fisheries limited entry permits. The salmon caught at Salt Lake were distributed among crew members, who in turn distributed them widely to other family members and the community (George and Kookesh 1982).

Traditional rights to Sitkoh Bay and Lake were once owned by the Ganaxadi clan, but were turned over to the Deisheetan when the Ganaxadi left the Angoon area (de Laguana 1960). There is a petroglyph in Sitkoh Bay that reportedly signifies this transfer, which took place prior to the arrival of Russians in Alaska. When some Sitka Tlingit fled from the Russians to Sitkoh Bay, the Angoon Deisheetan allowed them to establish a settlement and gave them some fishing rights there. In 1890 a crew fishing for the Redoubt cannery entered Sitkoh Bay and, backed by the U.S. military, forcibly took over fishing rights to the most productive streams. In 1900, the Chatham Cannery was built in Sitkoh Bay, under an agreement with the Deisheetan, which nominally allowed the clan to retain ownership and control over the village and bay. The Deisheetan and others from Angoon and Sitka worked for the cannery, and maintained seasonal subsistence activities there, until the cannery closed in 1974 (Thornton et al. 1990). Angoon and some Sitka residents still go to Sitkoh Bay to fish for Chinook salmon in the spring and sockeye salmon in July; between 25–60% of Angoon residents reported using Sitkoh Bay for subsistence fishing each year between 1957 and 1984 (George and Bosworth 1988).

Basket Bay belonged to a group of the Angoon Deisheetan, known as the Kak'w.wedi, who had a tribal house there. People continued to live there until the early 1900s (de Laguna 1960; Goldschmidt and Haas 1998). Between 1957 and 1984 an average of 21% of Angoon households used Basket Bay for subsistence fishing. Angoon harvesters claimed that the Kook Lake sockeye salmon were larger than those from their other traditional sources, Sitkoh and Kanalku Lakes. In addition to salmon fishing, Angoon residents have used the area for seal and deer hunting, and for gathering shellfish and other resources (George and Bosworth 1988). In more recent times, residents of Hoonah, Tenakee, and Juneau also take advantage of the Kook Lake sockeye salmon runs for subsistence and personal use fishing.

Angoon Subsistence Salmon Harvests and Commercial Fisheries

Since the early 20th Century commercial salmon fishing and processing have played a vital role in the life of the community but since the late 1980s the role of commercial fishing in Angoon has diminished. In 1990, 76 persons in Angoon held CFEC permits and participated in salmon, halibut and other fisheries, fishing 119 permits. By 1997, this had dropped to 42 residents fishing 59 commercial permits. By 2000, only 24 commercial fishing permit holders were fishing 28 permits. This decline in commercial fishing has led to an increasing reliance on procuring fish in the subsistence fisheries, rather than retaining fish caught in commercial fisheries.

SITE DESCRIPTIONS

Kanalku Lake

Kanalku Lake (ADF&G stream no. 112-67-58/60; N 57° 29.22' W 134° 21.02') is about 20 km southeast of Angoon (Figure 1) and lies in a steep mountainous valley within the Hood-Gambier Bay carbonates ecological subsection (Nowacki et al. 2001). The U-shaped valley and rounded mountainsides are characterized by underlying carbonate bedrock and built up soil layers supporting a highly productive spruce forest, especially over major colluvial and alluvial fans. The watershed area is approximately 32 km^2, with one major inlet stream draining into the east end of the lake. The lake elevation is about 28 m. The lake surface area is about 113 hectares, with mean depth of 15 m, and maximum depth of 22 m (Figure 2). The outlet stream, Kanalku Creek, is 1.7 km long and drains into the east end of Kanalku Bay. In addition to sockeye salmon returning to the lake, large numbers of pink salmon (*O. gorbuscha*) spawn in the lower part of the outlet creek and intertidal area. A few coho (*O. kisutch*) and chum salmon (*O. keta*) spawn in the Kanalku system, and resident populations of cutthroat trout (*O. clarki* spp.), Dolly Varden char (*Salvelinus malma*), and sculpin (*Cottus sp.*) are found in Kanalku Lake. A waterfall, approximately 8–10 m high and about 0.8 km upstream from the tidewater, forms a partial barrier to migrating sockeye salmon.

Figure 2.–Bathymetric map of Kanalku Lake, showing 5 m depth contours and the mark-recapture study area.

Sitkoh Lake

Sitkoh Lake (ADF&G stream no. 113-59-005; N 57°30.89', W 135°2.52') is located on the southeastern tip of Chichagof Island, about 30 km from Angoon, and drains east into Sitkoh Bay (Figure 1). Situated between Chatham and Peril Strait, the Sitkoh Lake drainage lies within the Peril Strait granitics ecological subsection, while the outlet stream and the bay are part of the Kook Lake carbonates subsection to the east (Nowacki et al. 2001). Continental ice sheets covering this area left rounded and heavily scoured mountains. Sitkoh Lake and its outlet stream lie in a broad, U-shaped valley that nearly bisects the peninsula at the tip of Chichagof Island. The Sitkoh Lake watershed area is about 31 km^2; the lake is situated at an elevation of about 59 m. Its surface area is 189 hectares, the average depth is 20 m, and the maximum depth is 39 m (Figure 3). Several steep-gradient inlet streams enter the lake on the north and south sides, ending in productive alluvial fans on the lakeshore; the outlet stream is about 6 km long with at least two tributaries. The lake supports runs of sockeye, coho, pink, and chum salmon. It also supports a run of as many as 50,000 anadromous Dolly Varden char, several thousand sea-run cutthroat trout and a smaller number of summer resident cutthroat trout, and one of the region's largest steelhead (*Oncorhynchus mykiss*) runs (Yanusz 1997; Jones and Yanusz 1998; Cook 1998; Brookover et al. 1999). The Sitkoh drainage was extensively clear-cut between 1969 and 1974.

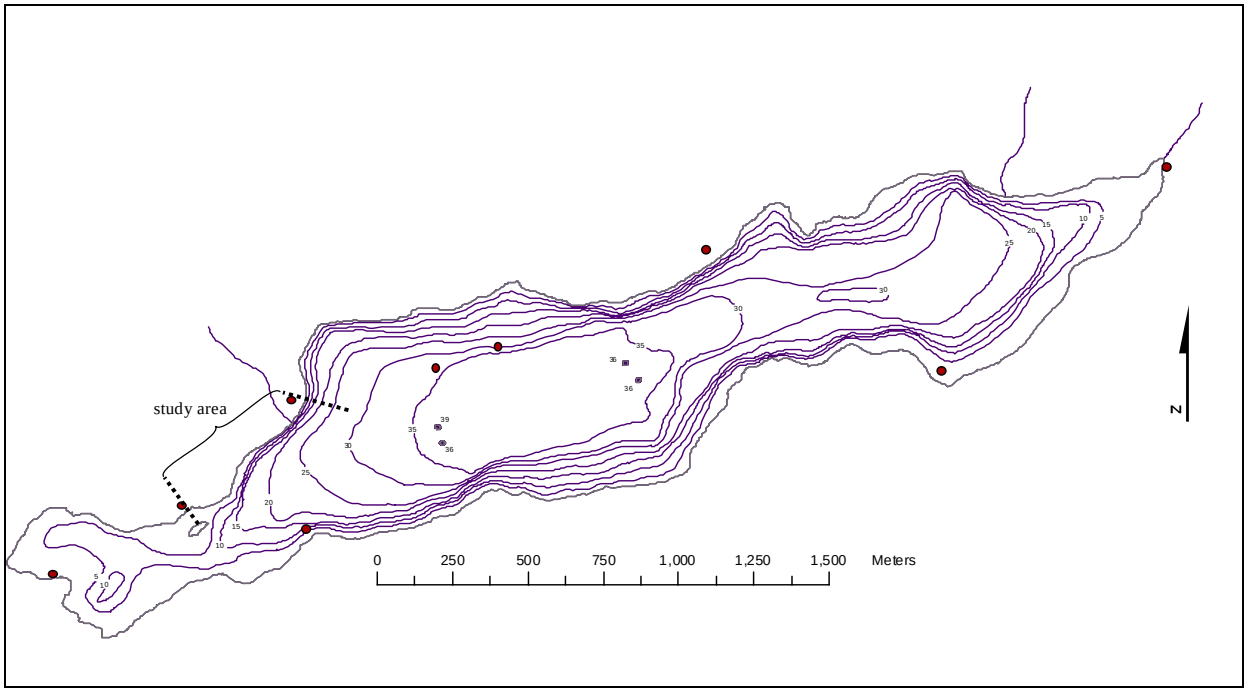


Figure 3.–Bathymetric map of Sitkoh Lake, showing 5 m depth contours and the mark-recapture study area.

Kook Lake

Kook Lake (ADF&G stream no. 112-12-026; N 57°39.86', W 134°57.25') is across Chatham Strait from Angoon, about 26 km to the northeast, and on the east side of Chichagof Island. Its watershed lies within the Kook Lake carbonates ecological subsection (Nowacki et al. 2001). Past glaciations over the entire area has rounded the mountains and created cirque basins such as the one containing Kook Lake. The total drainage area is about 54 km^2 and there are two main inlet streams entering the southwest end of the lake. Kook Lake has a surface area of about 240 hectares, a mean depth of 30 m, and a maximum depth of 44 m (Figure 4). The lake lies at an elevation of about 123 m, and has a 2 km outlet stream, Kook Creek, that flows into Basket Bay on Chatham Strait. Three natural caves, each about 150-300 m long, have formed in the carbonate bedrock along the Kook Creek channel, and salmon swim through these on their way up to the lake to spawn. In addition to sockeye salmon, the lake supports runs of coho, chum, and pink salmon; resident fish include Dolly Varden char, cutthroat trout, threespine stickleback (*Gasterosteus aculeatus*), and sculpin. The Kook Lake watershed is extensively clear-cut and crossed by a logging road system, which connects with the Corner Bay logging camp in Tenakee Inlet.

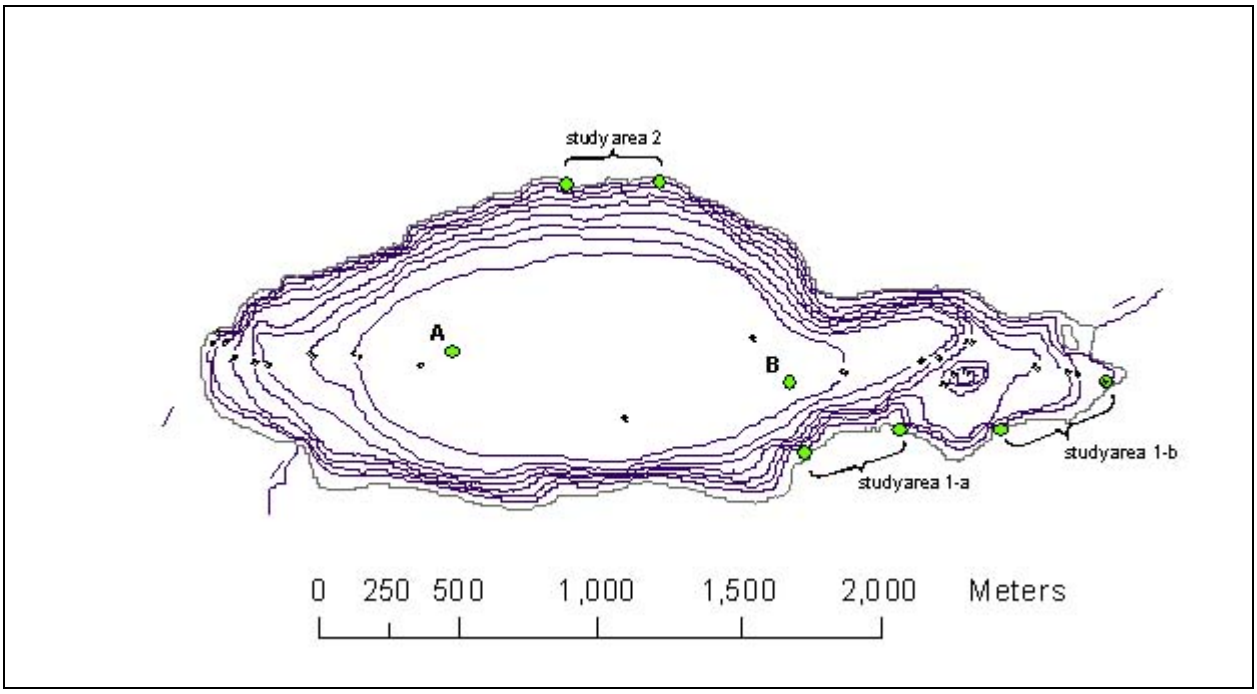


Figure 4.–Bathymetric map of Kook Lake, showing 5 m depth contours, two permanent limnology sampling stations (A, B), and three mark-recapture study areas (1a, 1b, 2**).**

Hasselborg River/Salt Lake

Hasselborg Lake (ADF&G stream no. 112-67-035) is 14 km long covering a 5,500 hectare area and is the largest of a series of lakes covering a 55 km^2 area in the interior of Admiralty Island. Its outlet stream, Hasselborg River, flows for 13.3 km into the Salt Lake estuary (N 57^{o}34.58' W 134^{o}21.00') at the extreme east end of Mitchell Bay. Two barrier falls on Hasselborg River prevent sockeye and other salmon from reaching the lake. The lower falls is about 1.8 km above Salt Lake and about 5.5 m high; some migrating salmon are able to successfully jump the falls. The upper falls is about 2.5 km above the lower falls in a steep section of the valley and, at 9.2 m, forms a total barrier to fish passage. Salt Lake, a brackish water estuary, is separated from the rest of Mitchell Bay by a tidal falls, and can only be reached by boat during high tide. Sockeye, pink, chum, and coho salmon spawn in the Hasselborg River, and the Salt Lake drainage is the largest coho salmon producing system on Admiralty Island. Steelhead (*O. mykiss*) and cutthroat trout and Dolly Varden char are also present. Chinook salmon (*O. tshawytscha*) have been observed in Hasselborg River recently and are thought to be strays from Chatham hatcheries.

