

Unuk and Chickamin Chinook Salmon Stock Status and Action Plan, 2022

by

Bo L. Meredith

Nathan D. Frost

Kelly S. Reppert

and

Grant T. Hagerman

June 2022

Alaska Department of Fish and Game

Division of Commercial Fisheries



Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used without definition in the following reports by the Divisions of Sport Fish and of Commercial Fisheries: Fishery Manuscripts, Fishery Data Series Reports, Fishery Management Reports, Special Publications and the Division of Commercial Fisheries Regional Reports. All others, including deviations from definitions listed below, are noted in the text at first mention, as well as in the titles or footnotes of tables, and in figure or figure captions.

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

REGIONAL INFORMATION REPORT NO. 1J22-13

**UNUK AND CHICKAMIN CHINOOK SALMON STOCK STATUS AND
ACTION PLAN, 2022**

By
Bo Meredith and Nathan Frost
Alaska Department of Fish and Game, Division of Commercial Fisheries, Ketchikan

Kelly Reppert
Alaska Department of Fish and Game, Division of Sport Fish, Ketchikan

and

Grant Hagerman
Alaska Department of Fish and Game, Division of Commercial Fisheries, Sitka

Alaska Department of Fish and Game
Division of Commercial Fisheries, Publications Section
802 3rd, Douglas, Alaska, 99824-0020

June 2022

The Regional Information Report Series was established in 1987 and was redefined in 2007 to meet the Division of Commercial Fisheries regional need for publishing and archiving information such as project operational plans, area management plans, budgetary information, staff comments and opinions to Board of Fisheries proposals, interim or preliminary data and grant agency reports, special meeting or minor workshop results and other regional information not generally reported elsewhere. Reports in this series may contain raw data and preliminary results. Reports in this series receive varying degrees of regional, biometric and editorial review; information in this series may be subsequently finalized and published in a different department reporting series or in the formal literature. Please contact the author or the Division of Commercial Fisheries if in doubt of the level of review or preliminary nature of the data reported. Regional Information Reports are available through the Alaska State Library and on the Internet at: <http://www.sf.adfg.ak.us/statewide/divreports/html/intersearch.cfm>.

Product names used in this publication are included for completeness and do not constitute product endorsement. The Alaska Department of Fish and Game does not endorse or recommend any specific company or their products.

*Bo Meredith and Nathan Frost
Alaska Department of Fish and Game, Division of Commercial Fisheries, Ketchikan, USA*

*Kelly Reppert
Alaska Department of Fish and Game, Division of Sport Fish, Ketchikan, USA*

and

*Grant Hagerman
Alaska Department of Fish and Game, Division of Commercial Fisheries, Sitka, USA*

This document should be cited as:

Meredith, B. L., N. D. Frost, K. S. Reppert, and G. T. Hagerman. 2022. Unuk and Chickamin Chinook salmon stock status and action plan, 2022. Alaska Department of Fish and Game, Alaska Department of Fish and Game, Regional Information Report No. 1J22-13, Douglas.

The Alaska Department of Fish and Game (ADF&G) administers all programs and activities free from discrimination based on race, color, national origin, age, sex, religion, marital status, pregnancy, parenthood, or disability. The department administers all programs and activities in compliance with Title VI of the Civil Rights Act of 1964, Section 504 of the Rehabilitation Act of 1973, Title II of the Americans with Disabilities Act (ADA) of 1990, the Age Discrimination Act of 1975, and Title IX of the Education Amendments of 1972.

