

**Regional Information Report No. 1J09-03**

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**McDonald Lake Sockeye Salmon Action Plan, 2009**

by

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Alaska Department of Fish and Game

Division of Commercial Fisheries



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

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**McDONALD LAKE SOCKEYE SALMON ACTION PLAN, 2009**

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## ABSTRACT

McDonald Lake, located on the Southeast Alaska mainland, approximately 40 miles north of Ketchikan, has been considered the largest sockeye salmon (*Oncorhynchus nerka*) producing system in southern Southeast Alaska. Coded-wire tagging studies in the 1980s showed that this stock was harvested primarily in the District 6 drift gillnet fishery, with the next largest portions of the run harvested in the District 1, 2, and 4 purse seine fisheries. This stock was also harvested in a terminal purse seine fishery in upper West Behm Canal in 1991–1993 and 1996–2001, and there is an ongoing personal use fishery in Yes Bay (at the outlet of McDonald Lake). The department has completed three years of studies (2005–2007) to improve escapement estimates at McDonald Lake, and updated the escapement goal for the system based on these improved estimates of escapement. ADF&G recommends a new Sustainable Escapement Goal of 55,000 to 120,000 sockeye salmon. Sockeye salmon escapements have been below this recommended escapement goal in four of the last five years, and are not anticipated to meet the escapement goal in upcoming years. As a result, McDonald Lake sockeye salmon were identified as a candidate stock of concern in a memo to the Board of Fisheries in the fall of 2008 based on the definition of “management concern” contained in Alaska’s Sustainable Salmon Fisheries Policy. This action plan for McDonald Lake has been approved by the Alaska Board of Fisheries and is intended to rebuild the McDonald Lake sockeye salmon run back to levels that attain the current escapement goal range. The rebuilding plan includes measures to reduce harvests and improve stock assessment.

Key words: Action Plan, commercial fisheries, escapement goal, gillnet, McDonald Lake, *Oncorhynchus nerka*, purse seine, sockeye salmon, stock of concern.

## SYNOPSIS

In response to the guidelines established in the Sustainable Salmon Fisheries Policy (Sustainable Salmon Fishery Policy; 5 AAC 39.222), the Alaska Department of Fish and Game (ADF&G) identified the McDonald Lake sockeye salmon (*Oncorhynchus nerka*) stock as a candidate stock of concern in a memo to the Board of Fisheries in the fall of 2008. Identification of McDonald Lake sockeye salmon as a candidate stock of concern is based on the definition of “management concern” contained in the policy: “a concern arising from a chronic inability, despite use of specific management measures, to maintain escapements for a salmon stock within the bounds of the SEG, BEG, OEG, [sustainable, biological, and optimal escapement goals] or other specified management objectives for the fishery” (5 AAC 39.222 (f) (21)). The policy defines “chronic inability” as “the continuing or anticipated inability to meet escapement thresholds over a four to five year period” (5 AAC 39.222 (f) (5)). Escapements of sockeye salmon at McDonald Lake had been below the existing sustainable escapement goal range of 70,000 to 100,000 fish in seven of the last eight years, 2001–2008. The department recently completed studies to improve estimates of total escapement for the McDonald Lake stock (Heinl et al. *in press*) and has established a new sustainable escapement goal of 55,000 to 120,000 fish, based on a spawner-recruit analysis using the improved escapement estimates (Eggers et al. *in press*). These improvements in stock assessment do not change the department’s recommendation that the McDonald Lake sockeye salmon stock be considered a candidate for stock of concern status, because escapements have been below this new goal range in four of the last five years, and are not anticipated to meet the escapement goal over the next few years.

## INTRODUCTION

McDonald Lake is located on the Southeast Alaska mainland, approximately 40 miles north of Ketchikan (Figure 1). The McDonald Lake sockeye salmon run has been considered the largest sockeye salmon producing stock in southern Southeast Alaska (Geiger et al. 2004). Like most other major sockeye salmon systems in Southeast Alaska, the McDonald Lake run has a history

of commercial exploitation and hatchery operation during the late 19th and early 20th centuries (Roppel 1982). Runs were thought to exceed 100,000 sockeye salmon in 1909 and 1911, and more than 200,000 in 1910 (Johnson et al. 2005). More recently, McDonald Lake was the target of a long-term enhancement project initiated by the Alaska Department of Fish and Game (ADF&G) in the late 1970s, and carried out via lake fertilization from 1982 to 2004. Over most of the enhancement period, runs of sockeye salmon to McDonald Lake were strong, with many escapements in excess of 100,000 fish. The stock was actively managed during the 1990s, and fish that were expected to be in excess of the escapement goal were harvested in directed, near-terminal purse seine fishery in District 1 in upper west Behm Canal. Peak harvests were 150,000 sockeye salmon in 1993, worth an exvessel value of \$0.75 million, and 250,000 sockeye salmon in 1996, worth an exvessel value of \$1.5 million (catch numbers included all sockeye salmon harvested in subdistricts 101-80, 101-85, and 101-90). The McDonald Lake stock has supported the largest personal-use fishery in southern Southeast Alaska, with a maximum reported harvest of more than 10,000 fish in 1994. McDonald Lake sockeye salmon were also used as a brood source for stocking projects at a number of other sites in southern Southeast Alaska (Johnson et al. 2005). The stock began a decline after 2001, however, despite lake fertilization.

## **STOCK ASSESSMENT BACKGROUND**

McDonald Lake was the subject of a lake fertilization enhancement effort for more than two decades. Fertilizer was applied to the lake weekly between mid-May and early September in every year from 1982 to 2004. A variety of limnological and fisheries assessment information was collected at McDonald Lake during the 1980s and 1990s when the lake was fertilized, including information on smolt size and age (1980s), coded-wire tagging of smolts (returns in 1985, 1989, and 1990) rearing fry abundance, the lake's chemical composition (phosphorus and nitrogen levels), physical characteristics (light and temperature), and primary and secondary production (chlorophyll concentration, zooplankton species composition, density, and biomass), and the adult escapement (abundance and age) (Johnson et al. 2005). The ADF&G, Commercial Fisheries Division, and the Fisheries Rehabilitation and Enhancement Division (FRED) initiated these programs. The State of Alaska eliminated FRED in the mid-1990s, along with most of its programs. The Southern Southeast Regional Aquaculture Association (SSRAA) assumed or assisted with operation of many aspects of the program through 2003.

The sockeye salmon escapement to McDonald Lake was estimated through weir counts from 1981 to 1984, and, since 1985, through a foot-survey method based on calibrations from the 1983 and 1984 weir counts (Johnson et al. 2005). The department recently completed a project to improve the escapement estimation at McDonald Lake through comparison of weir counts (1981, 1983, and 1984) and mark-recapture estimates (2005, 2006, and 2007) to peak foot surveys conducted in those years (Heinl et al. *in press*). The previous method of estimating the escapement produced estimates that were generally biased low (e.g., accounted for only 82% of the escapement on average) compared to estimates of escapement derived from six years of weir counts and mark-recapture studies. These new studies allowed the department to re-cast the estimated escapements to McDonald Lake based on the peak annual foot survey (Heinl et al. 2008, Heinl et al. *in press*), and to update the escapement goal using spawner-recruit methodology (Eggers et al. *in press*). Escapements averaged greater than 100,000 fish from 1980 to 2001; since that time, however, the estimated escapement has averaged less than 50,000 fish, and was below the new sustainable escapement goal range in four of the last five years (Figure 2).

Poor escapements at McDonald Lake since 2004 have resulted in very low fall fry abundance. The estimated fall fry abundances during 2005–2007, were the lowest in the history of the McDonald Lake fall fry assessment (Figure 3). Based on the dominant age at return for McDonald Lake sockeye salmon (age-5), adult fish from fry populations in 2005–2007 will return in 2008–2011. Therefore, it is likely that depressed runs of McDonald Lake sockeye salmon will continue in the near future, and annual runs are not anticipated to meet the escapement goal over the next few years.

Most of the information on the contribution and distribution of the McDonald Lake sockeye salmon in the Alaska traditional commercial harvest comes from coded wire tag studies conducted by ADF&G in 1982–1985, and 1986–1991 (Johnson et al. 2005). Useful information provided by these studies is limited to only three years of adult returns: 1985, 1989, and 1990. Coded-wire tag returns in 1991 were compromised by a very low rate of tagging in 1988, and the fact that tags were not applied throughout the entire smolt outmigration period. Fewer than 6,000 smolts were tagged (compared to 22,000 in 1986, and 38,000 in 1987), 51% of which were tagged during the last three days of the six-week tagging period (Johnson et al. 2005). Tag recovery information for 1991 is included here for completeness, but it must be pointed out that the information is badly biased and almost certainly not representative of the entire run.

The Department has recently implemented a multi-year, genetic stock identification project to help identify areas of potential catch of McDonald Lake sockeye salmon from 2007 to 2009. Weekly samples will be collected from the District 6 drift gillnet fishery and the District 1 purse seine fishery (along the Gravina Shore, Subdistrict 101-29), as well as other purse seine fisheries in Districts 2, 5, 6, and 7, when available. Preliminary data are available for 2007. The information from this project, once analyzed, will be used to update the coded-wire tagging studies and provide improved information about the time and area distribution of McDonald Lake sockeye salmon in those fisheries.