MEASURES OF ESCAPEMENT OR RUN MAGNITUDE

RECENT ADULT ESCAPEMENT ESTIMATES

We have very little information about escapement into northern Chatham Strait sockeye systems. We have estimated escapements into Sitkoh Lake since 1996. Since 2001, Federal funding has allowed for some level of stock assessment work to be conducted on Kook Lake, Kanalku Lake, and Sitkoh Lake (Table 1). See Conitz and Cartwright (2005a and 2005b and other reports in this series) to find source material on these estimates. At times ADF&G uses the term “escapement index” to mean a series of escapement measures that do not adequately measure the entire escapement magnitude, but that nevertheless are useful for monitoring trends. For example, using an aerial survey of the spawning grounds biologists might only see, on average, about 10% of the total escapement at low escapement levels and only 5% of the escapement at high escapement levels. If over a 25-year period measurements these “index measurements” might have increased from a 5-year average of 250 fish to a 5-year average of 500 fish. Then ADF&G biologists would confidently conclude that the escapement had increased, but they would have no way to judge the size of the increase. In all cases we have attempted to be consistent in using the term “escapement estimate” if we mean an estimate that was intended to capture both the trend and the magnitude of escapement, and we used the term “escapement index” if we mean an escapement measure that was only intended to be used to measure trends by comparison to other numbers in the index time series.

Table 1.–Escapement of sockeye salmon (*Oncorhynchus nerka*), by lake system and year, estimated using weirs, mark-recapture studies, a combination of both, or "expanded mark-recapture" estimates.

Note: The latter data type means that originally a mark-recapture study was completed on only a fraction of the fish in the lake in a specific study area, but the authors made some attempt to crudely estimate and account for the remaining fish, typically by visually estimating the fraction of spawners with the study area.

Lake	Year	Type of Estimate	Estimated Escapement	Citation
Sitkoh	1982 - 1996	weir count (rounded)	7,200	Crabtree 2001
	1996	weir with mark-recapture	16,300	Cook 1998
	1997	mark-recapture	6,000	Cook 1999; Crabtree 2001
	1998	expanded mark-recapture	6,600	Crabtree 2000; Crabtree 2001
	1999	expanded mark-recapture	10,400	Crabtree 2001
	2000	expanded mark-recapture	17,000	Crabtree 2001
	2001	expanded mark-recapture	14,100	Conitz and Cartwright 2005; Appendix C
	2002	expanded mark-recapture	11,900	Conitz and Cartwright 2005; Appendix C
	2003	expanded mark-recapture	8,700	Conitz and Cartwright 2005; Appendix C
	2004	expanded mark-recapture	3,700	Conitz and Cartwright 2007
	2005	expanded mark-recapture	13,400	ADF&G unpublished (draft report)
	2006	expanded mark-recapture		ADF&G unpublished (draft report)
Kook	1994	weir count (rounded)	1,800	Conitz and Cartwright 2005; Appendix C
	1995 - 2001	weir count (rounded)	5,800	Conitz and Cartwright 2005; Appendix C
	2002	expanded mark-recapture	380	Conitz and Cartwright 2005; Appendix C
	2002 - 2005	expanded mark-recapture	3,600	Conitz and Cartwright 2005; Appendix C
	2005	weir count	1,994	USDA Forest Service unpublished
	2006	weir count (rounded)	9,800	USDA Forest Service unpublished and preliminary
Kanalku	2001	expanded mark-recapture	240	Conitz and Cartwright 2005; Appendix C
	2002	expanded mark-recapture	1,600	Conitz and Cartwright 2005; Appendix C
	2003	expanded mark-recapture	280	Conitz and Cartwright 2005; Appendix C
	2004	expanded mark-recapture	1,200	Conitz and Cartwright 2007
	2005	expanded mark-recapture	1,100	ADF&G unpublished (draft report)
	2006	expanded mark-recapture	1,300	ADF&G unpublished and preliminary

HISTORICAL INFORMATION FROM THE MID-20TH CENTURY

Personnel from the USDA Forest Service Sitka Ranger District surveyed the Kanalku Lake system in July 1963, May 1964, and July 1964. Among their observations and comments (memoranda and field notes on file at ADF&G Division of Commercial Fisheries Douglas Office) are the following:

> …the population has been reported to be composed of small fish...
>
> Another consideration was the population of cutthroat trout in the lake. Harry Telford stated that the trout are numerous and run to three pounds. There will always be a problem in building a sockeye salmon run in the face of a predaceous cutthroat population…
>
> A follow-up survey was made on July 24, 1964 …hiked approximately 1/8 mile of the inlet stream. The inlet stream is very clear and averages 35 to 40 feet wide. At the mouth the streambed is primarily composed of fine sand and sediment and appears to be somewhat pavemented. There are many little potholes and deep pools. Upstream the percentage of gravel in the riffles and bar areas increases markedly although there is still a considerable amount of fine material mixed with the larger gravel, three inches or less in diameter. Spawning habitat improved as we went upstream; however, Wadman (Roger Wadman, ADF&G) stated that the spawning habitat was not exceptional in his estimation. No fish were observed. Only one beach (from what little could be seen) looked like it might be good spawning habitat. Jumps were observed in the lake, but the fish were not identified. The outlet stream was hiked from the lake to its mouth at salt water. No salmon were observed in the stretch above the fall which is a little more than halfway down the stream.
>
> About 200 sockeyes, schooled at the base of the fall, were constantly jumping. Some were making the lower section and were finding their way up the crevices and minor flows generally on the left side. Bears had been feeding extensively on the salmon as they worked their way up through the very shallow exposed area of the upper fall. …It is obvious that only part of the run makes it into the lake under the prevailing adverse circumstances.
>
> There are very few places for fish to school up and hold until they reach the area just below the fall.
>
> Lake rearing area is probably not large enough to support a sockeye salmon run of more than ten to thirty thousand fish under the best of conditions.
>
> Spawning area in the lake and lake tributaries appears to be limited.

They also caught and measured five adult sockeye salmon at the falls, two males averaging 475 mm (mid-eye to fork) length and three females averaging 490 mm.

Kanalku Lake was one of eight proposed salmon habitat improvement projects (mostly fish ladders) being considered in 1963–1964 by the USDA Forest Service and ADF&G; the others were Redoubt Lake, Goulding Lakes, Port Banks, Klag Bay, Pavlof Lake, Ward Creek, and Fishery Creek (ADF&G and USDA Forest Service memoranda on file at ADF&G Division of Commercial Fisheries Douglas Office).

In ADF&G stream surveys from 1960 to 1974, surveyors frequently reported seeing no sockeye salmon in Kanalku Lake and its inlet and outlet stream. ADF&G survey counts for the Kanalku Lake systems are available in the ADF&G Division of Commercial Fisheries database and were summarized by Conitz and Cartwright (2002). In most years the high counts were 200–300 sockeye salmon. Counts only exceeded 1,000 fish in three years (1968, 1986, and 2000) but those were in the intertidal area and could have included sockeye bound for other areas or for harvest, as well as salmon of other species. In three years, sockeye salmon were counted at the mouth of the inlet stream, but there are no records of sockeye salmon or any other species counted in the inlet stream.

In a 1970 ADF&G Lake and Stream Inventory for Kanalku Lake, biologists sampled with a fyke net overnight from May 21–22 and caught 14 cutthroat trout and one kokanee (ADF&G Division of Commercial Fisheries, internal memorandum). These biologists wrote on the inventory form that: "Silver salmon, red salmon, cutthroat trout, kokanee, and Dolly Varden are present in the lake. The populations of silver salmon, cutthroat trout, and kokanee appear to be in excellent condition, and the red salmon run is quite distinctive. The red salmon in this run are smaller than normal red salmon, and it is thought that this is the result of smaller fish being able to successfully negotiate a partial block at the outlet of the lake." In 1971, the [ADF&G] Sport Fish Division included Kanalku Lake in its listing of outstanding sport fishing areas in Southeast Alaska (Fisheries, Wildlife, and Recreational Importance of the Kootznahoo Inlet-Mitchell Bay Area, Admiralty Island, USDA Forest Service 1975).

On 16 or 17 July, 1970, personnel from the USDA Forest Service blasted the falls at Kanalku Creek in order to create some "resting pools." Although they selected what is probably the peak of the escapement period to conduct this disruptive work, they commented that, "No mortality among red salmon present at the falls during this blasting was observed" (memo from Tom Richardson, Area Management Biologist, ADF&G). Two years later, Dick Powers (USDA. Forest Service) wrote in a memo commenting about the blasting project, "On July 30, 1972 I visited Kanalku Falls during the red salmon run. The step blasting project appears to be working well. … Rod Darnell commented 'The blasting really did some good. There are more schools of reds in the lake than I have seen since it was over-fished' – in the 1950's."

A one-year limnology study was conducted in Kanalku Lake in 1995 (Barto and Cook 1996). They attempted to compare the actual versus potential sockeye smolt production, and concluded:

> Calculated sockeye smolt production (based on fall acoustic surveys) from Kanalku Lake indicates this lake is currently producing ~0.083 x 10^6 smolts·year^{-1}. The EV [euphotic volume] and smolt biomass models predict this production should range from 0.380 to 0.306 x 10^6 smolts·year^{-1}. When compared to other sockeye salmon nursery lakes in Southeast Alaska, Kanalku Lake ranks relatively high in macrozooplankton abundance (102,427 organisms·m^{-2}) and biomass (372 mg·m^{-2}). Results indicate this lake could potentially increase its current level of sockeye production if additional fry were available to utilize the existing zooplankton food-forage resource.

They estimated about 127,000 sockeye fry in the lake based on a September hydroacoustic survey, and trawl samples yielding 42 sockeye fry and 3 sculpins. Their recommendation was to use "adult sockeye salmon within the lake as a brood source for eggs, [to] initiate a sockeye fry-stocking project of sufficient magnitude to utilize the abundant zooplankton food source and rearing area." No information on adult escapement was collected during the 1995 limnology

study. In May 1997, 851 sockeye smolt were counted and subsampled for age, weight, and length at the outlet of Kanalku Lake (D. Barto ADF&G Division of Commercial Fisheries, internal memorandum 1997).

HISTORICAL STATISTICS FROM THE BEGINNING OF THE INDUSTRIAL FISHERY

Commercial fisheries began in Chatham Straits in the 1890s (Table 2). Sockeye salmon were the only species taken by canneries during the first decade, but since there were no large sockeye runs in the Chatham district, the expansion of the commercial fishing industry there depended upon the exploitation of the more abundant pink and chum salmon. The first major commercial pink salmon harvest in 1901 was in northern Chatham Strait; within a few years, the number of canneries in the district had increased, and fish traps were in use. Depletion of the salmon resource, especially small sockeye runs in the bays along Chatham, led to commercial fishing legislation and the first closures in most of these bays, beginning in 1925 (Rich and Ball 1933).

Table 2.–Historic records of commercial sockeye salmon harvest from Basket Bay, Sitkoh Bay, and Kootznahoo Inlet (the latter includes Kanalku Bay and other areas within Mitchell Bay; Rich and Ball 1933).

	Total Sockeye Harvest		
Year	**Basket Bay**	**Sitkoh Bay**	**Kootznahoo Inlet**
1890	-	4,902	-
-	-	-	-
1895	-	4,260	-
1896	21,175	15,794	-
1897	-	566	-
-	-	-	-
1900	61,500	30,000	-
-	-	-	-
1904	86,000	12,000	-
-	-	-	-
1912	2,968	-	-
-	-	-	-
1918	314	833	587
1919	-	-	563
1920	892	-	102
1921	-	552	3,058
1922	523	3,462	1,291
1923	910	-	-
1924	221	234	-
1925	-	248	458
1926	962	337	896
1927	2,340	122	601

SUBSISTENCE HARVEST AND MANAGEMENT

From 1960 to 1999 the State of Alaska was the entity responsible for fish and wildlife subsistence management in Alaska. In 1990, Federal agencies assumed authority for wildlife subsistence management on Federal lands. In 2000 Federal agencies assumed authority for subsistence fisheries management on Federal lands and waters, and the State maintained authority of fish and wildlife management in State lands and waters.