If you believe you have been discriminated against in any program, activity, or facility please write:

ADF&G ADA Coordinator, P.O. Box 115526, Juneau, AK 99811-5526

U.S. Fish and Wildlife Service, 4401 N. Fairfax Drive, MS 2042, Arlington, VA 22203

Office of Equal Opportunity, U.S. Department of the Interior, 1849 C Street NW MS 5230, Washington DC 20240

The department's ADA Coordinator can be reached via phone at the following numbers:

(VOICE) 907-465-6077, (Statewide Telecommunication Device for the Deaf) 1-800-478-3648,

(Juneau TDD) 907-465-3646, or (FAX) 907-465-6078

For information on alternative formats and questions on this publication, please contact:

ADF&G, Division of Sport Fish, Research and Technical Services, 333 Raspberry Rd, Anchorage AK 99518 (907) 267-2375

TABLE OF CONTENTS

	Page
LIST OF TABLES.....	ii
LIST OF FIGURES.....	ii
ABSTRACT	1
INTRODUCTION.....	1
STOCK ASSESSMENT BACKGROUND.....	2
Unuk River	2
Escapement.....	3
Harvest.....	3
Chickamin River.....	3
Escapement.....	4
Harvest.....	4
ESCAPEMENT GOAL EVALUATION	4
Escapement Goal History	4
Unuk River.....	4
Chickamin River.....	4
Spawner Data and BEG Analysis	5
Escapement Goal Recommendation.....	5
STOCK OF CONCERN RECOMMENDATION.....	5
Unuk River	5
Chickamin River.....	5
Outlook.....	5
HABITAT ASSESSMENT	6
Unuk River	6
Chickamin River.....	6
FISHERY MANAGEMENT OVERVIEW AND BACKGROUND.....	6
Commercial Fisheries	7
Purse Seine Fishery.....	7
Drift Gillnet Fishery.....	8
Troll Fishery	8
Past Commercial Fishery Management Actions.....	9
Purse Seine Fishery	9
Drift Gillnet Fishery	9
Troll Fishery	9
Subsistence and Personal Use Fisheries	10
Past Subsistence and Personal Use and Fishery Management Actions.....	10

TABLE OF CONTENTS (Continued)

	Page
MANAGEMENT ACTION PLAN OPTIONS FOR ADDRESSING STOCK OF CONCERN	10
Action Plan Goal	10
Action Plan Alternatives.....	11
Action #1 –Sport Fishery.....	11
Action #2 –Commercial Fisheries	12
RESEARCH PLAN.....	13
Past and Current Research Projects for the Unuk and Chickamin Rivers	13
REFERENCES CITED	15
TABLES AND FIGURES	17

LIST OF TABLES

Table	Page
1. Unuk River large Chinook salmon escapement and harvest rate estimates of \geq age-1.2 fish, 2011–2020.....	18
2. Escapement of large Chinook salmon in the Chickamin River, 2011–2020.	19
3. Chickamin River large Chinook salmon escapement and harvest rate estimates by gear group of \geq age-1.2 fish, 2006–2009. These are the only return years from the 2000–2005 broods that are complete for calendar year harvest rate analysis.	20
4. Unuk and Chickamin River Chinook salmon calendar year harvest rate estimates of (\geq age-1.2) fish, 2006–2009. These are the only return years from the 2000–2005 Chickamin broods that are complete for calendar year harvest rate comparison analysis between the Unuk and Chickamin Rivers.....	21

LIST OF FIGURES

Figure	Page
1. Map of the Unuk River watershed showing primary Chinook salmon spawning tributaries in the Alaska portion of the watershed.	22
2. Map of Unuk River Chinook salmon coded wire tag recoveries in SEAK fisheries from 1985 to 1992 and 1995 to 2020.	23
3. Map of Chickamin River watershed showing location of major tributaries and barriers to fish migration.	24
4. Map of Chickamin River Chinook salmon coded-wire tag recoveries in SEAK fisheries from 1985 to 1992 and 2003 to 2011.	25
5. Map of the Ketchikan Sport Terminal Harvest Area. Beginning in 2014, regionwide regulations applied through June and liberalization of bag and size limits were postponed until July 1.	26
6. Map of Southeast Alaska commercial purse seine fishing areas.	27
7. Map of traditional commercial drift gillnet fishing areas in Southeast Alaska.	28
8. Map of Southeast Alaska commercial troll fishing and Big Six management areas, Cape Suckling to Dixon Entrance.	29
9. Map of spring commercial troll fishing areas in Southeast Alaska.	30
10. Map of spring troll and Terminal Harvest Area (THA) fisheries in Ketchikan vicinity.....	31
11. Map of Ketchikan area troll restrictions during the summer troll fishery, July 1–Sept 20.....	32
12. Map depicting the sport fishery regulations implemented by EO per the 2018 Unuk River king salmon action plan. In addition to the action plan measures, king salmon nonretention was implemented in District 1 through June 14, except in hatchery access areas.....	33