Although it was long thought that the lake fertilization enhancement effort was highly successful and increased the survival rate of rearing fry, the recent downturn in the escapement has occurred entirely during the lake fertilization period (Figure 2). The first “non-fertilized” adults (2-ocean age class) did not return to McDonald Lake until 2008. In addition, escapements from 1981 to 1985 were unaffected by lake fertilization, yet averaged 91,000 per year (range 51,000 to 130,000). Only two years of lake chemistry data were collected prior to the lake enhancement, and none have been collected since 2003; thus, little comparative information exists with which to adequately assess the affects of the lake enrichment effort. The habitat in the McDonald Lake drainage is considered pristine and there are no habitat-related concerns identified for this stock.

## **FISHERY MANAGEMENT BACKGROUND**

### **Southern Southeast Purse Seine Fisheries**

All commercial salmon fisheries conducted in Southeast Alaska harvest mixed stocks, except in the most terminal harvest locations. Commercial purse seine fisheries are managed primarily to harvest pink salmon. While there are some exceptions, such as fisheries directed at returning hatchery stocks or fall chum salmon fisheries, most management decisions are based on pink salmon escapement levels, harvest levels, and fishing effort. Overall, pink salmon make up approximately 91% of the annual Southeast Alaska harvest (in numbers of fish), chum salmon account for 5% of the harvest, sockeye salmon 3% of the harvest, and coho salmon 1% of the

harvest. (Unless otherwise noted, all of the data discussed here will cover the most recent twenty fishing seasons from 1989 through 2008.)

Southern Southeast Alaska includes all fisheries in Districts 1 through 8. Approximately 69% of the purse seine harvest of sockeye salmon in southern Southeast Alaska is taken in District 4. The majority of those sockeyes (70 to 80%) are made up of Canadian fish bound primarily for the Skeena and Nass Rivers. Early season management in District 4 is greatly influenced by the Pacific Salmon Treaty, which was officially put in place in 1985. The Treaty has placed severe restrictions on the first three to four weeks of the season in that district. While the intent of the Treaty is to pass Canadian sockeye salmon, it also has the effect of passing other early run salmon through the district. The average annual harvest of salmon in the southern Southeast Alaska purse seine fishery (Districts 1 through 7) from 1989 through 2008 was 27 million pink salmon, 1.5 million chum salmon, 800,000 sockeye salmon, and 270,000 coho salmon (Table 1).

### **District 1 Purse Seine Fishery**

District 1 encompasses Revillagigedo Channel, portions of East and West Behm Canal, and the eastern portion of southern Clarence Strait. Commercial purse seine vessels congregate near the mouth of Boca de Quadra, Point Sykes, and Point Alava at the entrance to East Behm Canal, the southeast shore of Revillagigedo Island, the Percy Islands, and the west shoreline of Gravina Island.

The southern section of District 1 opens on the first Sunday in July to target early returning pink salmon. Fishers concentrate on Point Alava, Point Sykes, and the Percy Islands during the early part of the season. Sockeye salmon have accounted for an average of 9.3% of the total catch of salmon by the purse seine fleet in District 1. In most years, after the initial openings in District 1 to harvest pink salmon traveling through southern Clarence Strait, the fishing area is expanded north to include the Gravina Island shoreline.

Limited coded-wire tagging information suggests that statistical weeks 29, 30, 31, 32, and 33 are the weeks when the greatest numbers of McDonald Lake sockeye salmon move through District 1. A large portion of the McDonald Lake sockeye salmon harvested by the purse seine fleet in District 1 probably occurs along the Gravina Island shoreline (subdistrict 101-29), the area closest to West Behm Canal. The harvest of sockeye salmon accounted for approximately 2.5% of the total catch of all species of salmon in subdistrict 101-29. During 2007 and 2008, the total sockeye salmon catch accounted for 0.09% and 0.02% of the total catch of all salmon species in this subdistrict respectively.

McDonald Lake sockeye conservation measures implemented in the District 1 purse seine fishery have been in the form of area restrictions on the upper portion of the Gravina Island shoreline (Subdistrict 101-29). In 2006, 2007, and 2008, purse seine fishing on the Gravina shoreline was restricted to the area south of the latitude of Cone Point during statistical weeks 29, 30, and 31. In 2006 and 2008, these conservation measures were not needed, because similar restrictions were instituted due to poor pink salmon runs in those years. There have been no directed fisheries for McDonald Lake sockeye salmon in West Behm Canal since 2001.

### **District 2 Purse Seine Fishery**

District 2 encompasses the waters of Clarence Strait on the southeast shore of Prince of Wales Island south of Narrow Point, and also the western shore of the Cleveland Peninsula, between Lemesurier Point and Caamano Point. Pink salmon fisheries in District 2 begin on the first

Sunday in July in the southern sections of the district. Northern portions of District 2 may open as early as week 30 in years of high pink salmon abundance, or not at all in years of poor pink salmon abundance. Samples of sockeye salmon harvested in this fishery are sometimes difficult to obtain because they are often mixed aboard salmon tenders with deliveries of fish from Districts 1 and 4. Subdistrict 102-80 is the closest portion of District 2 to the entrance of Behm Canal, and is directly south of District 6 where McDonald Lake sockeye salmon are known to be harvested. The stocks harvested in subdistrict 102-80 are probably similar to those harvested in the adjacent gillnet fishery in Clarence Strait (106-30). ADF&G has managed this area conservatively during the past three years to make certain McDonald Lake sockeye salmon conserved in Districts 5, 6, and 7 are passed through upper District 2. The average sockeye salmon harvest in Subdistrict 102-80 for 2007 and 2008 was 586 fish. The total catch of sockeye salmon accounted for approximately 3% of the total catch of all salmon in Subdistrict 102-80 during the last two seasons.

### **District 5 Purse Seine Fishery**

District 5 encompasses the waters of western Sumner Strait, approximately 50 miles southwest of the community of Petersburg. Fisheries occur either inside the major bays, which include Affleck Canal, Port Beauclerc, Shakan Bay, and Shipley Bay, or in the more exposed waters along the eastern side of District 5 between Cape Pole and Point Baker.

Fisheries normally begin in District 5 during the first or second week in August. Those fisheries are all directed at harvesting pink salmon, or occasionally chum salmon, and they are often confined to inside bays. Since 1989, sockeye salmon comprised less than 1% of the average annual harvest of salmon in District 5. Occasionally, the area just south of the District 6 gillnet area is opened and when that occurs the percentage of sockeye salmon is slightly higher. That shoreline area (subdistrict 105-41) from Point Baker south to Ruins Point has been opened three years during statistical week 31. Statistical week 31 starts between July 24 and July 30. Harvests during those three years have averaged slightly less than 3% sockeye. Harvests of sockeye salmon in this fishery are so small that no attempt has been made to sample them; however, the stocks harvested are probably very similar to those harvested in the adjacent gillnet fishery in Sumner Strait. Restrictions, during what is expected to be the peak timing of the McDonald sockeye run through the fishery (statistical weeks 29, 30, and 31), have not been necessary. Poor pink salmon returns in that area have not warranted opening the area since 2003. One of the unique things about the incidental sockeye harvest in District 5 is that 66% of the sockeye harvested in that district since 1960 were harvested during only three seasons, 1993, 1995 and 1997; however, because of the large pink salmon harvests during those years, the average sockeye salmon harvest was still less than 2% of the total harvest of salmon. Large sockeye salmon harvests also occurred during those three years in the District 6 gillnet fishery and the District 4 seine fishery.

### **District 6 Purse Seine Fishery**

District 6 is split into four sections. Purse seining is limited to Sections 6-C and 6-D, which are located between 15 and 30 miles southwest of Wrangell. Section 6-D includes most of the waters of northern Clarence Strait and the southern portion of Stikine Strait. Section 6-C is a small diamond shaped area adjacent to Screen Island and Lincoln Rock. Section 6-C together with the adjacent Screen Island shoreline of Section 6-D are the only waters in Southeast that, at times, may be fished simultaneously by the purse seine and drift gillnet fleets.

Fisheries normally begin in District 6 during the first or second week in August. Those fisheries are all directed at harvesting pink salmon. Since 1989, 0.7% of the average annual harvest of salmon in District 6 has been comprised of sockeye salmon. Openings occur in three general areas of the district. The earliest fisheries often occur along the western shoreline of Etolin Island in two of those areas, which include the Quiet Harbor to Screen Island shoreline and the area off the mouths of Mosman/Burnett/McHenry Inlets and the western side of Onslow Island. The third area is the Ratz Harbor shoreline, which usually opens between the second and third week in August. Harvests of sockeye salmon in this fishery are small, so it is usually difficult to obtain samples from them; however, the stocks are probably similar to those harvested in the gillnet fishery in Clarence Strait.

The Screen Island shoreline has been opened once during week 30 and three times during week 31 in the past 20 years. The percentage of sockeye salmon in the total harvest during week 30 was 2.3%, while during week 31 it was 0.4%. After week 31, the percentage of sockeye salmon was less than 0.2% of the total harvest.

The Mosman/Burnett/McHenry/Onslow area has been opened once during week 30 and 4 times during week 31 during the past 20 years. The percentage of sockeye salmon in the total harvest during week 30 was 0.25%. The percentage of sockeye salmon during week 31 was 1.9%. After week 31, the percentage of sockeye salmon was 0.5% or less of the total harvest.

The Ratz Harbor shoreline has only been opened twice during week 31. Sockeye salmon comprised 4.3% of the total harvest during those two openings. After week 31, the percentage of sockeye salmon was 1.3% or less of the average total harvest.