ADF&G manages subsistence salmon fisheries in Southeast Alaska under the terms of subsistence fishing permits [5 AAC 01.730]. Subsistence salmon fishing permits establish harvest limits, allowable gear types, fishing seasons, and other general harvest requirements. Permit stipulations are reviewed annually by area and regional salmon managers. In some cases harvest limits and fishing seasons are modified for specific fishing areas depending upon perceptions of sockeye salmon abundance (Table 3). Data on harvest, harvest timing, and gear type are collected on catch calendars that must be filled out for each fishing day. It is important to note that the Federal subsistence management program for sockeye salmon fishing in Southeast Alaska relies on the State's subsistence fishing permit system. State subsistence permits are valid in Federal jurisdiction, unless specifically superceded by Federal regulation.

There are four small systems in northern Chatham Strait that support subsistence fisheries for sockeye salmon. Angoon residents use Kook and Sitkoh lakes on Chichagof Island and Kanalku and Hasselborg lakes on Admiralty Island. The average annual harvest of sockeye salmon, as measured by reported harvest on returned State Subsistence Salmon Permits, by Angoon residents is 1,013 fish (Table 4). The average total reported harvest from all four lake systems combined for the 1985–2005 period is 1,598 sockeye (Table 5, Figure 5).

There several potential problems with using the sum of the reported harvests to represent the actual magnitude of the harvest. First, the sum of the reported harvests captures information from returned permits only. That is, some harvest was taken by individuals that did not return a permit. Additionally, those that did return permits may have under-reported their harvest. On-site creel surveys conducted at Falls Lake from 2001 to 2004 indicated that the permit holders under-reported subsistence sockeye harvests by an average of 36% (Conitz and Cartwright 2005b). We think it is reasonable to expect that these reported harvests under-represent the true community harvest, although we judged these statistics to be useful for looking at trends in subsistence catch.

ADF&G has historical notes regarding Kanalku Lake, dating back to the 1960s. Reported participation and harvests in the Kanalku Bay subsistence fishery increased substantially in the mid 1990s and remained high through 2001 (Table 5, Figure 6). As described above, in 2002 the harvest at Kanalku Lake was restricted by a voluntary closure implemented by ADF&G and the residents of Angoon.

Table 3.–Subsistence salmon fishing permit stipulations for northern Chatham Strait sockeye salmon stocks, 1988–2006.

	Kanalku			Basket Bay			Sitkoh			Haselborg River/Salt Lake[a]		
		Limits			Limits			Limits			Limits	
Year	Season	Individual	Household	Season	Individual	Household	Season	Individual	Household	Seasons	Individual	Household
1988-1991	June 1 - July 31	25	25	June 1 - July 31	25	25	June 1 - July 31	10	10			
1992-2000	June 1 - July 31	25	25	June 1 - July 31	10	20	June 1 - July 31	10	10			
2001	June 1 - July 31	25	25	June 1 - July 31	10	20	June 1 - August 31	15	15			
		Possession	Annual		Possession	Annual		Possession	Annual		Possession	Annual
2002	June 1 - July 31 (Voluntary Closure)	25	25	June 1 - July 31	15	15	June 1 - August 31	50	50	June 1 - July 31	25	25
2003	June 1 - July 31	25	25	June 1 - July 31	15	15	June 1 - August 31	50	50	June 1 - July 31	25	25
2004	June 1 - July 31 (Voluntary Closure)	25	25	June 1 - July 31	15	15	June 1 - August 31	50	50	June 1 - July 31	25	25
2005	June 1 - July 31 (Voluntary Closure)	25	25	June 1 - July 31	15	15	June 1 - August 31	50	50	June 1 - July 31	25	25
2006	July 20 - August 15	15	15	June 1 - July 31	15	15	June 1 - August 31	50	50	June 1 - July 31	25	25

[a] not listed on permits prior to 2002

[b] Annual limits first included on permits in 2002.

Table 4.–Subsistence sockeye harvest by residents of Angoon, 1985–2005.

Note: Because not all permits were returned, "Expanded Harvest from Permits" is a statistical adjustment for permits that were issued but not retuned, and it is not an adjustment for under-reporting or misreporting.

Year	Reported Harvest From Permits	Expanded Harvest from Permits[a]
1985	732	
1986	1,057	
1987	646	
1988	226	
1989	429	
1990	1,032	
1991	696	
1992	769	
1993	901	
1994	1,300	
1995	936	
1996	1,408	2,793
1997	1,495	2,349
1998	1,554	2,725
1999	1,620	2,180
2000	1,344	2,158
2001	1,147	2,225
2002	751	1,178
2003	1,496	
2004	1,479	
2005	261	
Average	1,013	2,230

[a] Alaska Subsistence Fisheries: 2003 Annual Report

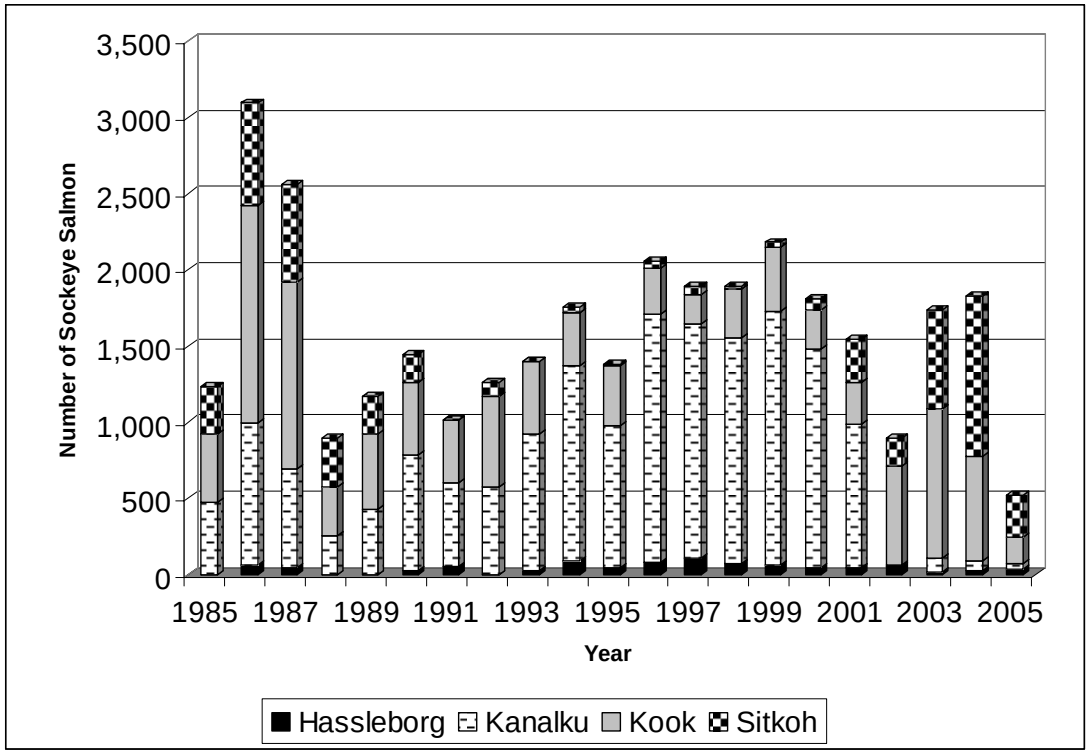


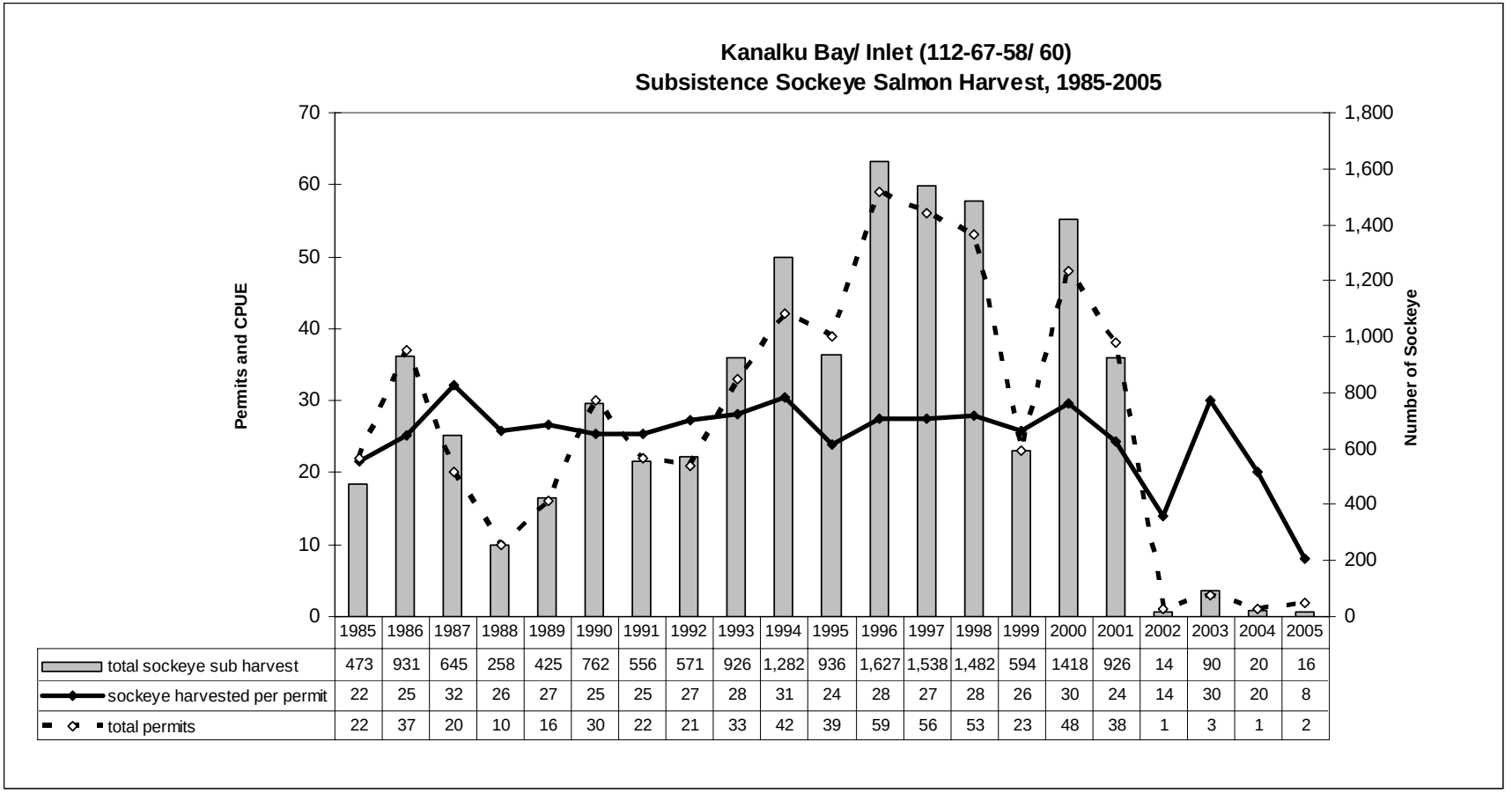
Figure 5.–Reported sockeye subsistence harvest for four Angoon area lakes 1985-2005.

Table 5.–Reported subsistence harvest by year from four sockeye systems in northern Chatham Strait, 1985–2005.

Year	Hassleborg	Kanalku	Kook	Sitkoh	Total
1985	0	473	450	313	1,236
1986	60	931	1,427	677	3,095
1987	45	645	1,233	636	2,559
1988	0	258	316	322	896
1989	0	425	493	248	1,166
1990	25	762	477	181	1,445
1991	50	556	406	0	1,012
1992	0	571	602	90	1,263
1993	25	901	475	0	1,401
1994	87	1,282	348	36	1,753
1995	45	936	387	10	1,378
1996	78	1,627	302	50	2,057
1997	110	1,538	187	60	1,895
1998	67	1,482	327	16	1,892
1999	60	1,666	418	36	2,180
2000	40	1,443	252	75	1,810
2001	40	946	279	276	1,541
2002	50	14	645	184	893
2003	20	90	976	647	1,733
2004	25	60	691	1,055	1,831
2005	34	40	169	275	518
Average	41	793	517	247	1,598