ABSTRACT

In response to guidelines established in the *Policy for the Management of Sustainable Salmon Fisheries* (SSFP), the Alaska Department of Fish and Game (department) recommended that the Unuk River stock of Chinook salmon (*Oncorhynchus tshawytscha*) be designated as a “stock of management concern” in October 2017. This recommendation was adopted by the Alaska Board of Fisheries (board) in January 2018. Then, in October 2020, the department recommended continuing this designation and additionally recommended that the Chickamin River stock of Chinook salmon be added as a “stock of management concern”. A “management concern” is defined as “a concern arising from a chronic inability, despite use of specific management measures, to maintain escapements for a salmon stock within the bounds of the SEG [sustainable escapement goal], BEG [biological escapement goal], OEG [optimum escapement goal], or other specified management objectives for the fishery.” The escapement of the Unuk River stock of Chinook salmon has been below the lower bound of the existing BEG (1,800–3,800 fish) in 3 of the past 5 years (2016–2020). The escapement of Chickamin River Chinook salmon has been below the lower bound of the existing BEG (2,150–4,300 fish) in 4 of the past 5 years (2016–2020). Since 2014, the department has implemented conservative management actions to reduce harvest of Unuk River Chinook salmon, and by extension and proximity to the Unuk River, it is assumed those actions have reduced harvests of Chickamin River Chinook salmon as well.

Keywords: Chinook salmon, *Oncorhynchus tshawytscha*, Unuk River, Chickamin River, Behm Canal, Southeast Alaska, stock of concern, fishing, sustainable salmon fisheries policy, Alaska Board of Fisheries

INTRODUCTION

The *Policy for the Management of Sustainable Salmon Fisheries* (SSFP; 5 AAC 39.222) directs the Alaska Department of Fish and Game (department) to provide the Alaska Board of Fisheries (board) with reports on the status of salmon stocks and identify any salmon stocks that present a concern related to yield, management, or conservation during regularly scheduled board meetings. Herein, the Unuk River and Chickamin River stocks of Chinook salmon *Oncorhynchus tshawytscha* will be referred to as Unuk River Chinook salmon and Chickamin River Chinook salmon.

In October 2017, the department recommended that the board designate Unuk River Chinook salmon as a stock of “management concern”. The board adopted this recommendation, and an action plan designed to reduce harvest on Unuk River Chinook salmon was developed at the January 2018 Southeast and Yakutat board meeting (Lum and Fair 2018). In October 2020, the department recommended continuing this designation, and additionally recommended that the Chickamin River stock of Chinook salmon be added as a stock of “management concern”. The stock of concern recommendations were based on guidelines established in the SSFP, which describes a management concern as “a concern arising from a chronic inability, despite use of specific management measures, to maintain escapements for a salmon stock within the bounds” of the established escapement goal whether it be a sustainable escapement goal (SEG), biological escapement goal (BEG), or optimal escapement goal (OEG), or other specified management objective. Chronic inability is further defined in the SSFP as the “continuing or anticipated inability to meet escapement thresholds over a 4 to 5-year period, which is approximately the generation time of most salmon species.” Prior to the stock of “management concern” recommendation in October 2017, Unuk River Chinook salmon escapements were below the lower bound of the BEG range of 1,800 to 3,800 large fish (Chinook salmon ≥ 660 mm mid-eye to tail fork length, primarily fish age 1.3 and older) in 5 out of 6 years from 2012 to 2017. More recently, Unuk River Chinook salmon escapements have been below the lower bound of the current BEG in 3 of the last 5 years from 2016 to 2020. During this same period, escapements of Chickamin River Chinook salmon were below the lower bound of the BEG range of 2,150 to 4,300 large fish in 4 of the past 5 years.