### **District 7 Purse Seine Fishery**

District 7 encompasses the waters of Ernest Sound, Bradfield Canal, Zimovia Strait, and Eastern Passage. Purse seining primarily takes place in the waters of Ernest Sound, 20 to 40 miles south of the community of Wrangell. District 7 is divided into the early and middle run northern portion (Section 7-A), which is known as the Anan fishery, and a later run into lower Ernest Sound (Section 7-B). Until recently, the area was primarily a pink salmon harvesting area. Beginning in 1997, chum salmon from enhancement facilities entered the district in large enough numbers to attract additional purse seiners to the area.

Fisheries normally begin in District 7 the first Sunday in July when Section 7-A (Anan) is open for purse seining. Those fisheries are all directed at harvesting pink salmon. Since 1989, 1.0% of the average annual harvest of salmon in District 7 has been comprised of sockeye salmon. Harvests of sockeye salmon in this fishery are small, so it is usually difficult to obtain samples from them; however, the stocks are probably similar to those harvested in the gillnet fishery in Clarence Strait.

Seine fisheries in Section 7-A (Anan) start the first Sunday in July. Openings occur most consistently during week 28 and 29, and by week 31 and 32 Section 7-A is open about one out of every four years. Between weeks 27 and 31, sockeye salmon make up an average of 0.6% to 0.7% of the total catch.

Seine fisheries in Section 7-B (lower Ernest Sound) normally start between statistical week 30 and 32. Section 7-B was opened once during week 29, three times during week 30, and six times during week 31. The percentage of sockeye salmon in the total harvest during week 29 was

0.6%, during week 30 it was 3.3%, and during week 31 it was 1.7%. After week 31, the percentage of sockeye salmon was 1.0 % or less of the total harvest.

Area closures have been implemented as McDonald Lake sockeye salmon conservation measures in the seine fisheries. The pink salmon run was poor in Districts 5, 6, and 7 in 2006, so no conservation measures were necessary. In 2007, the Union Bay portion of District 7 was closed during two 39-hour openings in statistical week 32. The Screen Island shoreline also remained closed for one 39-hour opening in week 32. In 2008, the Union Bay portion of District 7 was closed during two 39-hour openings in statistical week 32.

### **District 6 Drift Gillnet Fishery**

The District 6 drift gillnet fishery takes place in Section 6-A in Sumner Strait, 6-B, 6-C, and a portion of 6-D in Clarence Strait. Harvests in District 6 consist of species of mixed stock origin. Management of District 6 is usually based on sockeye salmon stock assessment from early June to the end of July, pink salmon stock assessment throughout August, and coho salmon stock assessment from September through the end of the season. Although these salmon stocks largely dictate the management decisions for weekly openings, fishermen also target summer coho and chum as well as fall chum salmon during the season. The contribution of Stikine River sockeye salmon is estimated inseason, and the sockeye fishery is largely driven by provisions of the Pacific Salmon Treaty. Preseason forecasts of the Stikine River sockeye salmon run are used to guide the initial openings while inseason forecasts generally become available by the end of June or early July. In-season catch rate data are used throughout the sockeye fishery to further assess run strength. The sockeye salmon harvest in District 6 is typically dominated by Stikine River sockeye salmon until early July, at which point other sockeye salmon stocks, including local island stocks, represent the majority of the harvest. The average annual gillnet harvest of salmon in District 6, from 1989 through 2008, was 382,500 pink salmon, 207,000 chum salmon, 172,100 coho salmon, and 145,800 sockeye salmon (Table 2). Since 1989, sockeye salmon accounted for 16% of the total salmon harvest in the District 6 gillnet fishery. During statistical weeks 29, 30, and 31, the average percentage of sockeye salmon in the District 6 harvests ranged from 20% to 22%.

### **MCDONALD LAKE SOCKEYE IN THE SOUTHERN SOUTHEAST ALASKA FISHERIES**

Because much of the commercial harvest of the McDonald Lake stock takes place in distant, mixed-stock fisheries, we do not have the same kind of comprehensive commercial harvest information for this stock that we have for some other sockeye stocks in the state. Some information regarding the distribution of McDonald Lake sockeye salmon in U.S.-Canada boundary area fisheries was provided by joint U.S.-Canada mark-recapture studies conducted in 1982 (Hoffman et al. 1983), and 1983 (Hoffman et al. 1984). The best information that we have is limited to adult returns from coded wire tagging studies in 1985, 1989, and 1990. Tagging information from both studies showed that the McDonald Lake stock migrates around Prince of Wales Island through Sumner and Clarence straits to the north, and Dixon Entrance to the south, and is harvested in all the Alaskan commercial net fisheries from Districts 1 through 7, and in British Columbia Areas 1 and 3 (Geiger et al. 2004). Commercial fisheries in British Columbia were not sampled for coded wire tagged sockeye salmon so estimates of the contribution of McDonald Lake sockeye salmon to Canadian fisheries are not available. McDonald Lake sockeye salmon have also been harvested in directed purse seine fisheries in upper west Behm Canal, ADF&G test fisheries in west Behm Canal, and a personal-use fishery in Yes Bay.

In 1985, 1989, and 1990, coded-wire tagged McDonald Lake sockeye salmon were recovered from the commercial fisheries from early July to early September. Coded-wire tagged McDonald Lake sockeye salmon were harvested primarily in the District 6 drift gillnet fishery, followed by the District 1 and 4 purse seine fisheries (Table 3; Johnson et al. 2005). Coded wire tag recoveries in 1991 suggested that the McDonald Lake stock was harvested primarily in the District 101 fisheries; again, however, we note that the 1991 tag estimates were plagued by very low initial rates of tagging and were not representatively tagged with respect to the smolt outmigration period.

In the District 6 drift gillnet fishery, coded-wire tagged fish were recovered between statistical weeks 27 and 35. There were sufficient tag recoveries to examine the weekly run timing in the District 106 drift gillnet fishery in 1989 and 1990 (Johnson et al. 2005). In 1989, tagged McDonald Lake sockeye salmon were recovered in District 6 during statistical weeks 27–33, and in 1990 during statistical weeks 27–35; Figures 4 and 5); however, in both years approximately 90% of the tags were recovered over a 5-week period during statistical weeks 28 through 32. The longer run timing in 1990 may have reflected the greater abundance of McDonald Lake sockeye salmon in 1990.

In District 1 coded-wire tagged McDonald Lake sockeye salmon were recovered in both the drift gillnet and purse seine fisheries between statistical weeks 29 and 35, but there were not enough recoveries to examine weekly run timing. The maximum number of coded-wire tagged McDonald Lake sockeye salmon recovered were nine in the purse seine fishery in 1985 (not including West Behm Canal), seven in the drift gillnet fishery in 1990, and 14 in the Metlakatla Indian Community fisheries in 1990. Tag recoveries expanded for fishery sample size are presented by statistical week in Table 4.

Fishery samples are often difficult to obtain from the District 2 purse seine fishery, because purse seiners often deliver to tenders, and their catch is often mixed with fish from other districts prior to delivery at the dock. Coded-wire tag recoveries of McDonald Lake sockeye salmon were limited to three in 1985, five in 1989, and five in 1990. Coded-wire tagged fish were recovered during statistical weeks 28 through 35.

Fisheries were sampled for genetic stock identification in 2007, to determine the time and distribution of McDonald Lake sockeye salmon in areas where that stock was likely to be harvested. Preliminary results corroborate coded-wire tag findings in subdistricts 106-41 and 106-30 drift gillnet fisheries, and in subdistricts 101-29 and 107-10 purse seine fisheries. This project is a three-year study, so final analysis of the results will not be available until after the 2009 fishing season.

## **Management Actions**

The overall management strategy for Southeast Alaska purse seine fisheries is to protect the terminal areas first and not to change management in districts that are farther away from the spawning systems. The State of Alaska has for many years fought these types of mixed-stock fishery closures in more remote districts in the Pacific Salmon Commission forum. While the department acknowledges the difficult task of passing McDonald Lake sockeye salmon through the purse seine and drift gillnet fisheries that target other stocks, it has taken steps in recent years when it looked as though management action was appropriate. The Department implemented management actions in 2006, 2007, and 2008, that included time and area closures in the District 1, 2, 5, 6, and 7 purse seine fisheries and the District 6 gillnet fishery.

McDonald Lake sockeye conservation measures implemented in the District 1 purse seine fishery have been in the form of area restrictions on the upper portion of the Gravina Island shore (Subdistrict 101-29). Beginning in 2006, purse seine fishing on the Gravina shore was restricted to the area south of the latitude of Cone Point during statistical weeks 29, 30, and 31. In 2006 and 2008, these conservation measures were not needed, because similar restrictions were instituted due to poor pink salmon runs in those years. In 2007, fishing was also restricted to the area south of the latitude of Cone Point on the Gravina Island shore until statistical week 32, due to the late timing of the pink salmon run. There have been no directed fisheries for McDonald Lake sockeye salmon inside of West Behm Canal since 2001. Subdistrict 102-80 is the closest portion of District 2 to the entrance of Behm Canal, and is directly south of District 6 where McDonald Lake sockeye salmon are known to be harvested. ADF&G has managed this area conservatively during the past three years to ensure that McDonald Lake sockeye salmon conserved in Districts 6 and 7 are passed through upper District 2.

The main McDonald Lake sockeye conservation measures implemented in the District 6 gillnet fishery have been in the form of time restrictions. In 2006, the District 6 gillnet fishery was limited to two days during statistical weeks 30 and 31. Poor pink salmon returns during this season also resulted in minimal two-day openings from statistical weeks 32 through 35. In 2007, the District 6 gillnet fishery was limited to two days from statistical weeks 30 through 32 for McDonald Lake sockeye conservation. On top of this, a significant closure was implemented in statistical week 31 that closed the vast majority of Sumner Strait, the main fishing area in District 6. In 2008, another three-week McDonald Lake sockeye conservation period was utilized resulting in two-day openings from statistical week 29 through 31 throughout District 6. Another poor pink salmon return resulted in minimal two-day openings from statistical weeks 32 through 35.