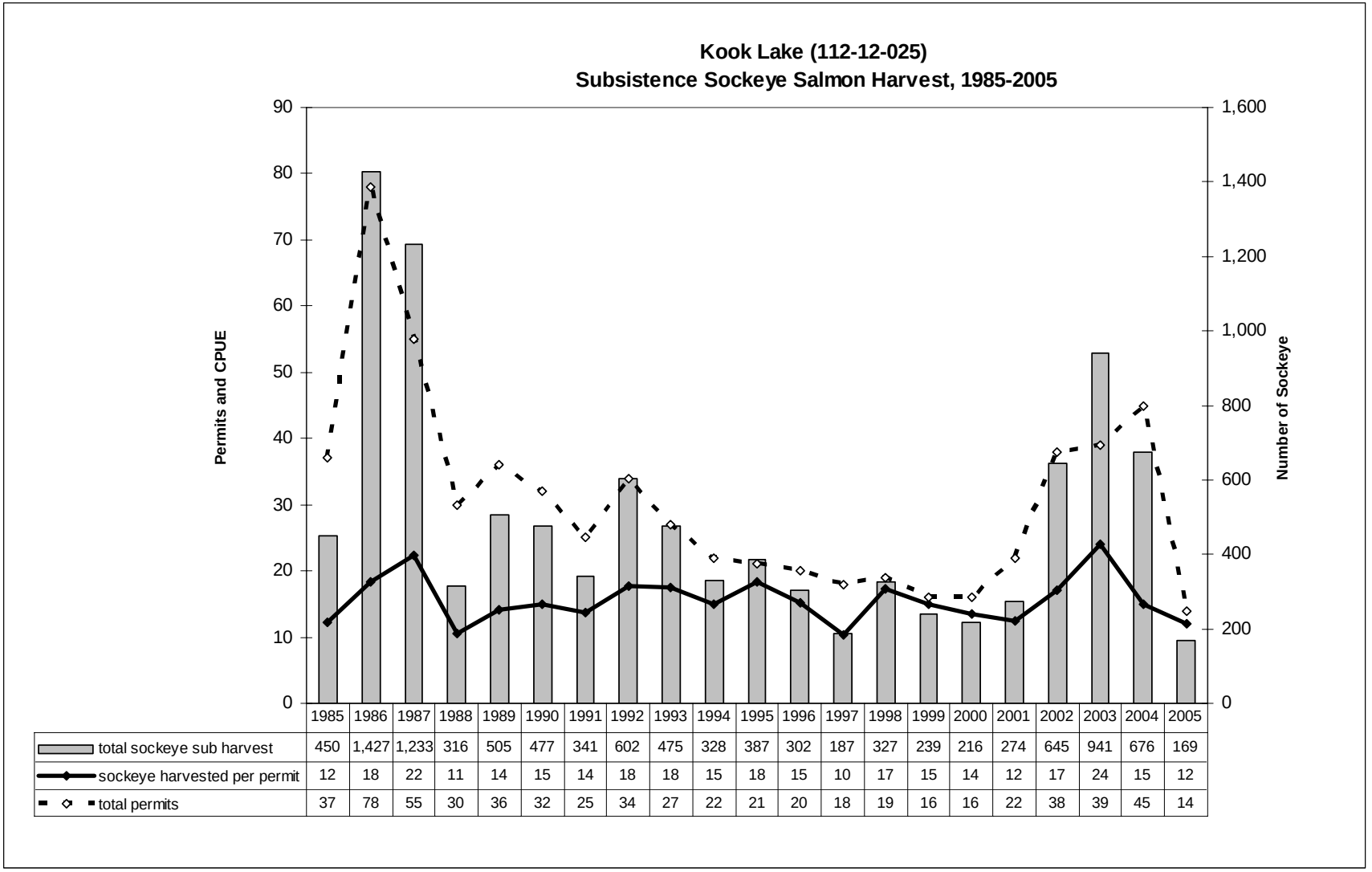
Reported participation and harvests in the Basket Bay (Kook) subsistence fishery was relatively stable from 1988 to 2001 but increased substantially in 2002 and remained high through 2004 (Table 5, Figure 7). The increase in effort and harvest in 2002 was probably due to the voluntary closure implemented at Kanalku and because ADF&G liberalized the harvest limits for sockeye salmon that year for the Kook Lake system.

Reported participation and harvests in the Sitkoh Bay subsistence fishery was relatively stable from 1992 to 2000 but increased substantially in 2001 and remained high through 2004 (Table 5, Figure 8). The increase in effort and harvest in 2001 was probably due to the voluntary closure implemented at Kanalku and because ADF&G liberalized the harvest limits for sockeye salmon that year from the Sitkoh lake system.



	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
total sockeye sub harvest	473	931	645	258	425	762	556	571	926	1,282	936	1,627	1,538	1,482	594	1418	926	14	90	20	16
sockeye harvested per permit	22	25	32	26	27	25	25	27	28	31	24	28	27	28	26	30	24	14	30	20	8
total permits	22	37	20	10	16	30	22	21	33	42	39	59	56	53	23	48	38	1	3	1	2

Figure 6.–Kanalku reported subsistence harvest and number of permits fished 1985-2005.



	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
total sockeye sub harvest	450	1,427	1,233	316	505	477	341	602	475	328	387	302	187	327	239	216	274	645	941	676	169
sockeye harvested per permit	12	18	22	11	14	15	14	18	18	15	18	15	10	17	15	14	12	17	24	15	12
total permits	37	78	55	30	36	32	25	34	27	22	21	20	18	19	16	16	22	38	39	45	14

Figure 7.–Kook reported subsistence harvest and number of permits fished 1985-2005.

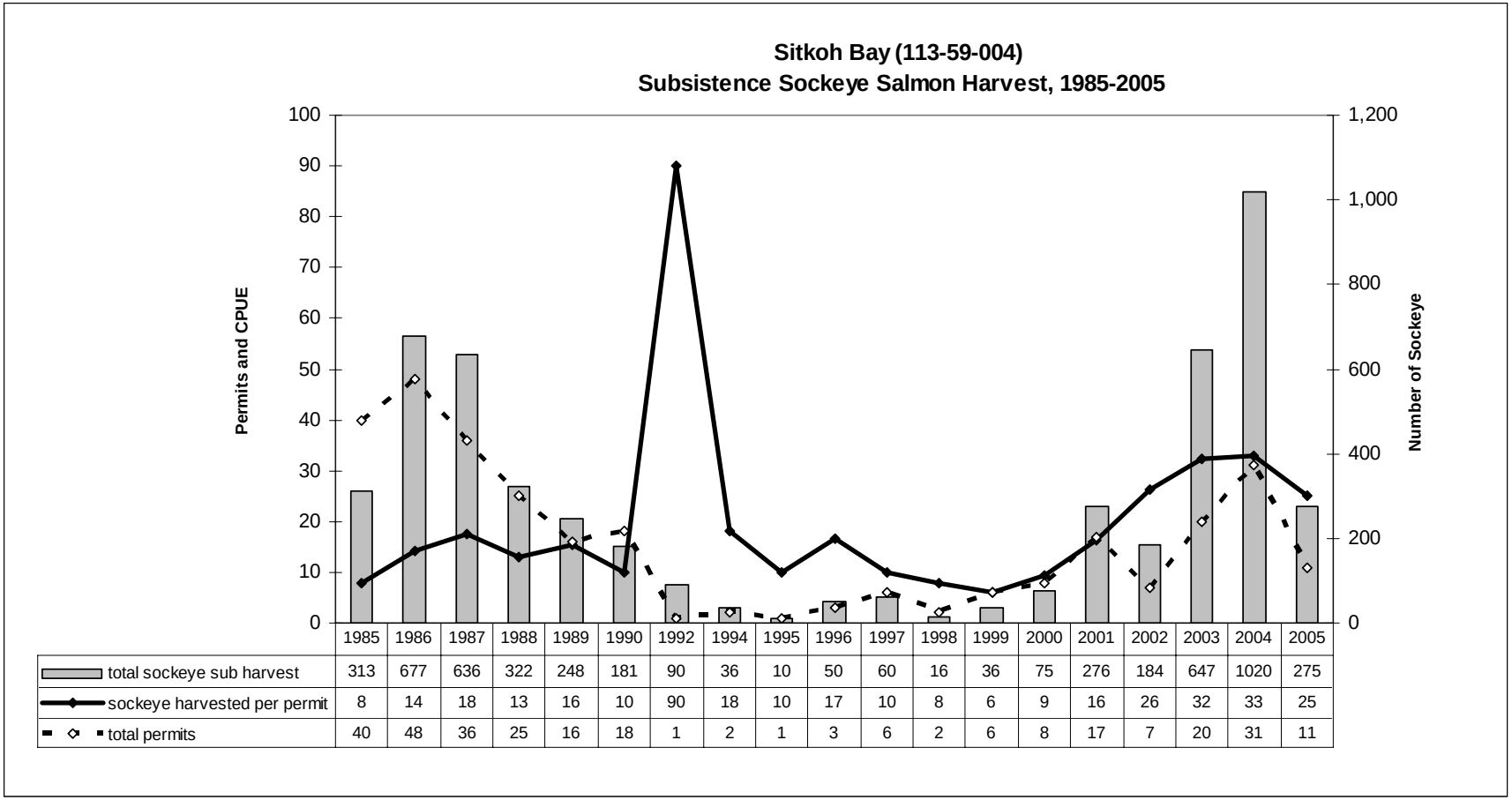


Figure 8.–Sitkoh reported subsistence harvest and number of permits fished 1985-2005.

SOUTHEAST ALASKA SUBSISTENCE SALMON AMOUNTS REASONABLY NECESSARY FOR SUBSISTENCE

Whenever there is a harvestable surplus on fish stocks subject to customary and traditional uses as determined by the Board, the subsistence statute also requires the Board to determine the amount reasonably necessary for subsistence uses (ANS) (AS 16.05.258). The USDA Forest Service through the Federal Subsistence Management Program does not have a similar requirement to determine ANS. The Federal subsistence priority is achieved by providing for the continued subsistence uses of fish and wildlife populations where they occur.

In making ANS findings, the Board considers information about subsistence harvest and use patterns from the department and the public and may periodically reconsider and update these findings or address public proposals to change them.

In 1989, the Alaska Board of Fisheries made Customary and Traditional (C&T) determinations covering all Southeast Alaska rural communities for all fisheries. There was a positive finding for sockeye salmon by rural residents of Angoon. In 1992, C&T findings based on residency were repealed because of constitutional compliance requirements. At its spring 1993 meeting the Board of Fisheries completed its work reauthorizing subsistence regulations for Southeastern Alaska. The Board delineated geographic areas where subsistence uses may be permitted, so that uses are not based on residency. In 1993 the Alaska Board of Fisheries established administrative ANS findings (not in regulations) for all salmon in the Southeastern and Yakutat areas. Subsistence harvest data collected over the previous decade (1983–1992) were considered in setting these amounts or ranges. At the time findings were based on subsistence permit data, which generally are low due to under- and non-reported harvests. The findings were for large geographic areas (Yakutat and Southeastern Management areas), as further refinement was determined to be unnecessary at the time. At the 2006 meeting the Board reviewed the 1993 findings and revised the ANS findings for Districts 1–15 and the Yakutat Area based on additional department data.

ANS Ranges

The Division of Subsistence expands subsistence salmon permit data into community estimates using a straight-line expansion by community of residence. For example, if 80 percent of the permits issued to residents of a particular community are returned, the reported harvest for each species would be multiplied by 1.25 (1 divided by .80). Based on this additional harvest analyses, possible ANS ranges were presented to the Board of Fisheries at the January 2006 meeting for the six fisheries permit areas: Yakutat, Haines, Juneau, Sitka, Petersburg, and Ketchikan. The possible ANS ranges were based on subsistence salmon fisheries permit data and the estimated salmon harvests (individual fish) from 1996–2003 shown in Table 6.

These harvest estimates are 40 to 50 percent greater than the earlier figures, which simply represented reported harvest from returned permits rather than harvest estimates based on expansions of unreturned permits. These expanded harvest estimates are considered to more closely approximate harvests for subsistence use in the permit areas. The permits returned without harvests, i.e. those that were not fished or that were fished unsuccessfully, are included in the returned permits. Based on Division of Subsistence research, unreturned permits are assumed to be fished at the same rate as the returned permits, catching the average harvest of each species for that community (Alaska Subsistence Fisheries Annual Report 2005).

At the 2006 meeting the Board reviewed the 1993 findings and revised the salmon ANS findings based on additional department data.

1. Districts 1-4, Ketchikan Permit Area: 9,068 to 17,503 salmon.
2. Districts 5-8, 10, and Section 9B, Petersburg Permit Area: 4,120 to 7,345 salmon.
3. Section 9A and District 13, Sitka Permit Area: 10,487 to 20,225 salmon.
4. Districts 11,12,13,14, and 16, Juneau Permit Area (Angoon, Kook and Kanalku are in District 12): 4,178 to 10,133 salmon.
5. District 15, Haines Permit Area: 7,174 to 10,414 salmon.
6. Yakutat Area: 5,800 to 7,832 salmon.

ADF&G supported the review and update of the amount reasonably necessary for subsistence use of salmon in Southeastern Alaska and Yakutat Management Areas. ADF&G was neutral on the amount reasonably necessary for subsistence as this is a Board determination. The Board revised and increased the amount of salmon reasonably necessary for subsistence uses for the Southeastern Alaska and Yakutat Management Areas. The Board of Fisheries can continue to review and revise findings as the need arises to provide a reasonable opportunity for subsistence uses.

Table 6.–Estimated Southeastern Alaska and Yakutat management areas, subsistence salmon harvests 1996–2003.