Poor production and declines of Chinook salmon runs over at least the past decade have been well documented throughout much of the species' range (ADFG 2013). Declines in survival rates and abundance of SEAK stocks have persisted since 2007. Although freshwater factors may be contributing to these declines, the wide geographic scope of the effect suggests poor production stems from factors in the ocean. This idea is supported by information produced through the department's SEAK Chinook salmon stock assessment program, which includes estimating both freshwater and marine survival rates for 4 wild Chinook salmon stocks originating in the Chilkat, Taku, Stikine, and Unuk Rivers. The long time series of detailed stock assessment information available for these stocks, including survival rates, is unique to the SEAK program, and is not available for wild Chinook salmon stocks found elsewhere along the coast. Freshwater survival rates of these 4 SEAK Chinook salmon indicator stocks have fluctuated similarly over time and do not show long-term trends; however, marine survival rates for these same stocks have severely declined and are currently far below prior long-term averages.

This action plan provides the department's assessment of the stocks of Chinook salmon from the Unuk and Chickamin Rivers, summarizes historical run sizes, and describes the existing regulations and emergency order (EO) authority that the department follows to manage for the Unuk River Chinook salmon BEG. The plan outlines board directed management actions for the sport, commercial, and personal use fisheries, and research projects for the Unuk River and Chickamin River Chinook salmon stocks. Criteria that must be met for future removal of the stock of concern designation are also outlined.

STOCK ASSESSMENT BACKGROUND

UNUK RIVER

The Unuk River is a river system that originates in British Columbia and flows into northeast Behm Canal near Ketchikan, Alaska (Figure 1). The Unuk River produces the largest run of Chinook salmon in southern Southeast Alaska (SEAK). The Unuk River Chinook salmon run is 1 of 4 SEAK Chinook salmon stocks for which a full stock assessment program is conducted annually. Full stock assessment programs include coded-wire-tagging of juveniles, which, in combination with adult monitoring and sampling programs, provides estimates of smolt abundance, parr to smolt overwinter survival rates, marine survival rates (smolt-adult), total annual run size (escapement plus harvest by age), and total return, along with estimates of harvest (calendar year) and exploitation (brood year) rates. Juveniles were captured, marked with adipose fin clips, and injected with coded-wire tags (CWTs) from 1982 to 1986 and from 1992 to present. Since 1992, juveniles have been tagged at relatively high rates (8–12%). Estimates of escapement are germane to large spawners and are based on mark-recapture estimates of total escapement from 1997 to 2009 and in 2011, and standardized helicopter and foot surveys from 1977 to 1996, 2010, and 2012 to present. Field sampling programs to gather age, sex, length, tag, and genetic information occur annually. Radiotelemetry studies conducted in 1994 and 2009 indicated that current aerial and foot surveys cover more than 80% of the spawning area (Weller and Evans 2012). Seven years of concurrent mark-recapture studies and standardized survey counts were used to develop a factor of 4.83 (Hendrich et al. 2008) that expands survey counts to drainage wide estimates of escapement.

Recoveries of CWTs indicate that Unuk River Chinook salmon rear in a wide geographic area. Unuk River Chinook salmon rear predominantly in SEAK inside waters, but tags are also recovered in the Gulf of Alaska, Bering Sea, and, to a lesser extent, Northern British Columbia.

Marine waters of Behm Canal adjacent to the Unuk River are currently closed to salmon fishing under sport fishing regulations (5AAC 47.021 (j)(2)). Immature and mature fish are harvested in marine mixed stock fisheries in SEAK and northern British Columbia (Table 1).

Escapement

Standardized surveys of escapement began in 1977, and for 34 years the escapement of Unuk River Chinook salmon met or exceeded the BEG in every year (1977–2011); however, this stock has failed to achieve the lower bound of the BEG in 6 of the most recent 9 years (Table 1).