The closures and time modifications that were used moved the nearest commercial net fisheries to approximately 40 miles away from McDonald Lake. These time and area closures were based on a limited amount of coded-wire tagging data, since it is not possible to discern the actual harvest of McDonald Lake sockeye salmon on an inseason basis in the common property fisheries. Returns to McDonald Lake are also unknown until stream surveys are completed in September. Run-time information suggests returns to the natal streams occur primarily after the peak of the commercial purse seine season. Weir data from the early 1980s showed that sockeye salmon entered McDonald Lake in large pulses, primarily after the beginning of August (beginning statistical week 32; Figure 6). Sockeye salmon do not enter the spawning stream until early September (Figure 7).

While the department realizes that area and time closures will pass some amount of McDonald Lake sockeye salmon, it also realizes that closures in these areas during the peak of the salmon season will result in significant foregone harvest of other healthy stocks, in some cases this may mean hundreds of thousands of pink salmon in the purse seine fishery and tens of thousands of sockeye and chum salmon from healthy stocks in the gillnet fishery.

There are several obvious complications regarding management options for reducing the harvest rate on McDonald Lake sockeye salmon. First, the migratory timing of these fish broadly overlaps the timing of other pink, chum, sockeye, and coho salmon stocks. Second, McDonald Lake sockeye salmon are a minor contributing stock in all intercepting fisheries, at least in recent seasons. Finally, the migratory patterns of these fish can vary from year to year. Small numbers of coded-wire tagged McDonald Lake sockeye salmon were recovered in the District 1 drift

gillnet fishery, District 1 purse seine fisheries south of the Gravina Island shore, and in the District 1 Metlakatla Indian Community trap, drift gillnet, and purse seine fisheries. It is certainly possible that in some years a larger portion of the run migrates to inside waters around the southern end of Prince of Wales Island and north through Clarence Strait, rather than through the District 6 drift gillnet fishery along the north end of Prince of Wales Island.

### **Non-Commercial Harvest**

McDonald Lake sockeye salmon caught in non-commercial fisheries are primarily harvested by personal use fishers in the Yes Bay terminal area. From 1985 to 1999, fishers were required to return permits together with a record of their catch and, since 2000, have been required to report their catch from the previous year before they can be issued a new permit. Reported catches may have been underestimated, particularly prior to 2000, but even if the recorded harvest represents a substantial undercount, the personal-use harvest must typically represent less than 10% of the entire run. Reported personal-use catches averaged about 5,600 fish from 1985 to 2005, with a range of about 1,100 in 1985 to 10,000 in 1994 (Figure 8). The personal use harvest has averaged less than 1,000 fish per year since 2006. The bag limits were gradually reduced between 2002 and 2007. The bag limit was 50 fish per person (75 fish per household) per day through 2002. In 2003, the daily limit was reduced to 40 fish per person per day (with no designation for household). In 2005, the bag limit was further reduced to a daily limit of 25 fish per person. Finally, in 2007, the bag limit was changed to a seasonal limit of 20 fish per person and the season was shortened from a starting time of June 1 to a starting time of July 1. The sport fish harvest was assumed to be around 200 fish annually (Geiger et al. 2004), and likely accounted for a very small fraction of the total annual run.

## **STOCK OF CONCERN RECOMMENDATION**

Given that the McDonald Lake sockeye salmon stock has not met the newly established sustainable escapement goal for four out of the past five years, and is not expected to meet the escapement goal in the very near future, the department judges this stock to be a candidate stock of concern as defined in the Sustainable Salmon Fishery Policy. The policy defines a management concern as “a concern arising from a chronic inability, despite the use of specific management measures to maintain escapements for a stock within the bounds of [an escapement goal]...’Chronic inability’ means continuing or anticipated inability to meet objectives over a four- to five-year period...” The department assesses the level of concern for the McDonald Lake sockeye salmon stock as a management concern. Escapements have been below the sustainable escapement goal range in four of the last five years.

### **OUTLOOK**

No formal forecasts of McDonald Lake sockeye salmon are made; however, fry populations have mirrored the decline in adult population. As noted earlier, the estimated fall fry abundances during 2005–2007, were the lowest in the history of the McDonald Lake fall fry assessment (Figure 3). Based on the dominant age at return for McDonald Lake sockeye salmon (age 5), these fish will return in 2009–2012. Therefore, it is likely that depressed runs of McDonald Lake sockeye salmon will continue for some time, and annual runs are not anticipated to meet the escapement goal over the next few years.

## **ALASKA BOARD OF FISHERIES ACTION**

The department presented a memorandum to the Alaska Board of Fisheries at the October, 2008 work session in Fairbanks recommending McDonald Lake sockeye as a stock of management concern according to provisions of the Sustainable Salmon Fisheries Policy.

A draft version of this report was presented to members of the Alaska Board of Fisheries in late January, 2009 for their review and consideration prior to the February, 2009 Southeast Alaska and Yakutat finfish meeting.

The status of sockeye salmon at McDonald Lake was presented in both oral and written reports by staff at the February, 2009 Southeast Alaska and Yakutat Board of Fisheries meeting in Sitka. The draft McDonald Lake Action Plan was submitted as Record Copy 70 (RC 70) and publicly distributed at the meeting. During the Committee E meeting on February 21, 2009 the McDonald Lake Action Plan was presented by the department to the Board Committee and to the Public Panel members present. There was general agreement during this public meeting that the action plan presented was reasonable and appropriate, even though it was recognized that this action plan would have large impacts on harvests by both the purse seine and drift gillnet fleets. There was consensus to support the plan from the public panel. The Board Committee forwarded their concensus to support the plan in the Committee E report, with RC 70 becoming a board-generated proposal.

On February 26, 2009 the Board of Fisheries deliberated the McDonald Lake sockeye salmon stock status and Action Plan. Board action was taken to classify McDonald Lake sockeye salmon as a stock of management concern. The McDonald Lake Action Plan, as described by this report, was approved.

## **ESCAPEMENT GOAL EVALUATION**

### **ESCAPEMENT GOAL HISTORY**

The first escapement goal for McDonald Lake was set at 85,000 sockeye salmon in 1989, based on habitat considerations—specifically, the euphotic volume model developed by Koenings and Burkett (1987), which related physical water features of the lake to carrying capacity in other sockeye salmon lakes throughout Alaska. In 1993, the escapement goal was changed to a range of 65,000 to 85,000 sockeye salmon, based on an early Ricker analysis that was not formally documented (Geiger et al. 2004). The McDonald Lake escapement goal was most recently updated in 2005, to a sustainable escapement goal of 70,000 to 100,000 sockeye salmon, based on a brood-year yield analysis by Johnson et al. (2005).

### **REVISED SUSTAINABLE ESCAPEMENT GOAL**

As noted earlier, ADF&G recently completed work to provide improved estimates of the sockeye salmon escapement at McDonald Lake based on foot surveys, which have been conducted annually since 1980. Escapements to McDonald Lake were estimated from the peak foot survey counts using a multiple regression calibration estimated from comparison of paired peak foot survey counts to total escapements, and September precipitation as described in Heidl et al (*in press*). Total brood year returns from 1980 to 2002 were reconstructed using the recalibrated escapements, and assumed a constant distant water mixed-stock commercial fishery harvest rate of 41%. The assumed average harvest rate of 41% was based on the results of coded-wire tag returns from 1985, 1989, and 1990.

The stock-recruit data were subsequently used to develop a hierarchy of Ricker-type stock-recruit relationships to account for the effect of spawner density, auto-correlation, and fry plants on recruits (Eggers et al. *in press.*). The hierarchical model with the spawner-density and fry-plant terms was selected as the best model. This model was considered the most biologically meaningful, as it accounted for the bias in assessing wild stock production due to added production from stocking of fry that occurred in 1989 and 1990. Based on this analysis, we are recommending a new sustainable escapement goal of 55,000 to 120,000 spawners. The escapement goal is the escapement range that is predicted, on average, to produce 90% or more of maximum sustained yield. This goal is defined as a *sustainable escapement goal* because McDonald Lake was fertilized nearly continuously over the extent of the stock-recruit data set. It is uncertain what affect fertilizing had on lake productivity (due to a lack of pre-fertilization baseline data and the fact that the run declined despite fertilization); however, the stock recruit model reflects a fertilized condition that is no longer the case for McDonald Lake.

One stated purpose of the current McDonald Lake-stocking program is to provide a measure of restoration to the declining run; therefore, an *optimal escapement goal* that included hatchery-produced fish could be considered for the McDonald Lake stock. There are, however, some good reasons to carefully consider whether stocked fish should be counted toward the escapement goal or not. For example, in 2003 the department established an optimal escapement goal at Hugh Smith Lake in order to count hatchery-reared sockeye salmon that were back-planted into the lake toward the escapement goal (5 AAC 33.390). The stocked fish were reared to pre-smolt size in net pens at the outlet of the lake from 1999 to 2003, and returned as adults from 2002 to 2007. This stocking program was successful at returning adult fish to the lake: stocked fish made up an average of 61% of the escapement, and escapements quadrupled and were in excess of the optimal escapement goal range from 2003 to 2007 (Piston 2008).