	1996	1997	1998	1999	2000	2001	2002	2003	1996-2003 Average	min	max	Possible ANS Range
Yakutat Permit Area[a]	**6,385**	**5,800**	**6,624**	**6,036**	**6,869**	**7,832**	**7,629**	**6,872**	**6,756**	**5,800**	**7,832**	**5,800 to 7,832**
Southeastern Alaska[a]												
Haines Permit Area	**10,414**	**8,474**	**8,213**	**8,051**	**7,174**	**8,140**	**8,394**	**9,493**	**8,544**	**7,174**	**10,414**	**7,174 to 10,414**
Juneau Permit Area	**9,790**	**8,348**	**8,650**	**7,605**	**5,045**	**6,265**	**4,178**	**10,133**	**7,502**	**4,178**	**10,133**	**4,178 to 10,133**
Angoon Area	5,345	3,841	4,154	3,295	3,219	3,549	1,532	3,240	3,522	1,532	5,345	1,532 to 5,345
Hoonah Area	4,445	4,506	4,496	4,311	1,826	2,716	2,646	6,893	3,980	1,826	6,893	1,826 to 6,893
Sitka Permit Area	**20,108**	**10,487**	**16,876**	**15,604**	**12,933**	**15,278**	**20,225**	**19,382**	**16,362**	**10,487**	**20,225**	**10,487 to 20,225**
Petersburg Permit Area	**5,841**	**4,583**	**5,506**	**5,325**	**4,120**	**4,798**	**5,905**	**7,345**	**5,428**	**4,120**	**7,345**	**4,120 to 7,345**
Petersburg Area	942	914	1,129	1,165	1,061	1,614	1,725	2,558	1,389	914	2,558	914 to 2,558
Wrangell Area	1,289	659	875	1,146	924	753	1,507	668	978	659	1,507	659 to 1,507
Kake Area	3,610	3,010	3,501	3,014	2,134	2,431	2,672	4,118	3,061	2,134	4,118	2,134 to 4,118
Ketchikan Permit Area	**17,503**	**14,469**	**11,641**	**12,014**	**10,684**	**11,473**	**9,068**	**11,773**	**12,328**	**9,068**	**17,503**	**9,068 to 17,503**
Kasaan Area	3,944	3,381	2,448	2,343	2,429	3,134	1,526	2,161	2,671	1,526	3,944	1,526 to 3,944
Craig/Klawock/ Hydaburg Area	13,559	11,088	9,193	9,671	8,255	8,339	7,542	9,612	9,657	7,542	13,559	7,542 to 13,559
Totals	**70,041**	**52,162**	**57,510**	**54,635**	**46,824**	**53,787**	**55,399**	**64,998**	**56,919**	**46,824**	**70,041**	**46,824 to 70,041**

Source of permit data: Alaska Department of Fish and Game, Commercial Fisheries Division, Alexander: The Integrated Fisheries Database for Southeast Alaska and Yakutat.

Note: Description of method for harvest estimates see: Alaska Subsistence Fisheries 2003 Annual Report, Alaska Department of Fish and Game, Division of Subsistence, Juneau, Alaska.

[a] 1993 Administrative ANS range for Yakutat was 1,200 to 3,000 and for Southeast Alaska was 21,000 to 34,000.

Angoon Subsistence Salmon Harvests

The estimated subsistence sockeye salmon harvests by residents of Angoon for 1996–2002, based on expanded permit data, are shown in Table 4. The average sockeye salmon harvest for this seven-year period is 2,230 fish. The minimum harvest was 1,178 sockeye salmon and the maximum was 2,793 sockeye salmon.

Based on the results of the 1996 household harvest surveys, salmon made up the largest portion of subsistence harvest in Angoon, as measured in pounds of useable weight, 47,590 pounds for the community or about 296 pounds per household. In 1996, an estimated 2,544 sockeye salmon (12,107 pounds), approximately 16 fish per household were harvested by Angoon residents.

ADF&G permit data shows that Angoon residents primarily harvest sockeye salmon using subsistence nets. Net fishing is conducted with beach seines at the heads of bays or near mouths of creeks. Drift gillnets are also used to harvest salmon in bays. Since the early 1990s, Kook (Basket Bay) and Kanalku have been the primary subsistence sockeye salmon sources for residents of Angoon. In 2002, the community of Angoon instituted a "voluntary closure" of Kanalku due to concerns about the declining numbers of sockeye salmon returning to spawn.

Since the early 20th Century commercial salmon fishing and processing have played a vital role in the life of the community, but since the late 1980s the role of commercial fishing in Angoon has diminished. In 1990, 76 persons in Angoon held CFEC permits and participated in salmon, halibut and other fisheries, fishing 119 permits. By 1997, this had dropped to 42 residents fishing 59 commercial permits. By 2000, only 24 commercial fishing permit holders were fishing 28 permits. This decline in commercial fishing has led to an increasing reliance on procuring fish in the subsistence fisheries, rather than retaining fish caught in commercial fisheries.

The Validity and Reliability of Fisheries Harvest Monitoring Methods, Angoon 2001

The primary objective of this research was to evaluate the reliability and validity of harvest monitoring methods used to estimate the salmon harvested using legal subsistence/personal use gear in Southeast Alaska. Kake, Hoonah, Angoon, Petersburg, Wrangell, and Yakutat were the communities chosen. Methods included household surveys of the harvest of salmon using legal subsistence/personal use gear and statistically comparing the estimated harvests from surveys and permits. Research results indicated that for Angoon in 2001, estimated harvests from surveys were not statistically different from the expanded harvests from permit reporting (Walker 2007).

In 2001, 117 Southeast Alaska subsistence/personal use salmon permits were issued to individuals with an Angoon mailing address. Between 1999 and 2002 the number of permits issued has ranged from 91 to 117, with the high in 2001. All of the 2001 Southeast subsistence/personal use salmon permits for Angoon residents were issued for the Juneau Management Area. The number of permits issued in 2001 to Angoon residents (117) was double the number of active fishing households (57), as determined by the Division of Subsistence. Between 1999 and 2002, the rate of subsistence/personal use reporting for Angoon permit holders has ranged from 50.4% to 74.5%, with the lowest rate of reporting occurring in 2001.

These harvest reports for Angoon residents identified that 1,222 sockeye salmon were harvested in 2001, along with 208 coho salmon, 33 chum salmon, 63 pink salmon and one Chinook salmon. Beach seines were used to harvest all of the pink salmon, as well as the majority of coho (70.2% of the total coho harvest), and sockeye salmon (63.5%). Harvests in Kanalku Bay accounted for 54.0% of the pink salmon reported harvests, 77.5% of the sockeye salmon, 57.6%

of the chum salmon, and 45.7% of the coho salmon harvested in 2001. An additional 32.7% of the coho harvests occurred in the Hasselborg River.

As only about one-half of the subsistence/personal use salmon permits issued for Angoon in 2001 had harvest reports, the estimated or expanded harvest would be significantly higher than the reported harvest. The estimated harvest included 2,217 sockeye, 409 coho salmon, 63 chum salmon, 124 pink salmon and one Chinook salmon.

The estimated harvests of salmon for Angoon in 2001 from the survey of identified fishing households included 1,933 sockeye salmon, 309 coho salmon, and 36 pink salmon harvested by subsistence/personal use methods. An additional 130 coho and six Chinook salmon were estimated to have been harvested by rod and reel. The survey did not collect information on salmon removed from the commercial catch for home use. Harvests in Kanalku Bay accounted for all of the pink salmon, and 88.3% of the sockeye salmon harvested by subsistence/personal use methods. Over 92% of the coho salmon harvests by subsistence/personal use methods occurred in Mitchell Bay.

A comparison of the frequency distributions of reported subsistence/personal use and household survey salmon harvests for Angoon residents for 2001 was conducted. In both instances the majority of households did not report Chinook, chum, coho or pink salmon harvests. However, about 40% of the households reporting from subsistence/personal use salmon permits identified no harvest of sockeye, but fewer than 25% of the identified fishing households surveyed reported no sockeye salmon harvest using subsistence/personal use methods.

The confidence intervals for sockeye, coho and pink salmon overlap, suggesting that the estimated totals were not statistically different. No Chinook or chum salmon were recorded on household interviews.

Subsistence Fishery Citations

Some residents of Angoon have been concerned for years about the unreported harvest of Kanalku sockeye salmon and have stated that concern to department biologists and fishery managers. In response to that concern and related to efforts to build the Kanalku sockeye stock, department biologists asked the Department of Public Safety (DPS), Division of Wildlife Troopers, to occasionally monitor the harvest of subsistence taken salmon in the Chatham area. The result of that effort is summarized below and is taken from DPS data.

Aircraft patrols of the purse seine fishery in recent years occasionally included overflights of Basket Bay and Kanalku Bay. There were three cases generated in these areas where people were cited for offenses during 2006 and 2007. The three cases resulted in 7 people charged. The offenses in 2006 were illegal anchoring of a drift gillnet at Basket Bay and taking over limit of sockeye at Kanalku Bay. The 2006 Kanalku citation involved three individuals who were actively fishing when contacted and had 148 sockeye salmon in their possession. The annual limit for Kanalku is 15 sockeye per household. The offense in 2007 involved two adults of the same household who were fishing with out permits at Kanalku Bay in mid July. They had in their possession 28 sockeye and 3 pink salmon. The individuals were fishing when contacted and were made to release fish in the net estimated to be another 15-20 sockeye.

There were no cases generated by DPS during 2004 and 2005 for subsistence offenses in these areas.

COMMERCIAL PURSE SEINE HARVEST AND MANAGEMENT

Commercial purse seine fisheries in District 12, the upper Chatham Strait area, can take place within approximately 700 square miles of State of Alaska managed marine waters extending from the latitude of Point Couverden to Point Gardner and including Tenakee Inlet. District 12 purse seine fisheries initially open in late June and the total season commercial harvest can be apportioned into 21 subdistricts or statistical areas (Figure 9).

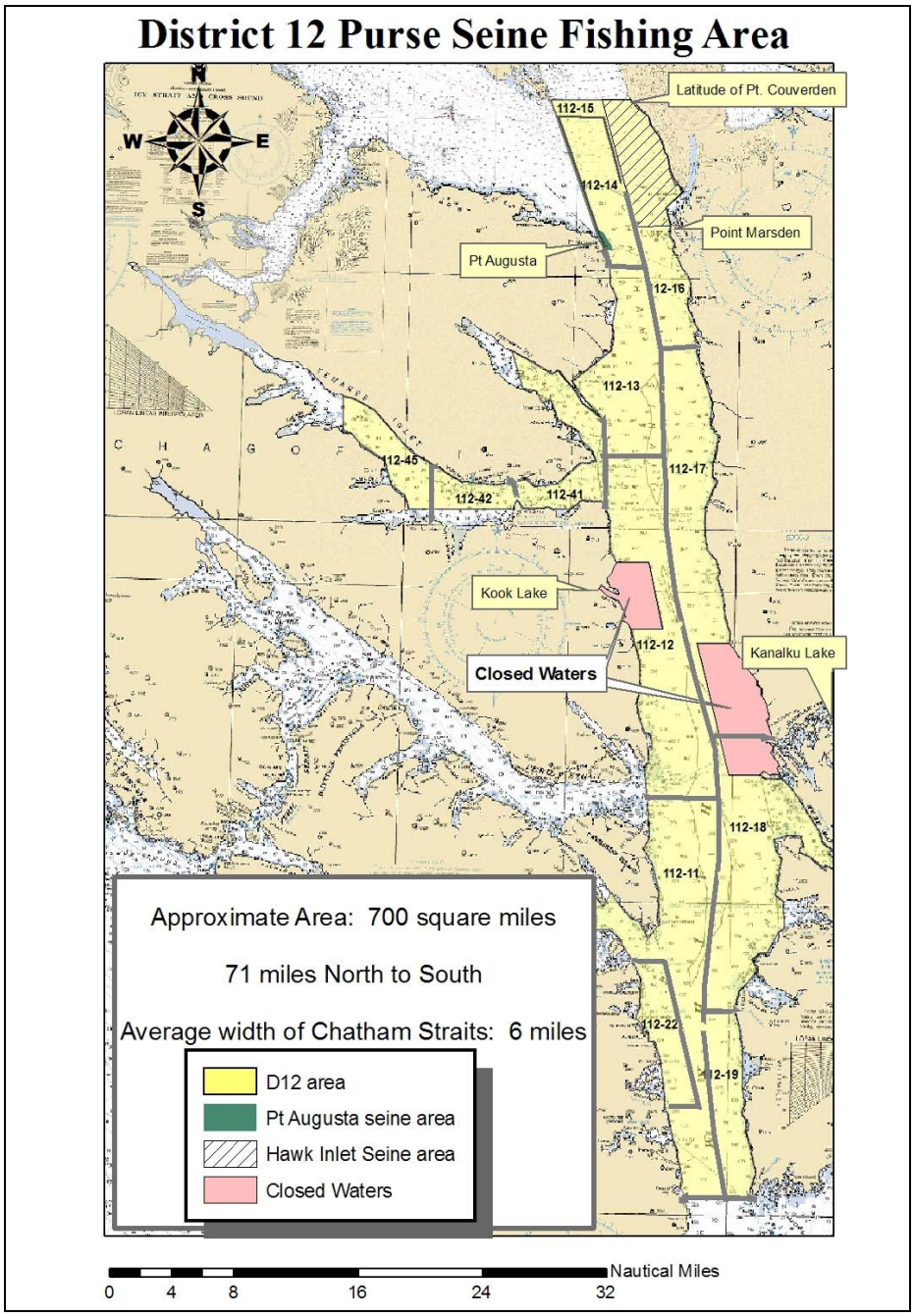


Figure 9.–District 12 purse seine fishing statistical areas in northern Southeast Alaska.

With the exception of the Hidden Falls Hatchery chum fishery, the purse seine fisheries in District 12 are directed at the harvest of pink salmon although king, chum, sockeye, and coho salmon are harvested incidentally.