Harvest

Unuk River Chinook salmon are harvested in various commercial and sport fisheries in Southeast Alaska (Figure 2). Over the 10-year period (2011–2020), the harvest rate of Unuk River Chinook salmon averaged 43% (range 18–73%; Table 1). Average harvest rates by fishery were 23% in the commercial troll, 13% in the commercial net, and 8% in the sport for the same 10-year period. Harvest rates have decreased since restrictive measures were implemented following the designation as a stock of “management concern” in January 2018. Over the 5-year period 2016–2020, the average harvest rate on Unuk River Chinook salmon decreased to 32% (range 18–48%; Table 1), but the BEG was not achieved in 3 of those 5 years. The BEG was met in 2018 and 2019, but not in 2020; harvest rates in the most recent 3 years were 30% in 2018, 18% in 2019, and 33% in 2020 (Table 1). The commercial harvest in the troll fishery over the last 10 years (2011–2020) occurred in the winter, spring, and summer fishing periods. Most troll harvest occurred in the spring fishery through 2017, but management restrictions have since decreased spring troll harvest from an average of 15% between 2011 and 2017, to only 4% from 2018 to 2020 (Table 1). Harvest rates in the commercial net fisheries (drift gillnet and purse seine fisheries combined) averaged 11.1% from 2010 to 2017 and averaged 12.1% from 2018 to 2020, when the action plan was in place (Table 1). Harvest in the sport fishery occurred primarily from May through July; however, in recent years (2014–2020), when restrictive measures were implemented in the terminal areas near Ketchikan, harvest in the sport fishery occurred primarily in June. Harvest rates in the sport fishery averaged 8% over the past 10 years and 5% over the most recent 5 years (Table 1).

CHICKAMIN RIVER

The Chickamin River is a glacial system that originates in British Columbia and flows into east Behm Canal, east of Ketchikan, Alaska. The mouth of the river is 32 km south of Burroughs Bay, where the mouth of the Unuk River is located (Figure 3). The Chickamin River produces the second largest run of Chinook salmon in southern SEAK and is 1 of 4 Behm Canal index streams for the Chinook salmon escapement estimation program (Pahlke 1998; Frost et al. *In prep*). Juveniles were captured and injected with CWTs from 1983 to 1988 and 2001 to 2007. These data, when paired with spawning abundance estimates, provided estimates of smolt abundance, parr to smolt overwinter survival rates, marine survival rates, and total annual run size, along with harvest (calendar year) and exploitation (brood year) rates. Due to budgetary restraints, coded-wire-tagging on the Chickamin River was discontinued following the 2005 brood year. Currently, the Chickamin River is monitored annually with standardized helicopter surveys of spawning abundance coupled with field sampling programs to gather age, sex, length, tag, and genetic information.

Estimates of escapement are germane to large spawners and are based on mark–recapture estimates of total escapement in 1996 and from 2001 to 2005 and expanded observer index counts in all

other years since 1975. Radiotelemetry studies conducted in 1996 showed that approximately 83% of all spawning occurred in the 8 index tributaries and that approximately 17% of all spawning occurred in small unnamed tributaries in the upper reaches of the drainage. No salmon were tracked into British Columbia (Pahlke 1997). The relationship between the mark–recapture estimates and standardized survey counts was used to develop an expansion factor of 4.75 (Weller et al. 2007) to expand survey counts to drainagewide estimates of escapement.

Historical CWT information and proximity to Unuk River Chinook salmon suggests Chickamin River Chinook salmon also rear over a wide geographic area ranging from inside waters of SEAK and British Columbia, to the Gulf of Alaska, and the Bering Sea. Historical CWT and escapement data indicate Chickamin River Chinook salmon have a slightly later run timing (7 to 10 days) than Unuk River Chinook salmon.

Escapement

Standardized surveys of escapement began in 1975, and the escapement of Chickamin River Chinook salmon met or exceeded the BEG in 23 of 37 years (1975–2011); however, escapement has failed to achieve the lower bound of the BEG in 5 of the most recent 9 years (Table 2).