Despite the dramatic increase in adult runs at Hugh Smith Lake, the subsequent smolt production remained relatively flat (i.e., the smolt population did not quadruple in step with the brood year escapement), and it was apparent that stocked fish likely did not produce as they were expected to. The stocked fish were reared at the outlet of the lake, far from the spawning tributaries, because of concerns over transmittal of infectious hepatic necrosis virus (IHNV); as a result, a large but unknown portion of the returning stocked fish appeared to home to the outlet of the lake rather than to suitable spawning habitat (Piston et al. 2006 and 2007; Piston 2008). The escapement of wild fish at Hugh Smith Lake increased over the same period, and the escapement of wild fish alone met the escapement goal from 2005 to 2007. Had the wild run remained depressed, however, we would have witnessed a situation where the *optimal escapement goal* was technically met, or even exceeded, despite the fact that the “effective” escapement did not meet the escapement goal.

The current lake stocking program at McDonald Lake calls for releasing full-term smolt as close as possible to the spawning tributary so that smolt can properly imprint on the spawning stream, and migrate from the lake shortly thereafter. This strategy has not been previously employed in Southeast Alaska. Although the current McDonald Lake stocking program may contribute adult fish to the escapement, we recommend that the new escapement goal remain a *sustainable escapement goal*, rather than an *optimal escapement goal*, until it is proven that stocked fish contribute to salmon production in the lake as determined from stock assessment studies.

## **ALASKA BOARD OF FISHERIES ACTION**

The Alaska Board of Fisheries took no action to adopt an optimal escapement goal for McDonald Lake sockeye salmon. Therefore, the Division of Commercial Fisheries and Division of Sport Fisheries directors will proceed to finalize the new sustainable escapement goal of 55,000 to 120,000 spawners for McDonald Lake sockeye salmon.

## **MANAGEMENT ACTION PLAN OPTIONS FOR ADDRESSING STOCK OF CONCERN AS OUTLINED IN THE SUSTAINABLE FISHERIES POLICY**

### **MCDONALD LAKE SOCKEYE SALMON MANAGEMENT PLAN REVIEW/DEVELOPMENT**

#### **Current Stock Status**

In response to the guidelines established in the Sustainable Salmon Fisheries Policy (5 AAC 39.222), the department identified McDonald Lake sockeye salmon as a candidate for stock of management concern status. The Board of Fisheries, after reviewing stock status information and public input during the February 2009 regulatory meeting, classified McDonald Lake sockeye salmon as a stock of management concern. This determination was based on the inability, despite the use of specific management measures, to maintain escapements for a salmon stock within the bounds of the sustainable escapement goal during the last five years.

#### **C&T Use Finding and the Amount Necessary**

A customary and traditional use finding for McDonald Lake sockeye is not appropriate under state regulations since the stock is located within the Ketchikan non-subsistence area. The department regulates access to this stock under personal use permit conditions, which may be re-evaluated and re-established on an annual basis. Sport fisheries on this stock are very limited. Both personal use and sport fisheries are subject to inseason action under emergency order authority.

#### **Habitat Factors Adversely Affecting the Stock**

The habitat in the McDonald Lake watershed is considered pristine (e.g., there has been virtually no logging in the drainage) and there are no identified habitat related concerns identified for this stock.

#### **Do New or Expanding Fisheries on this Stock Exist?**

Presently there are no new or expanding fisheries on this stock.

#### **Existing Management Plans**

There is no existing management plan specific to McDonald Lake sockeye salmon. The current regulations pertinent to sockeye salmon in McDonald Lake are:

**5 AAC 33.360 DISTRICT ONE PINK SALMON MANAGEMENT PLAN.**

On and after the third Sunday in July in District 1, when a purse seine fishery is harvesting pink salmon stocks subject to concurrent salmon fishing by drift gillnets in Section 1-B, the following time formula applies:

- (1) when the purse seine fishery is open for any portion of one day during a fishing week, the drift gillnet fishery must be open for 48 hours during the same fishing week;
- (2) when the purse seine fishery is open for any portion of two days during a fishing week, the drift gillnet fishery must be open for 96 hours during the same fishing week;
- (3) when the purse seine fishery is open for any portion of three or more days during a fishing week, the drift gillnet fishery must be open for 120 hours during the same fishing week.

### **5 AAC 33.350. CLOSED WATERS.**

Waters of Behm Canal between a line from Nose Point to Snail Point and a line from Cactus Point to Point Eva are closed to the taking of salmon with commercial net gear.

## **ACTION PLAN DEVELOPMENT**

The goal of this Action Plan is to rebuild the McDonald Lake sockeye salmon run back to levels that attain the current escapement goal range. The rebuilding plan will include measures to reduce harvests and improve stock assessment. Note that the fishery management portion of this action plan will remain flexible with respect to any new information provided on where and when McDonald Lake sockeye salmon are harvested—new information that would allow the department to improve fisheries actions designed to pass more McDonald Lake sockeye salmon through the commercial fisheries.

### **ACTION 1. MANAGEMENT PLAN**

Reduce the commercial harvest of McDonald Lake sockeye salmon.

#### **Objective**

Modify historic purse seine and drift gillnet fisheries to reduce the harvest of McDonald Lake sockeye salmon in the District 1, 2, 5, 6, and 7 purse seine and District 6 drift gillnet fisheries so that the McDonald Lake sockeye escapement goal range can be achieved.

#### **Specific Actions Recommended to Implement the Objective**

Conservation measures will be put into place in the form of reduced openings in Districts 1, 2, 5, 6, and 7. These reduced openings will occur in a four-week time span to allow more McDonald Lake sockeye to pass through the fisheries when these fish are present in the most significant numbers in the waters of those fisheries based on historical coded wire-tag and GSI data.

1. District 1 purse seine—From statistical weeks 29 through 31, the purse seine fishery on the western shore of Gravina Island will be closed north of the latitude of Cone Point.
2. District 2 purse seine—From statistical weeks 29 through 32, the purse seine fishery on the western shore of the Cleveland Peninsula (within 3 nautical miles of the shoreline) will be closed.

3. District 5 purse seine—From statistical weeks 29 through 31, the District 5 purse seine fishery along the northwest corner of Prince of Wales Island between Point Baker and the Barrier Islands will remain closed.
4. District 6 purse seine—From statistical weeks 29 through 31, the District 6 purse seine fishery along the west side of Etolin Island between Point Stanhope and the latitude of Round Point will remain closed. From statistical weeks 29–31, the District 6 purse seine fishery along the east side of Prince of Wales Island between Luck Point and Narrow Point will remain closed.
5. District 7 purse seine—From statistical weeks 29 through 31, the District 7 purse seine fishery in Section 7-B will remain closed. If pink salmon runs are extremely strong, the northern portion of section 7-B, north of Union Point may be open during statistical week 31. If this occurs, restrictions may occur in that area south of Union Point into statistical week 32 to reduce the overall interception of sockeye salmon.
6. District 6 drift gillnet—From statistical weeks 29 through 31, the District 6 drift gillnet fishery will open for a maximum of two days. Additional area closures are not perceived at this time, however, ongoing GSI studies may highlight certain areas and time that McDonald Lake sockeye salmon are more susceptible to harvest in this fishery and modifications to these conservation measures would proceed accordingly.

### **Cost/Benefit Analysis**

There would be an immediate loss of fishing opportunity and potential harvest of pink, chum, and other sockeye salmon stocks by the purse seine fisheries in Districts 1,2,5,6, and 7 and the drift gillnet fishery in District 6. However, if the escapement goal range is consistently reached as a result of the actions, the need for future management actions could be reduced due to improved returns. A rebuilding of the McDonald Lake sockeye salmon stock would also result in more harvestable sockeye salmon in southern Southeast Alaska fisheries.

### **Terminal Fishery Considerations**

Management measures have been taken to limit the personal use fishery in Yes Bay (Figure 9). The department has not conducted a directed purse seine fishery on McDonald Lake sockeye salmon in the terminal area in front of McDonald Lake since 2001. The department will continue to monitor the commercial fisheries to determine if additional measures are needed.

### **Performance Measures**

The sustainable escapement goal range for McDonald Lake sockeye salmon would be met annually.

## **ACTION 2. RESEARCH PLAN**

Conduct a review of the McDonald Lake sockeye salmon stock assessment programs.

### **Objective**

Ensure that stock assessment programs operated on the McDonald Lake sockeye stock are appropriate and effective, while minimizing biological risk to the stock.

### **Specific Actions Recommended to Implement the Objective**

Conduct reviews of the goals, objectives, methods, and results of existing stock assessment and smolt stocking programs to identify possible changes or improvements to the programs.

### **Cost/Benefit Analysis**

Review of the stock assessment and stocking programs may result in efficiencies and improvements, at minimal cost.

### **Subsistence Issues/Considerations**

None.

### **Performance Measures**

Improve the long-term stock assessment database.