Purse seine openings along the west Admiralty shoreline, statistical area 112-16 (District 12, Sub-district 16), in early July, are restricted north of Point Marsden and generally consist of 8-, 10-, or 15-hour openings once or twice per week. This is known as the Hawk Inlet fishery where early openings are directed at north migrating pink salmon and occur only in years of high pink salmon abundance. The average opening date for the area is July 20. The recent 1996–2005 average purse seine sockeye harvest in this statistical area is 39,000 fish. This is up from the 20-year average sockeye harvest of 32,000 fish. In 2004 and 2005 there were 175,000 and 115,000 sockeye harvested in this area. Fisheries in this statistical area account for 58% of all sockeye salmon harvested in District 12, although in recent years it has been as high as 78% of the total district harvest. No other statistical area accounts for more than 8% of the District 12 total sockeye harvest.

Southern boundaries for the fishery typically are extended south into statistical area 112-17, from Point Hepburn to Fishery Point and then to Parker Point, either the last week of July or in August. The 15-year average first purse seine opening for this area is July 28. The average 1996–2005 sockeye harvest is approximately 3,000 sockeye, or 4.4% of the total district 12 sockeye commercial harvest.

The Point Augusta index fishery, statistical area 112-14, takes place along a one-mile stretch of the Chatham Strait shoreline on northeast Chichagof Island. This area has been opened annually since 1992, between late June and mid-July, to monitor incoming pink salmon run strength in northern Chatham Strait. The average sockeye salmon harvest since 1992 is 4,400 fish and this accounts for approximately 8% of the total sockeye harvest in District 12.

The False Bay/Freshwater Bay fishery (statistical area 112-13) has only been open in three of the past 10 years. Early openings are very rare in this area and account for only a few hundred sockeye salmon.

The Chichagof Island shoreline south of Tenakee Inlet is known as the Basket Bay fishery. This statistical area, 112-12, opens on average on July 29 to target returns of pink salmon to Tenakee Inlet, Peril Strait, and local-area streams. This purse seine fishery averages 3,000 sockeye salmon per year, or 4.5% of the total District 12 sockeye harvest. This area is rarely open before the last week of July.

Hidden Falls (statistical area 112-22) hatchery openings typically begin after the third week of June and continue through July. Through mid-July common property seine fisheries are typically restricted to one or two days per week with cost recovery harvest often occurring throughout the week. Cost-recovery harvests have averaged approximately 200 sockeye salmon each year. Overall, the trend has been for decreasing effort in the Hidden Falls Hatchery purse seine fishery since the mid-1990s. The decline in effort is due to both declining chum salmon returns and an overall reduction in number of seiners participating in the seine fishery. Annual harvests at Hidden Falls have averaged 5,000 sockeye for the past 10 years and 1.58 million chum salmon. The Hidden Falls sockeye harvest represents about 7.5% of the total District 12 purse seine sockeye harvest.

MANAGEMENT OVERVIEW

To understand what the available harvest data tell us, one needs to know how purse seine fisheries are prosecuted throughout Southeast Alaska. In the case of Chatham Strait, understanding the timing and location of the openings is key to understanding the impact purse seining may or may not have on individual sockeye stocks. In Southeast Alaska, sockeye salmon production is the result of run strength to many small stocks and a few large stocks. To prevent over fishing of individual stocks the majority of the purse seine effort is directed into mixed stock areas, held to conservative levels, and spread over as many stocks as possible. Van Alen (2000) maintains that this style of management "effectively moderates exploitation rates and reduces the risk of overexploiting individual runs or temporal segments of runs, as occurred historically."

Commercial purse seine fisheries in northern Chatham Strait, or commercial fisheries management District 12, begins in mid to late June. During June through mid July only three areas are open to seining for 15 hours on Sundays. These are the Point Augusta index area (statistical area 112-14), Tenakee Inlet (statistical area 112-41), and Hidden Falls Terminal Harvest area (statistical area 112-22). This means that in a typical week from June through mid July, the District 12 purse seine fishery is open 9% of the available time in approximately 12% of the total available fishing area. As the pink salmon run progresses, and if the pink return is strong, the time and area available for fishing area conservatively increased. The first expansion or liberalization of the purse seine fishery occurs in mid to late July, with the addition of statistical area 112-16. The vast majority of the sockeye harvest in District 12 comes out this statistical area, 112-16, known as the West Admiralty or Hawk Inlet shoreline (Figure 10, Table 7).

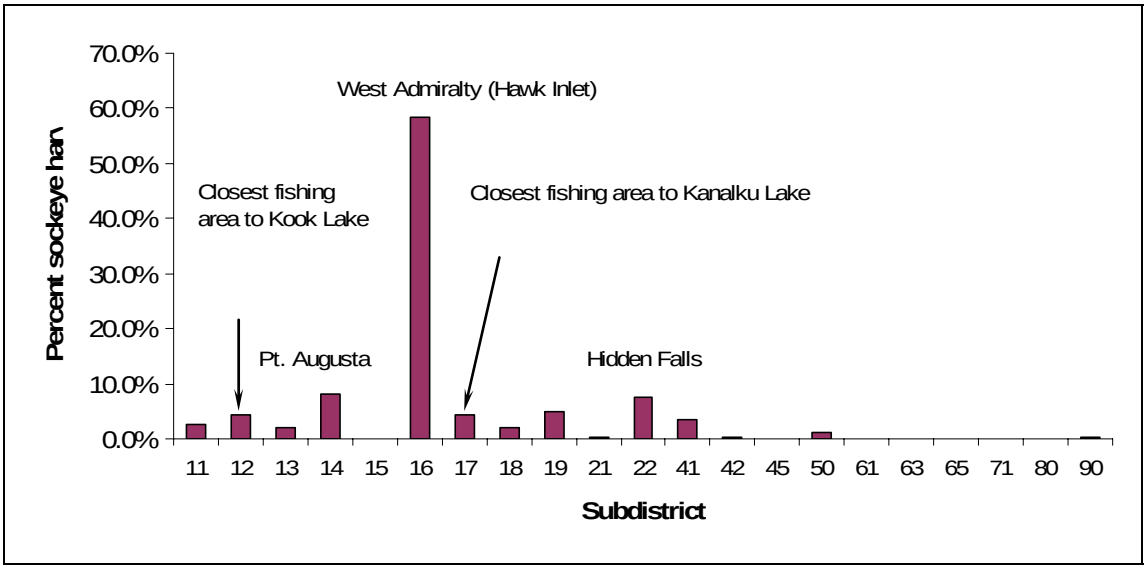


Figure 10.–District 12 commercial purse seine sockeye salmon harvest by statistical area (1996–2005 average catch as a percent of the entire district's harvest).

Table 7.–Sockeye salmon harvest by District 12 statistical area, 1996-2005.

Statistical Area Name	Statistical Area	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	10-yr Avg.
Outer Kelp Bay	11	1,214	944	648	1,678	396	1,720	354	1,345	3,076	5,322	1,670
Basket Bay	12	1,031	3,597	3,409	6,022	298		384		6,998	2,021	2,970
False Bay	13				1,930						958	1,444
Pt. Augusta	14	5,159	2,066	1,616	6,067	4,895	13,483	3,517	7,659	4,461	5,481	5,440
S. Lynn Canal	15											0
W. Mans. Peninsula	16	16,923	13,056	16,195	29,328	9,565	37,116	15,039	45,158	134,468	74,111	39,096
Angoon to Hepburn	17	411	1,664		2,038	42	168	650	5,697	9,259	6,440	2,930
Angoon to Whitewater	18	979		822	485	2,244	62	153	1,879	3,261	3,248	1,459
Wilson Cove Area	19	203		368	1,841	1,690		793	3,858	5,165	13,262	3,398
Kelp Bay	21		26	59	77	115	182		395	0	532	173
Hidden Falls	22	7,957	2,380	5,608	6,058	6,972	9,034	2,741	2,891	6,124	94	4,986
Outer Tenakee	41	3,665	2,288	1,877	2,448	4,042	2,420	775	82	1,954	3,203	2,275
Tenakee Springs	42	272	7	0	3	62	96	247	156	573	43	146
Central Tenakee	45	79	0	0	5	38	59	98		434	8	80
Freshwater Bay	50		1,582								0	791
Howard Bay	61										0	0
Funter Bay	63										0	0
Hawk Inlet	65										0	0
Outer Hood Bay	71			0		179					0	60
Chaik Bay	80			124		98	0				0	56
Whitewater Bay	90			94							145	120
	Total	37,893	27,610	30,820	57,980	30,636	64,340	24,751	69,120	175,773	114,868	67,093

The southern boundary of this fishing area is located at the latitude of Point Hepburn, which is approximately 40 miles distant from Kanalku Bay. This area is managed in July in accordance with the Northern Southeast seine salmon fishery management plan. This management plan addresses conservation of stocks in the area. Since 1989, the Hawk inlet fishery has been opened in 10 years including 4 out of the last 5 years consecutively.

In late July further expansion of the purse seine fishery area includes statistical area 112-17 and 112-12. Fishing time is also increased with the start of a 2-day on and 2-day off fishing regime if pink salmon abundance is sufficient. Statistical area 112-17, Point Hepburn to Danger Point, is nearest to Angoon and closer to Kanalku Lake. The recent 15-year average opening date for this statistical area is July 29. Although we have no estimates of the interception of Kanalku Lake sockeye salmon by the purse seine fleet in upper Chatham Strait, management is based on the assumption that this interception is insignificant because of the early run timing of Kanalku sockeye salmon (Figures 11 and 12), the distance of Kanalku Bay from these fisheries, timing of the fishery openings, and the nature of the mixed stock area where fishing occurs.

In recent years, ADF&G has taken action to protect Kanalku sockeye salmon in additional to the time restrictions on the commercial fishery openings. The Chatham Strait shoreline along an area of approximately 9 nautical miles from Parker Point to Point Samuel, west and north of Kootznahoo Inlet and the community of Angoon and Kanalku Inlet, has been closed to the purse seine fishery for the entire season (see Figure 6 above). The area from Point Samuel south to Point Gardner opens typically in August—well after the majority of the Kanalku sockeye salmon are inside the bay or lake. The 15-year average first purse seine opening for statistical area 112-16 on the north Admiralty Island shoreline occurs on July 20, 40–45 miles distant from Kanalku Bay. Based on subsistence harvest data collected over the past 20 years, 87% of the total season's subsistence harvest is completed by the time the first purse seine fishery opens in Upper Chatham, 97% by the end of July (Figures 11 and 12).

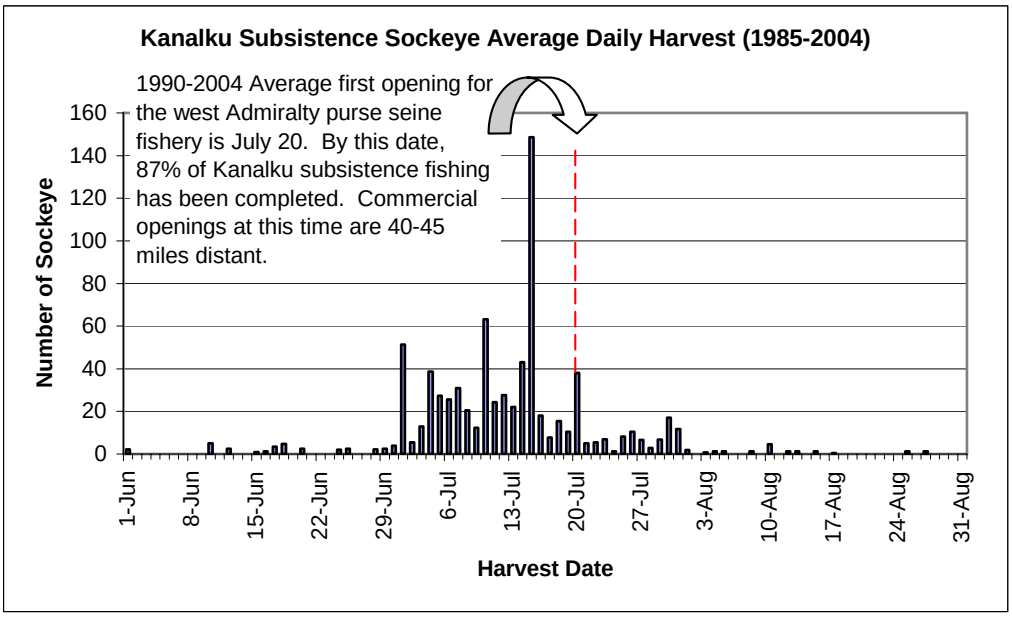


Figure 11.–Kanalku Subsistence Sockeye Average Daily Harvest 1985–2004.