Harvest

Tagged Chickamin River Chinook salmon were harvested in various SEAK commercial and sport fisheries (Figure 4; Frost et al. *In prep*). Harvest rates from 2006 to 2009 averaged 37% (range 18–50%; Table 3), and by fishery averaged 18% in the commercial troll, 5% in the commercial net, and 12% in the sport. During that same period, Chickamin River Chinook salmon were harvested at a higher rate (average of 37%) than the nearby Unuk River Chinook salmon run (average of 28%; Table 4). Harvest rates on Unuk River Chinook salmon decreased after it was designated as a stock of “management concern” in 2018, and presumably, harvest rates on Chickamin River Chinook salmon also decreased, given geographic proximity and similar rearing patterns.

ESCAPEMENT GOAL EVALUATION

ESCAPEMENT GOAL HISTORY

Unuk River

The *Policy for Statewide Salmon Escapement Goals* (SSEGP; 5 AAC 39.223), adopted by the board in 2001, established the formal process for setting escapement goals. Prior to this, the department followed its *Salmon Escapement Goal Policy* adopted in 1992 that established a formal process to set, evaluate, and modify existing escapement goals (Fried 1994). In 1994, the department established a Unuk River Chinook salmon escapement goal of 875 large spawners based on peak observer index counts. In 1997, the escapement goal was revised to a BEG range of 650 to 1,400 large spawners (McPherson and Carlile 1997) based on peak observer index counts. Using more robust methods and a longer time series of spawner and recruit data, including the 1982 to 2001 brood years (Hendrich et al. 2008), the current BEG range of 1,800 to 3,800 large spawners was established and adopted by the department in 2009.

Chickamin River

In 1981, the department established a Chickamin River Chinook salmon escapement goal of 900 large spawners based on the peak observer index count of 860 fish in 1972 (McPherson and Carlile 1997). In 1997, the goal was revised to a BEG range of 450 to 900 large spawners based on peak

observer index counts (McPherson and Carlile 1997). In 2018, the BEG was converted to estimates of total escapement by applying the peak survey count expansion factor (4.75) and rounding to a range of 2,150 to 4,300 large spawners (Heinl et al. 2017).

SPAWNER DATA AND BEG ANALYSIS

The SSEGP along with the SSFP require the department to report on salmon stock status and escapement goals to the board on a regular basis, document and review existing salmon escapement goals, establish goals for stocks for which escapement can be reliably measured, and prepare scientific analyses with supporting data when goals are created, modified, or recommended for elimination.

Escapement Goal Recommendation

The department has reviewed salmon escapement goals every 3 years prior to the Southeast and Yakutat board meeting and has not changed the Unuk River Chinook salmon goal since 2009 (Der Hovanisian et al. 2011; Heinl et al. 2014; Heinl et al. 2017; Heinl et al. 2021). The Chickamin River Chinook salmon escapement goal was modified in 2018 to convert it from index count units to estimated total escapement (Heinl et al. 2017).

STOCK OF CONCERN RECOMMENDATION

UNUK RIVER

Standardized escapement estimates for Unuk River Chinook salmon began in 1977 and were above the BEG for the first 34 consecutive years. However, in 2012 the escapement was below the BEG and since that time escapements have been below the BEG in most years. In response, the department implemented management measures designed to reduce the harvest of Unuk River Chinook salmon beginning in 2014. In October 2017, the department recommended designating the Unuk River Chinook salmon stock as a stock of “management concern” and the board adopted this recommendation at the regulatory meeting for Southeast and Yakutat in January 2018. Since implementation of the 2018 Unuk River king salmon action plan, the Unuk River Chinook salmon stock has achieved the lower bound of the BEG in 2 of the past 3 years, but criteria for removing the stock of concern designation (e.g., achieving the escapement goal for 3 consecutive years) have not been met. In October 2020, the department recommended that Unuk River Chinook salmon continue to be designated as a stock of “management concern”.