### **Current Research Projects**

The following programs are currently being conducted to gather information about McDonald Lake sockeye salmon:

- McDonald Lake Adult Escapement Monitoring—ADF&G recently completed a project to improve the escapement estimation at McDonald Lake (Heinl et al. 2008). The escapement to McDonald Lake is currently estimated based on the peak annual foot survey, calibrated to weir counts in 1981, 1983, and 1984, and mark-recapture estimates in 2005, 2006, and 2007 (Heinl et al. 2008). Foot surveys are conducted annually on September 10, 20, and 28. The escapement is sampled annually for age, sex, and size composition. Approximate cost of annual escapement estimation and sampling is \$8,000.
- McDonald Lake Juvenile Sockeye Monitoring—Hydroacoustic surveys are conducted annually in the fall to estimate fall fry abundance in the lake, in conjunction with tow netting to provide species apportionment of counts. Approximate cost of annual hydroacoustic and tow netting program is \$2,000.
- McDonald Lake Harvest—The Department has implemented a multi-year, genetic stock identification project to identify time and area of potential catch of McDonald Lake sockeye salmon in 2007, 2008, and 2009. Weekly samples are collected from the District 6 drift gillnet fishery and from the District 1 purse seine fishery, and from peripheral fisheries as available. These data, once analyzed, will be used to update the coded-wire tagging studies and provide improved information about the time and area distribution of McDonald Lake sockeye salmon in the commercial net fisheries closest to McDonald Lake. Approximate annual cost of the stock identification program is \$130,000.
- McDonald Lake Egg Takes and Fry Plants—Southern Southeast Regional Aquaculture Association (SSRAA) was recently permitted by ADF&G to conduct a lake stocking program at McDonald Lake. SSRAA was permitted to take up to 450,000 eggs annually from the McDonald Lake sockeye salmon run for three years, 2007–2009. These fish will be reared at SSRAA's Burnette Inlet Hatchery and full-term smolt will be returned to McDonald Lake in the springs of 2009–2011. The full-term smolt will be put into net pens located at the mouth Hatchery Creek at which time they are expected to immediately smolt after imprinting on the spawning creek. All of these fish will be thermally marked, allowing them to be tracked through the fisheries when they return as adults in 2011–2014. These fish will presumably exhibit the same migratory behavior of wild McDonald Lake sockeye salmon, and it is thought that this project would also provide a

measure of restoration, should the adults return to the lake and spawn with the wild population as intended. Total cost to SSRAA \$201,900.

### **Proposed Research Projects**

- Spawning Stock Assessment—A full stock assessment program will need to be implemented in 2011, to include a mark-recapture/radio-telemetry study to estimate the total escapement. Thermal-mark sampling of the escapement will be conducted, both at the tagging site (i.e., at the lake outlet) and on the spawning ground, to identify the proportion of wild and hatchery fish in the escapement and determine whether fish from the SSRAA stocking program return and spawn as anticipated. Annual costs of this program are estimated to be \$110,000.
- McDonald Lake Harvest—A multi-year project will be conducted (2011–2014) to sample the purse seine and drift gillnet fisheries for otolith-marked McDonald Lake sockeye salmon from the SSRAA stocking program. This information will be used to update the coded-wire tagging and genetic stock identification studies and provide improved information about the time and area distribution of McDonald Lake sockeye salmon in the commercial net fisheries closest to McDonald Lake. Approximate annual costs of this program are \$60,000.
- Lake Productivity Sampling—Although a great deal of limnological information was collected at McDonald Lake over the course of the fertilization project, the lack of long-term pre-fertilization data made it impossible to properly assess the effects of fertilization. To better understand freshwater population parameters of McDonald Lake sockeye salmon and to provide information necessary to assess the effectiveness of past (and potentially future) lake fertilization enhancement activity at the lake, a study of the lake’s physical and biological parameters should be implemented. This program could potentially include a) assessment of the lake’s physical and chemical characteristics, b) estimate zooplankton abundance and species, c) estimate approximate mortality rates of sockeye fry, from early summer to spring pre-smolt stage, d) assessment of smolt age and condition, and e) retrospective analysis of historical information. This work would potentially be designed and conducted in cooperation with the University of Alaska Fairbanks. Approximate annual costs of this program are to be determined.

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## **TABLES**

**Table 1.**—Average annual purse seine salmon harvest in Districts 1 through 7, by species, 1989–2008.

	<b>Species</b>				<b>Total</b>
	<b>Sockeye</b>	<b>Coho</b>	<b>Pink</b>	<b>Chum</b>	
District 1	116,594 2%	34,035 1%	6,308,765 96%	348,739 5%	6,538,132 100%
District 2	45,075 1%	50,659 1%	4,537,315 89%	459,887 9%	5,092,936 100%
District 3	25,825 1%	30,111 1%	4,055,505 96%	127,731 3%	4,239,172 100%
District 4	581,173 5%	127,913 1%	9,544,804 90%	367,611 3%	10,621,502 100%
District 5	6,086 1%	3,948 1%	655,324 96%	20,473 3%	685,831 100%
District 6	7,296 1%	11,222 1%	967,221 96%	17,793 2%	1,003,531 100%
District 7	14,984 1%	8,083 1%	1,343,386 88%	158,246 10%	1,524,699 100%
<b>Total</b>	797,032 3%	265,971 1%	27,142,320 91%	1,500,481 5%	29,705,804 100%

**Table 2.**—Average annual drift gillnet salmon harvest in Districts 1 and 6, by species, 1989–2008.

	<b>Species</b>				<b>Totals</b>
	<b>Sockeye</b>	<b>Coho</b>	<b>Pink</b>	<b>Chum</b>	
District 1	137,702 14%	44,402 4%	526,089 52%	308,937 30%	1,017,130 100%
District 6	145,828 16%	172,144 19%	382,542 42%	207,019 23%	907,533 100%
<b>Total</b>	283,530 15%	216,546 11%	908,631 47%	515,957 27%	1,924,663 100%

**Table 3.**—Distribution of coded wire tag recoveries of McDonald Lake sockeye salmon (expanded for fishery sample size) in the commercial fisheries of Southeast Alaska, 1985, and 1989–1991.

	Proportion Harvested by Area and Gear				Average
	1985	1989	1990	1991 <sup>1</sup>	
Total Tags Recovered	47	90	190	32	
Total Expanded Tags	203	370	670	112	
District 101-11 Gillnet	7%	2%	2%	26%	9%
District 1 Annette Island Gillnet	4%	2%	7%		3%
District 1 Seine	40% <sup>a</sup>	8%	9%	15%	18%
District 1 Annette Island Seine	3%	---	---	5%	2%
District 1 Annette Island Trap	1%	---	---		<1%
District 2 Seine	9%	17%	9%	16%	13%
District 3 Seine	---	---	<1%		<1%
District 4 Seine	10%	13%	17%	32%	18%
District 6 Gillnet	28%	57%	56%	6%	37%
District 7 Seine	---	1%	---		<1%
District 2 Troll	---	---	<1%		<1%

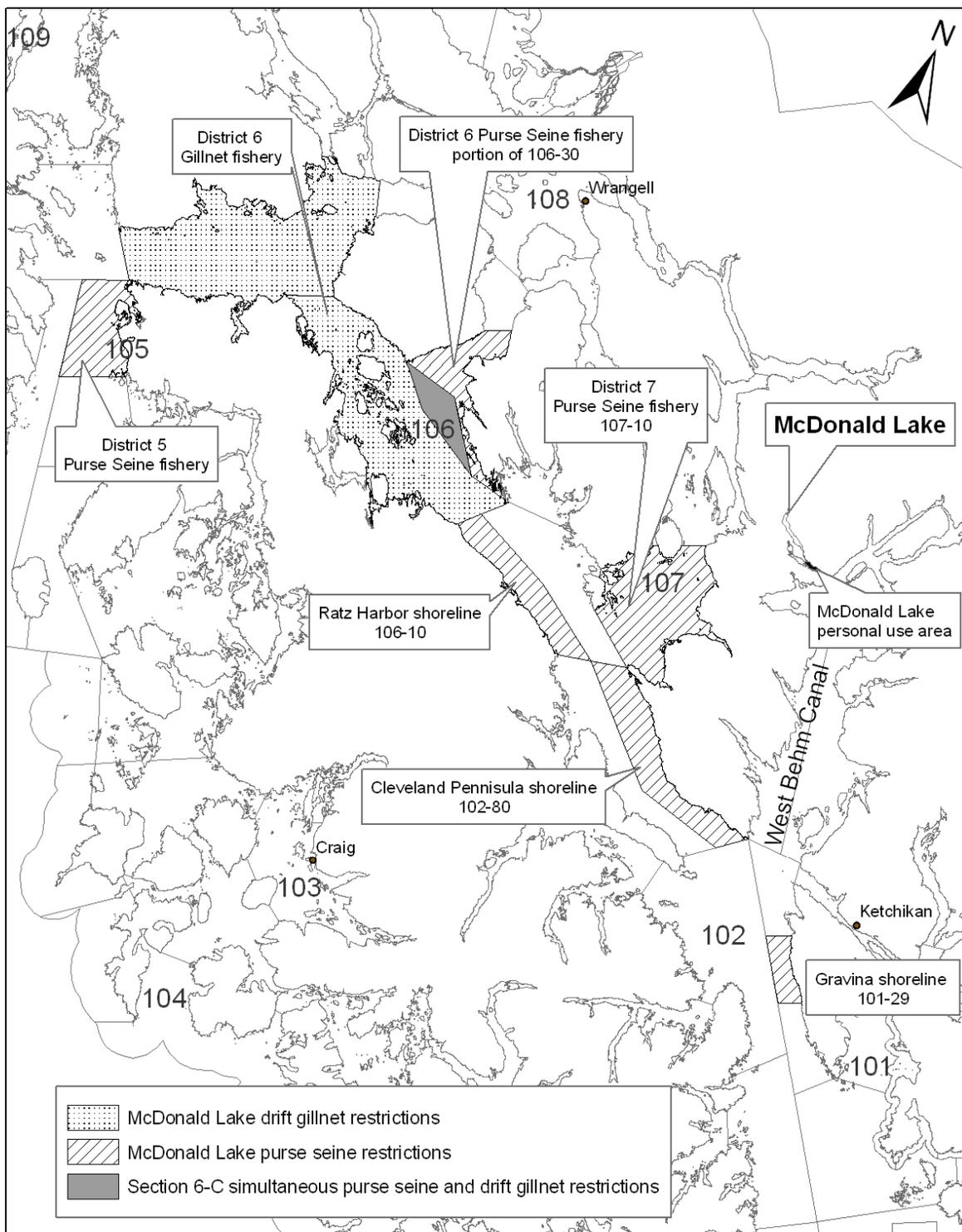
<sup>1</sup> Tag recovery information for 1991 is included here for completeness, but it must be pointed out that the information is badly biased and probably not representative. Coded-wire tag returns in 1991 were compromised by a very low rate of tagging in 1988, and the fact that tags were not applied throughout the entire smolt outmigration period. Fewer than 6,000 smolts were tagged (compared to 22,000 in 1986, and 38,000 in 1987), 51% of which were tagged during the last three days of the six-week tagging period (Johnson et al. 2005).