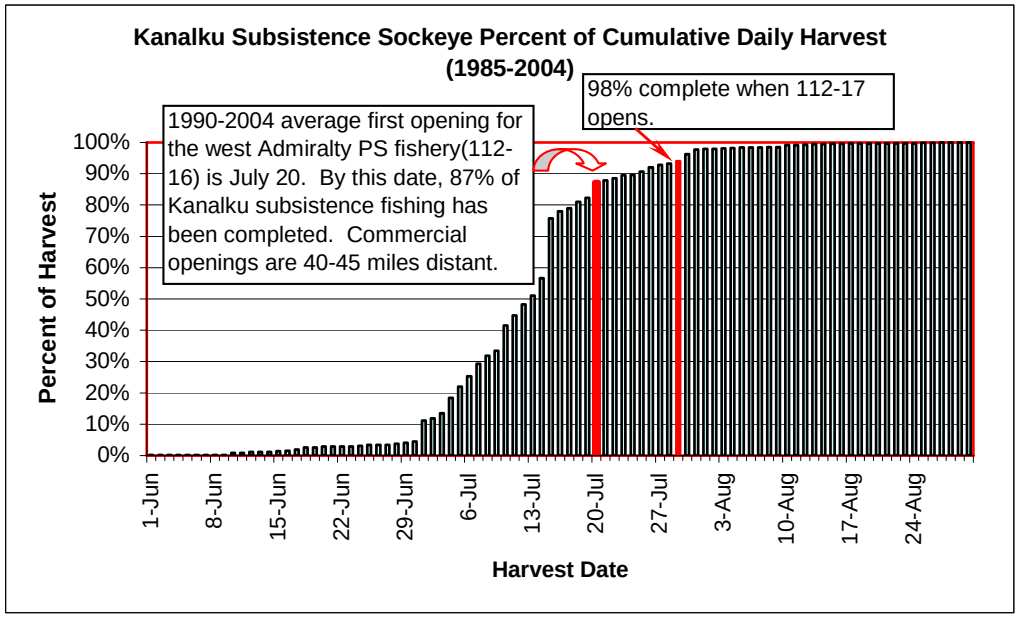


Figure 12.–Kanalku subsistence sockeye percent cumulative daily harvest 1985–2004.

In short, for the West Admiralty fisheries, both the timing of openings and the distance of the openings from Kanalku Lake were selected to cautiously allow purse seine fishing while protecting small sockeye stocks.

ADF&G has also routinely taken management actions in the Basket Bay shoreline purse seine fishery to protect Kook Lake sockeye stock along the west shoreline of Chatham Strait, opposite the community of Angoon. ADF&G managers consistently closed the commercial seine fishery within 4 nautical miles of state marine waters around the entrance to Basket Bay to manage for sockeye escapement to Kook Lake and for the Basket Bay subsistence fishery. The average opening date for this statistical area (112-12) is July 28—a date chosen because 92% of the subsistence sockeye fishery has been completed by that time (Figures 13 and 14). We also have run timing information for Kook Lake sockeye salmon from a weir that has been operated at the outlet of the lake in 1994, 1995, 2005, and 2006. The data available from the weir shows that the proportion of the sockeye salmon passed into the lake by statistical week 31, which is the average first purse seine opening week for the Basket Bay shoreline seine fishery, has ranged from 17% in 2005 to 75% in 1995 (Figure 15). It is important to note that the weir was located at the upper end of the outlet stream near the lake and not at the lower end of the outlet stream near saltwater. It is widely acknowledged that sockeye salmon will stage and mill in the terminal areas near stream mouths until stream flow is adequate to provide rapid passage into spawning locations.

ADF&G has taken these time and area actions, when managing the pursue seine fisheries in statistical areas 112-16, 112-17, and 112-12, the areas closest to these two small sockeye systems, in recognition of the need to provide escapements for sustainable returns as well as subsistence uses.

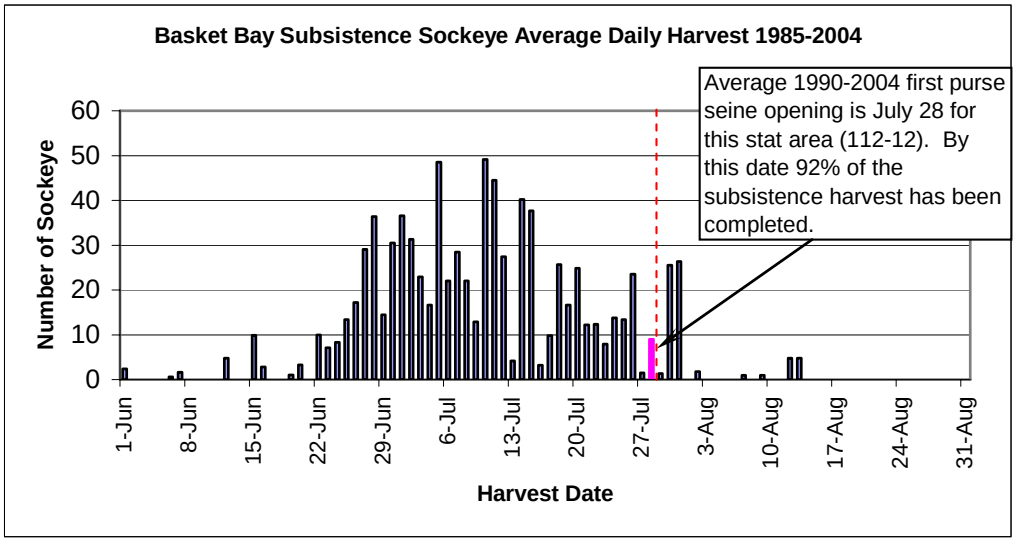


Figure 13.–Basket Bay subsistence sockeye average daily harvest 1985–2004.

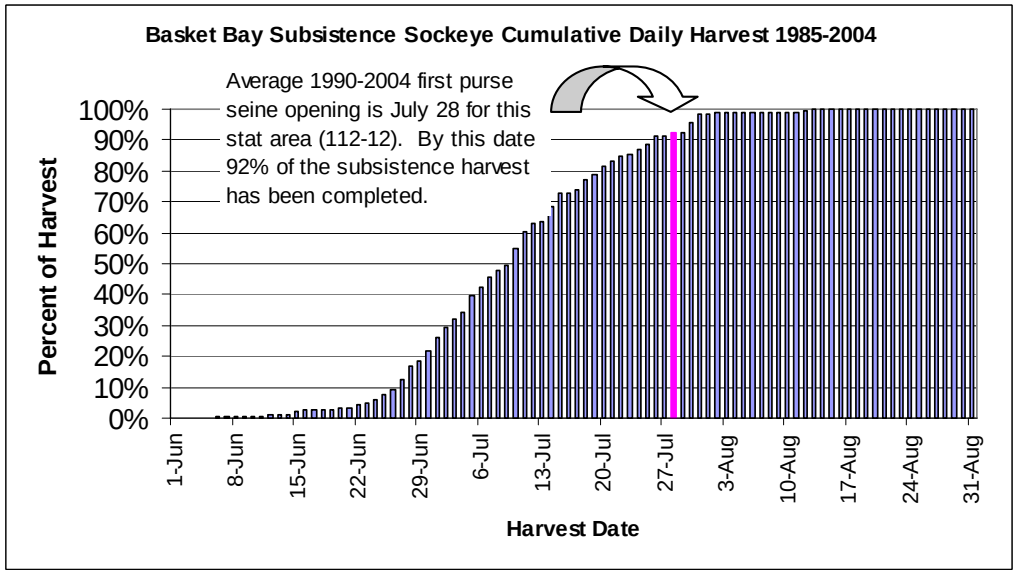


Figure 14.–Basket Bay subsistence sockeye percent cumulative daily harvest 1985-2004.

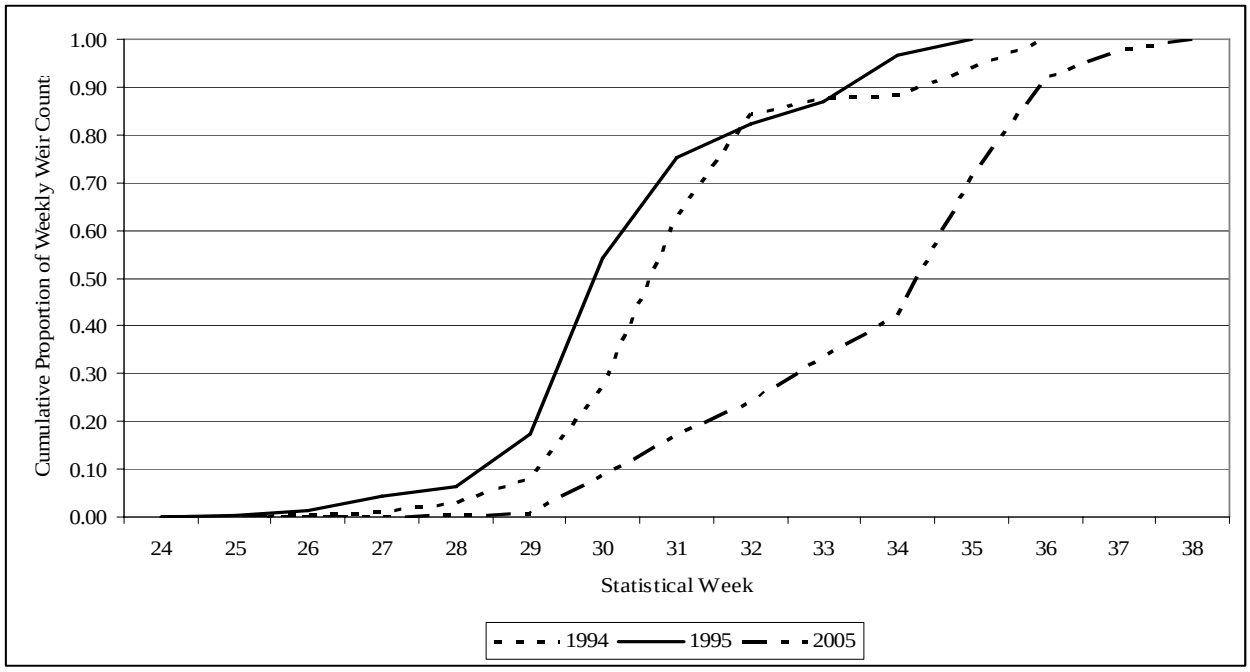


Figure 15.–Cumulative Weekly proportions of Kook Lake sockeye salmon weir counts, 1994, 1995, and 2005.

Note:"Statistical weeks" are simply the number from 1 to 52 of the calendar week of the year, and these are used in statistical catch and escapement accounting. For example, in 2006, Statistical Week 28 ran from July 9 to July 15, Statistical Week 29 ran from July 16 to July 22, Statistical Week 30 ran from July 23 to July 29, Statistical Week 31 ran from July 30 to Aug. 5, Statistical Week 32 ran from Aug. 6 to Aug 12, Statistical Week 33 ran from Aug 13 to Aug. 19, Statistical Week 34 ran from Aug. 20 to Aug 26, Statistical Week 35 ran from Aug. 27 to Sept. 2, and so on.

TRENDS IN HARVEST

The primary stocks being harvested in this area include the large north migrating driver stocks of Taku, Chilkat, Chilkoot, and Snettisham Hatchery. The recent trend in higher sockeye harvests from this statistical area, and from District 12 overall, can be largely attributed to the new sockeye production from DIPAC's Snettisham Hatchery (Figure 16). This hatchery program has averaged a return of 163,000 sockeye salmon per year since 1996.

In 2004 the total sockeye return to Snettisham Hatchery was 520,000 fish. Over 300,000 of these sockeye salmon were harvested in commercial purse seine and gillnet fisheries. The overall magnitude of the sockeye hatchery production and contributions were established with otolith marking, fishery port sampling, and otolith mark evaluation and analysis by both DIPAC and ADF&G (unpublished data available form ADF&G's Mark, Tag, and Age Laboratory). Another factor contributing to increased sockeye harvest in recent years is the abundance of northern wild stocks experiencing near-record high returns. Taku River, for example, experienced record sockeye returns in 2001 and 2003, and Chilkat River returns were very strong in the late 1990s. All northern Southeast Alaska sockeye stocks that ADF&G monitors in the Chatham area (Chilkat Lake, Chilkoot Lake, Taku River, Speel Lake, Crescent Lake, and Snettisham Hatchery) have generally met or exceeded escapement goals for the last 20 years (Geiger et al. 2005). The total combined run size of these stocks has exceeded 1,000,000 fish twice in the past 6 years.