**Table 4.**—Distribution of coded wire tag recoveries of McDonald Lake sockeye salmon (expanded for fishery sample size) in the District 1 commercial fisheries, 1985, 1989, and 1990 (does not include West Behm Canal). Note that expansions are based on few tag recoveries: 19 tags in 1985, 8 tags in 1989, and 25 tags in 1990.

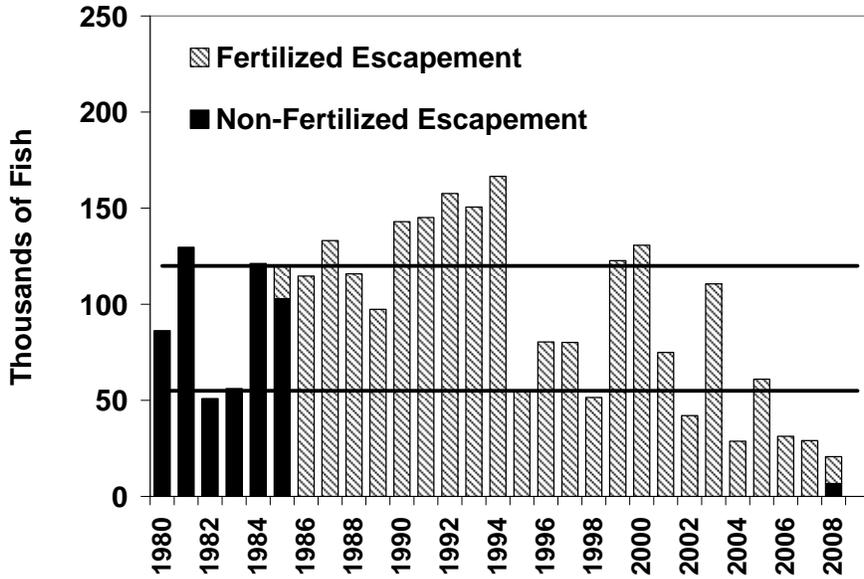
Year	Fishery	27	28	29	30	31	32	33	34	35
1985	Gillnet			3		3		9		
	Seine			3	3	4	6	4	10	
	MIC <sup>1</sup>				2	6	6		3	
1989	Gillnet					7				
	Seine			13	7		9			
	MIC	3				3	2			
1990	Gillnet			3			3	7	3	
	Seine				14	8	12	23		
	MIC					35		5	3	1
Average		3	0	5	7	10	6	10	5	1

<sup>1</sup> MIC = Metlakatla Indian Community trap, drift gillnet, and purse seine fisheries.

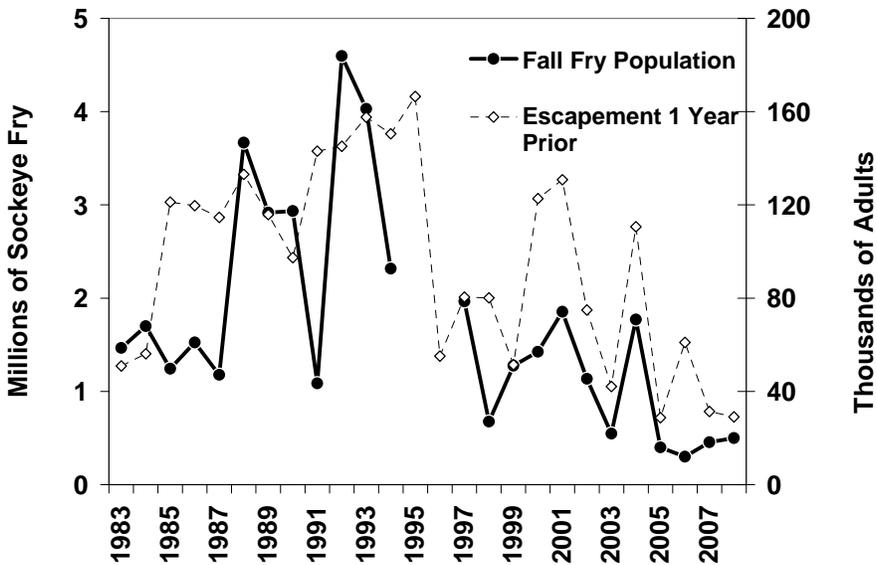
## **FIGURES**



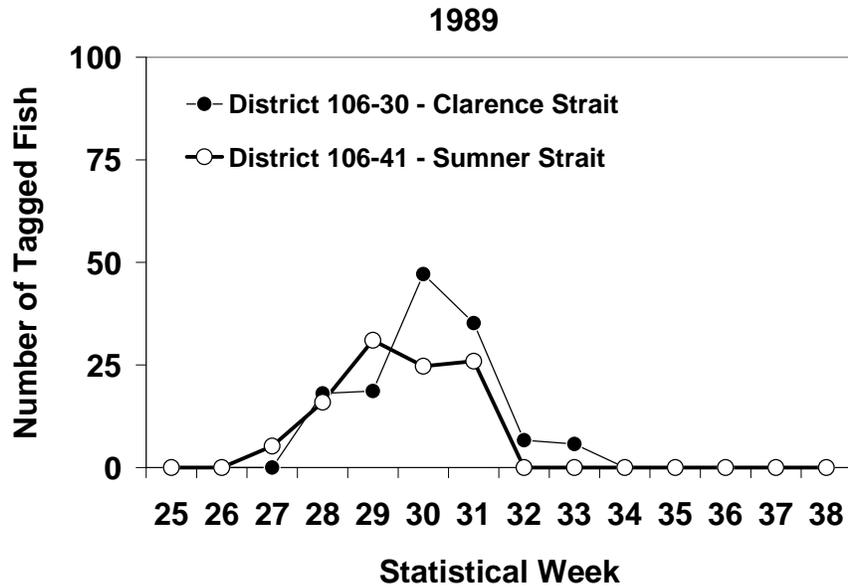
**Figure 1.**—Commercial fishing areas in southern Southeast Alaska, and the areas in Districts 1 through 7 delineated for potential restrictions in the McDonald Lake Action Plan.



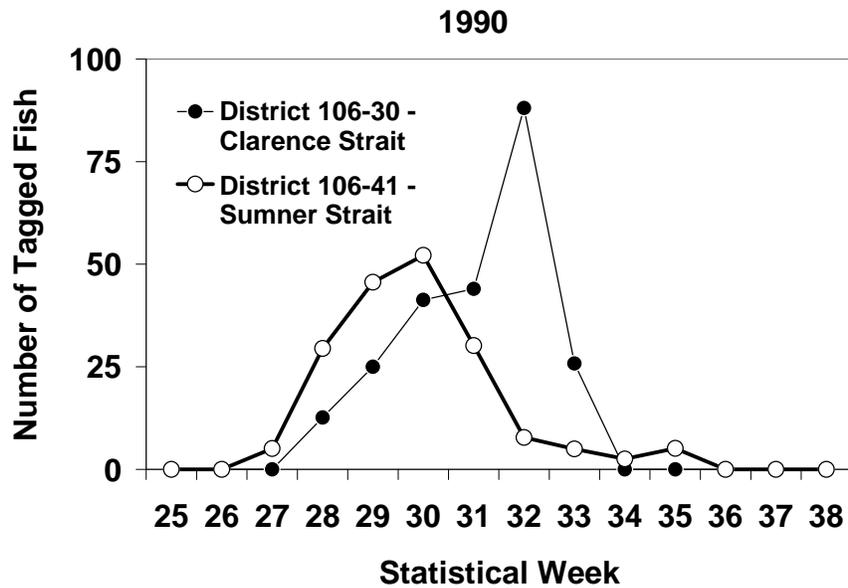
**Figure 2.**—Estimated McDonald Lake sockeye salmon spawning escapement, 1981–2008. Black bars represent escapements and portions of escapements that were not affected by lake fertilization. Bold black lines represent the recommended new sustainable escapement goal range of 55,000 to 120,000 spawners.



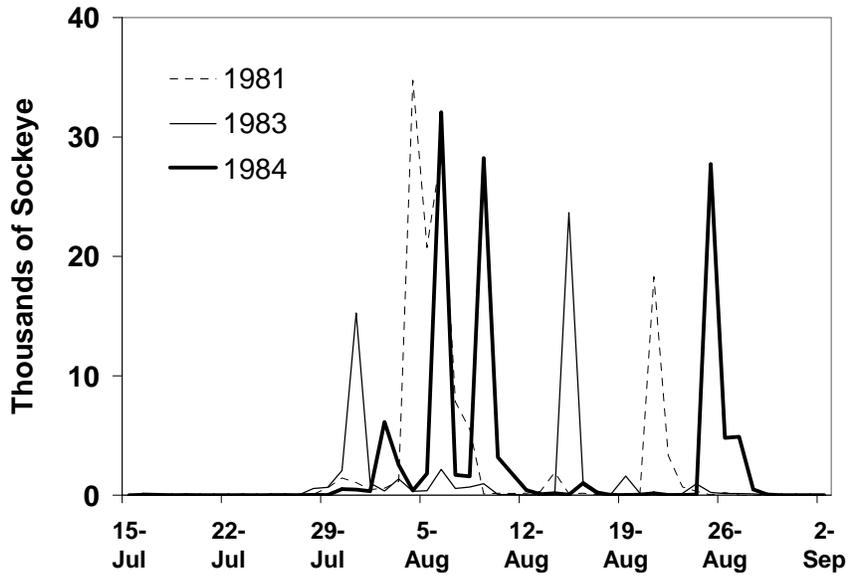
**Figure 3.**—Estimates of age-0 sockeye salmon fry in McDonald Lake, 1983–2008, compared to the estimated brood-year escapement of adult sockeye salmon one year prior. Note that McDonald Lake sockeye salmon fry were hatchery-reared and back-planted into the lake in 1989 (3.5 million fry) and 1990 (1.0 million fry).



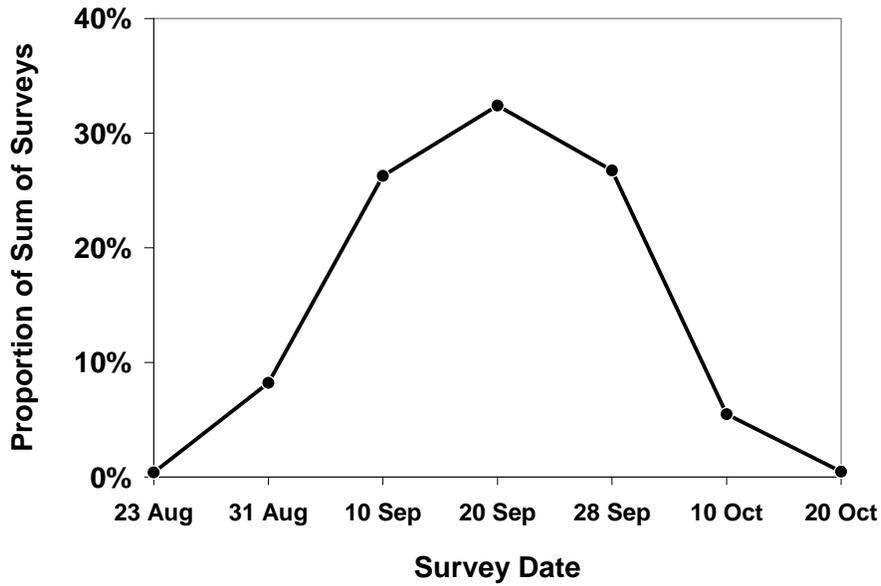
**Figure 4.**—Recoveries of coded-wire tagged McDonald Lake sockeye salmon in the District 6 drift gillnet fishery, expanded for fishery sample size, 1989.



**Figure 5.**—Recoveries of coded-wire tagged McDonald Lake sockeye salmon in the District 6 drift gillnet fishery, expanded for fishery sample size, 1990.



**Figure 6.**—Run timing of McDonald Lake sockeye salmon into the outlet stream, Wolverine Creek, based on daily weir counts in 1981, 1983, and 1984.



**Figure 7.**—Average run timing of McDonald Lake sockeye salmon into the spawning stream at Hatchery Creek, based on foot surveys conducted on the indicated dates, 1980–2007..

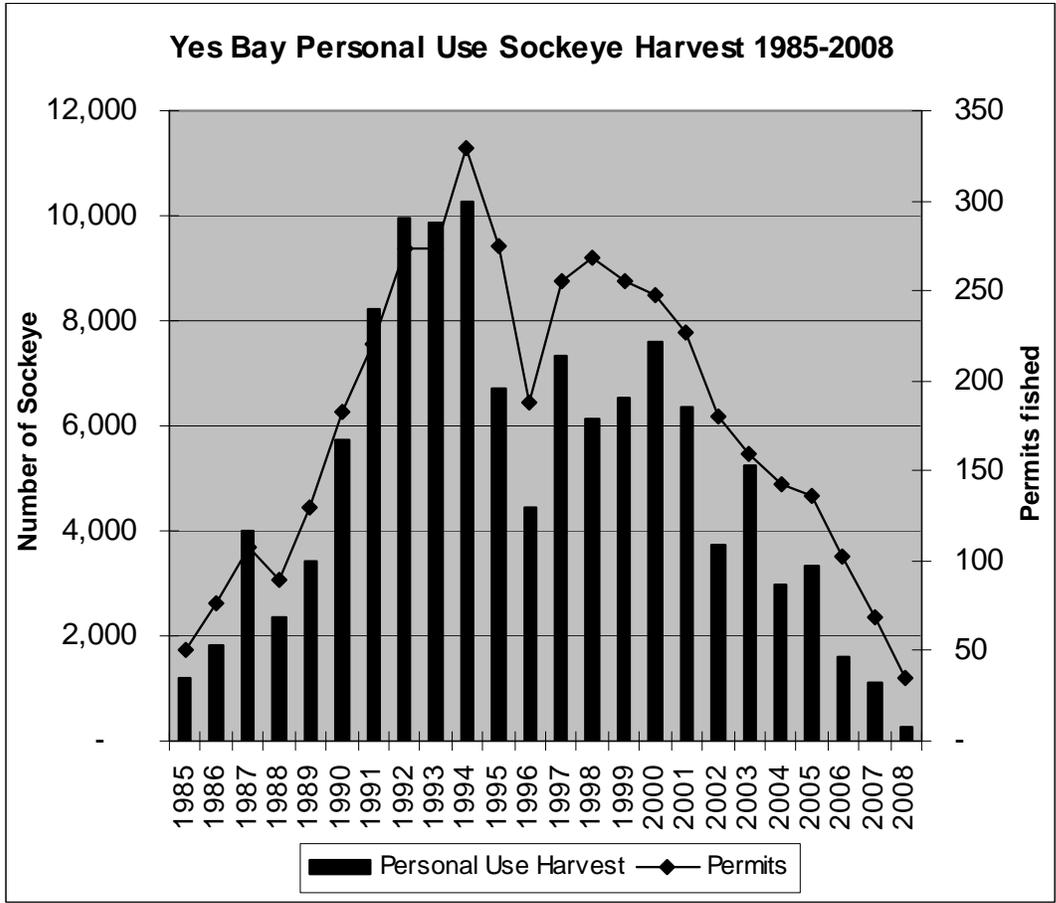
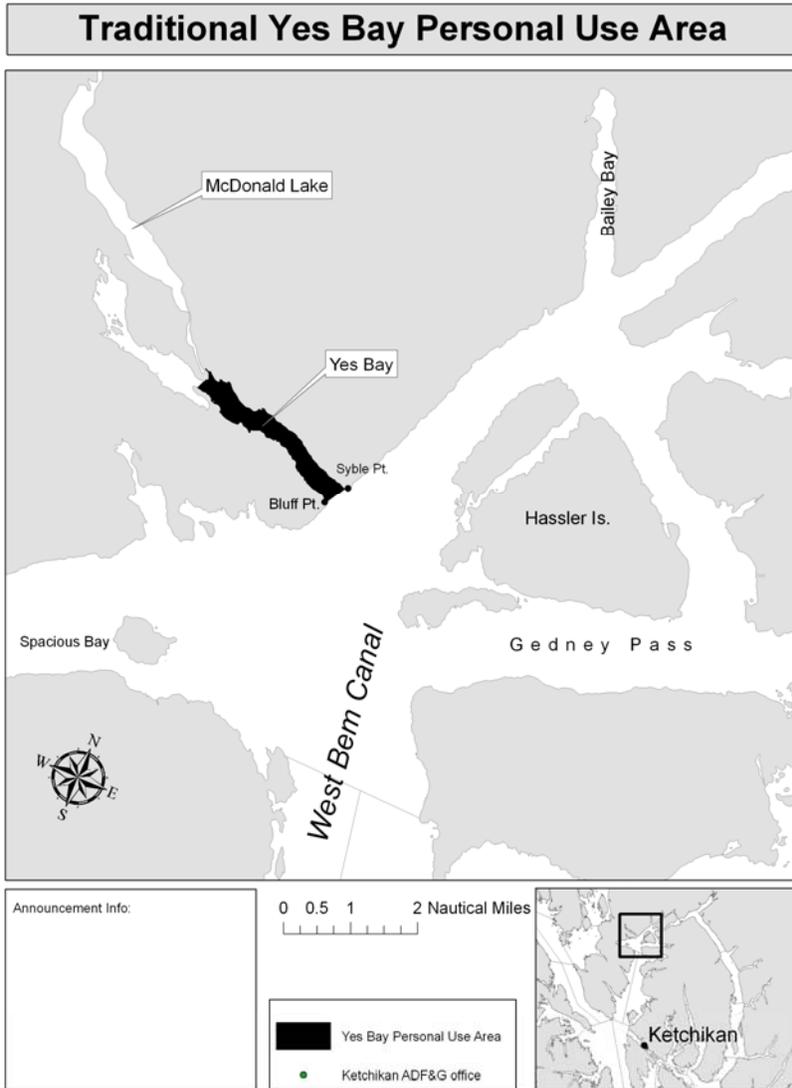


Figure 8.—McDonald Lake sockeye personal use harvest and permits fished, 1985–2008.



**Figure 9.**—Yes Bay personal use area.