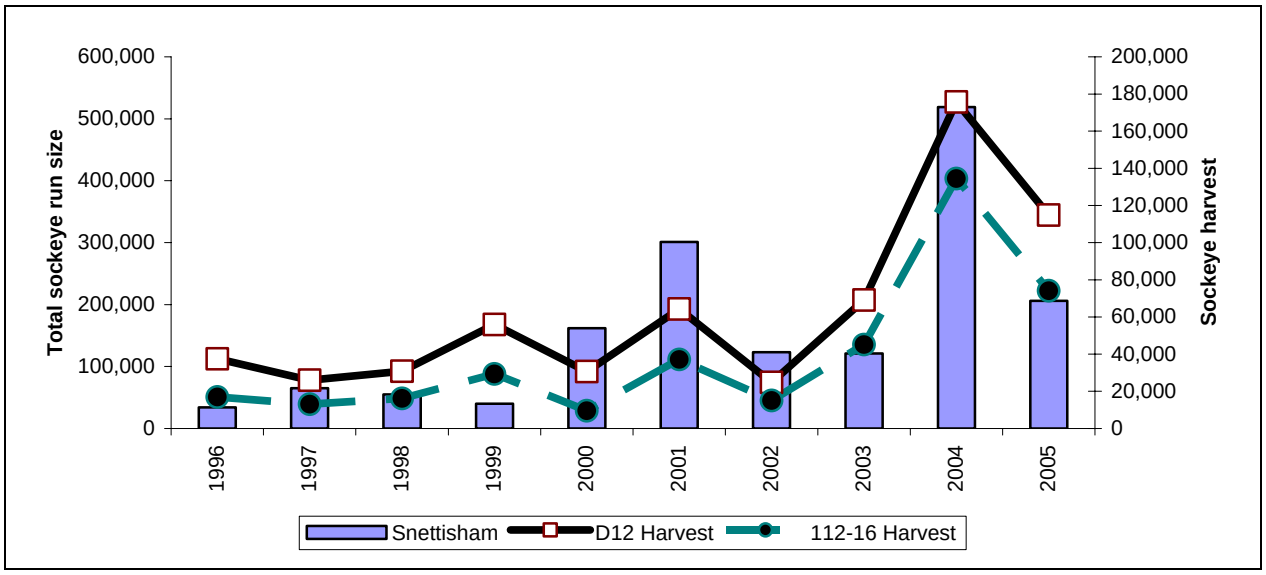


Figure 16.–Snettisham Hatchery sockeye production plotted with the District 12 purse seine harvest and the statistical area 112-16 harvest, from 1996 to 2005.

The recent 15-year trend in purse seine fishing effort for Southeast Alaska overall has been decreasing. In 1994, 404 permits fished compared to an all time low of only 211 permits fished in 2004. In 2005 a total of 234 purse seine permits fished in Southeast. Fishing effort for the primary sub-districts fished in District 12 however has been relatively stable in the last 10 years with upward and downward swings related to pink salmon abundance. Figure 17 shows the effort trend from 1990 to 2006 in District 12 and is based on fish ticket data. The data represented is the sum of boats x 1 day for each day that a boat actually reported catching fish. This means that any opening calendar day counts as one boat day even if the opening was only 8, 12, or 15 hours. This method probably overestimates the actual effort but is more representative of real fishing effort than simply multiplying the number of boats x days open for any specific fishing period. This is because, in almost every case that a fishery was open 4 days in recent years, the buyers controlled the fishery by putting boats on limits or not buying fish for two and sometimes three days of an open 4 day fishing period. The traditional method of accounting for boat-days (total boats x days open) can be a gross overestimate of true effort.

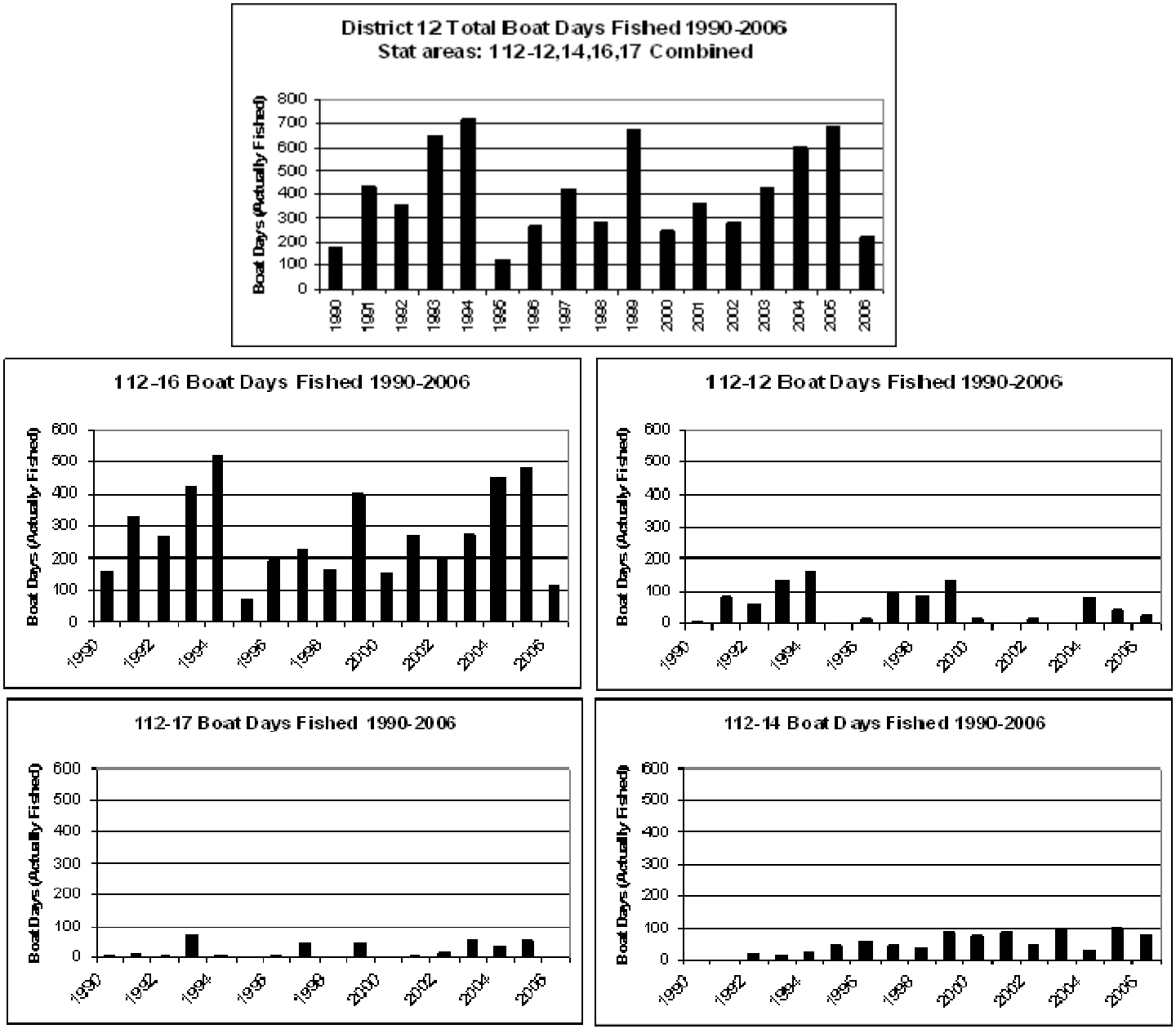


Figure 17.–Proportion of sockeye salmon harvest in District 12 purse seine fisheries by statistical area, 1990–2006.

SPORT FISHERY HARVEST AND MANAGEMENT

Sockeye salmon harvest data for the Chatham Strait area were extracted from the Statewide Angler Harvest Survey database for the years 1996–2005 (Table 8). The data query included Kanalku Bay and Lake, Salt Lake, Mitchell Bay, Hasselborg Creek, Kook Lake and Creek, Basket Bay, Sitkoh Creek, and "Angoon Area". As is typical for small fisheries and remote drainages, the number of survey respondents for the site-specific bays and drainages was either nonexistent, or so low that expanded harvest estimates are not useful, with the exception that few or no angler responses suggest low levels of fishing effort. Of the sites that were queried, no responses were found for Kanalku Lake, Kanalku Creek or Kanalku Bay.

The number survey responses for the "Angoon Area" are sufficient to generate harvest estimates for that site, and these are listed in Table 8. The sockeye harvest numbers presented for Angoon (those listed above) include boat and shore anglers and resident and nonresident angler harvests. Because very few respondents reported a harvest of sockeye salmon, it is likely that most angler effort was directed at species other than sockeye salmon (Chinook and coho salmon along with Halibut). It is also worth noting that 85% of the effort and harvest was derived by nonresidents.

Charter harvest of sockeye salmon for the Chatham Strait area was extracted from the Saltwater Charter Logbook database for the period (Table 9). The largest reported harvests occurred in the subdistricts west side of Point Retreat, adjacent to Funter Bay and Hawk Inlet, and adjacent to Angoon.

The regional background bag limit of 6 sockeye salmon daily with a possession limit of 12 fish applies in both fresh and salt waters. Over the last 5 years there have been no emergency orders restricting sport fishing within any of the drainages located proximate to the community of Angoon. There have been no significant biological concerns forwarded to ADF&G that would precipitate sport angler restrictions in the Chatham area based upon existing levels of effort or harvest.

Table 8.–Estimated sockeye salmon harvest by recreational anglers within the Angoon Area, 1996-2005.

Area	Year	Number of Respondent	Estimated Effort (angler days)	Estimated RS Harvest	Number of Respondents reporting RS harvest	Reputed RS Harvest
Angoon Area (Boat)	1996	72	3,278	334	3	38
Angoon Area (Boat)	1997	76	4,322	21	1	2
Angoon Area (Boat)	1998	57	2,921	0	0	0
Angoon Area (Boat)	1999	74	6,334	409	3	38
Angoon Area (Boat)	2000	80	7,782	0	0	0
Angoon Area (Boat)	2001	74	6,173	449	5	42
Angoon Area (Boat)	2002	76	4,585	151	1	16
Angoon Area (Boat)	2003	60	5,801	251	2	21
Angoon Area (Boat)	2004	46	3,550	11	1	1
Angoon Area (Boat)	2005	57	8,789	36	1	3
10 yr. Avg		67	5353	126	2	16

Table 9.–Reported sockeye salmon harvest by chartered anglers in the Chatham Strait area, 1990-2004.

Subdistrict	1999	2000	2001	2002	2003	2004	Average
11211	0	1	0	0	0	4	1
11212	16	4	0	0	0	0	3
11213	0	0	0	0	0	0	0
11214	0	0	0	0	0	1	0
11215	8	6	30	19	9	17	15
11216	0	9	8	2	2	8	5
11217	0	0	1	0	1	0	0
11218	0	25	0	2	4	1	5
11219	4	0	7	0	0	0	2
11221	0	0	0	0	0	0	0
11222	0	0	1	0	0	3	1
11265	0	0	0	0	0	0	0
11267	0	0	0	0	0	0	0
11271	0	0	0	0	0	0	0
11272	0	0	0	0	0	0	0
11280	0	0	0	0	0	0	0
11290	0	0	0	0	0	0	0
District 112 Total	**28**	**45**	**47**	**23**	**16**	**34**	**32**
11359 (Sitkoh Bay)	**0**	**0**	**0**	**0**	**0**	**0**	**0**

HABITAT ALTERATIONS

We were unable to find any fully developed habitat assessments for the drainages supporting the key sockeye stocks in northern Chatham Strait. The Sitkoh watershed has been extensively logged. About 20% of this 5,000 hectare drainage was affected by logging and there are about 30 km of roads in this watershed. The Kook Lake watershed was also logged in the 1970s and 1980, and about 18% of the watershed was affected. The outlet stream and sections of the inlet stream were clear-cut to the riverbanks. This system is also unique in that some portions of the stream are subterranean. The upstream entrances to these caverns have at times been completely blocked with logs and woody debris, which we assume is partially a result of the logging. The USDA Forest Service documented fish blockages to all three underground cavern entrances in the early 2000s. ADF&G staff has also noted that at times during very dry summers, there was no surface water in sections of the outlet stream for prolonged periods of time.

Both the Hasselborg and Kanalku lakes are in wilderness areas, and we assume they have been minimally affected by habitat alterations. The USDA Forest Service dynamited water falls in the outlet stream at Kanalku Lake in 1970, as mentioned above. At this time we have no reason to think that the current configuration of these falls is more difficult for the salmon to negotiate than it would have been had the falls not been altered by this blasting, although this remains an obvious possibility.

DISCUSSION

Since 2001, we have increased our meager store of information about the status of the sockeye resources in upper Chatham Strait. Even so, we still do not know enough. Specifically, we still cannot paint a clear picture of the status of these stocks, nor do we know enough to make technical recommendations about fishery management, escapement goals, or the capacity of these stocks to produce a sustained harvestable surplus. What we have attempted to do is present a body of information about Chatham Strait sockeye stocks, without interpretation or editorial comment, intending that this document simply be a reference.

That is not to say that individuals within the respective agencies have not come to personal conclusions about these stocks, their status, and the effects of the fisheries, but we have not reached broad consensus on many of the issues, and a lack of information is the principal hindrance. Even where we do have information, we remain concerned about the quality of some of it. We are not confident in the quality of many of the escapement estimates presented in Table 1 (especially those labeled "expanded mark-recapture," as those are somewhat questionable extrapolations of estimates of only part of the breeding populations).

In going back and reviewing the 13 questions that we posed in the introduction, we see that we have answered none of the five questions about escapement level or fishery status, we may have partially answered two of the questions about management processes and decisions, and we did not answer any of the questions about policy. What we did accomplish, however, was that we were able to assemble key information about the history of some of the fisheries; the information that does exist on harvest and escapement; and some information about the management operations, management rationale, and key assumptions that managers have used in the past. We hope that this document will be helpful to the public, decision managers, and agency staff as they work to develop larger conclusions about the status of these stocks, and work to develop recommendation for the stocks' management. Obviously, those conclusions and recommendations will need to come at a later time. While we do not offer recommendations about management, we do recommend the ADF&G staff continue to work to develop escapement targets for these sockeye systems, that these targets be used to guide management actions in the seine and subsistence fisheries. We also recommend that staff continue to develop inseason escapement monitoring tools, where possible, and that this monitoring be incorporated into their management.

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