CHICKAMIN RIVER

Inseason management actions taken annually since the 2014 fishing season to reduce harvests of Unuk River Chinook salmon likely also reduced harvest of Chickamin River Chinook salmon. However, these efforts proved insufficient to achieve the Chickamin River BEG, as escapements were below the lower bound of the goal range in 4 of the past 5 years. In October 2020, the department recommended the board designate Chickamin River Chinook salmon as a stock of “management concern”.

OUTLOOK

By December 1 each year, the department produces Chinook salmon preseason forecasts of total runs for the Situk, Chilkat, and Unuk Rivers stocks and forecasts of terminal runs for Taku and Stikine Rivers stocks. The 2021 preseason forecast for the total run of Unuk River Chinook salmon is 1,550 large fish, which, with no harvest, is below the lower bound of the BEG range of 1,800 to

3,800 large fish. The department does not produce preseason forecasts for the other 6 indicator stocks in the region, including Chickamin River Chinook salmon, due to a lack of sibling model information, which require estimates of harvest contributions. However, poor Chinook salmon production throughout SEAK is expected to continue into the near future.

HABITAT ASSESSMENT

UNUK RIVER

The Unuk River drainage encompasses an area of approximately 2,477 km². The lower 39 km of the river lies in Alaska, and the Alaska portion of the drainage contains 6 tributaries in which more than 80% of the Chinook salmon spawning occurs (Weller and Evans 2012). The entire Alaska portion of the Unuk River watershed is within and surrounded by the Misty Fjords National Monument Wilderness, and this land-use designation contributes to the pristine condition of the watershed. The anadromous portions of the 6 primary Chinook salmon spawning tributaries were surveyed from 2002 to 2004 using standardized habitat surveys developed by the U.S. Forest Service (USFS) and modified by the ADF&G Division of Sport Fish (Nichols et al. 2013). These surveys characterized the geomorphic, fluvial, and riparian attributes of the primary spawning areas, and serve as baseline information to be compared with other surveyed systems throughout SEAK.

The British Columbia portion of the Unuk River watershed similarly hosts mostly pristine terrestrial and aquatic habitat. One planned development project, the Kerr-Sulphurets-Mitchell mine, is currently being evaluated. The mine could have future impacts on downstream water quality and other components of anadromous habitat (e.g., water flow, physical habitat, etc.). The proponents of this project propose to mine the Sulphurets, Kerr, Mitchell, and Iron Cap deposits, establish mine support facilities in the non-fish bearing Mitchell and McTagg Creek valleys, and store and treat contact water before discharging the effluent into Sulphurets Creek, which drains into the Unuk River. Alaska and British Columbia have different regulatory measures in place to protect fish habitat, including water quality, riparian habitat, and other components. At this time, it would be impossible to estimate the potential effects of this specific project on the Unuk River Chinook salmon population; however, projects are currently being proposed to collect baseline water quality and quantity data, and to implement periodic monitoring in the watershed to assess impacts that might occur due to this mining project.

CHICKAMIN RIVER

The Chickamin River drainage encompasses an area of approximately 1,675 km². There is no road access to any portion of the watershed which has restricted anthropogenic impacts. In addition, the lower 60 km of the Chickamin River is in Alaska, and the entire Alaskan portion of the watershed is within and surrounded by the Misty Fjords National Monument Wilderness, which contributes to the pristine condition of the habitat. Radiotelemetry studies in 1996 showed that all Chinook salmon spawning occurred in Alaska, of which, 83% occurred in 8 index tributaries (Pahlke 1997).

FISHERY MANAGEMENT OVERVIEW AND BACKGROUND

The SEAK Chinook salmon fishery is managed to stay within the all-gear catch limit per mandates of the Pacific Salmon Treaty. Allocations among the troll, net and sport fisheries are governed by regulations established by the BOF.

SPORT FISHERIES

Unuk and Chickamin River Chinook salmon are caught in the sport fishery throughout the marine waters of SEAK, but primarily in the Ketchikan area. Chinook salmon fishing in freshwater is prohibited in SEAK east of the longitude of Cape Fairweather. Regional marine sport Chinook salmon regulations in SEAK are set annually by EO as specified in the *Southeast Alaska King Salmon Management Plan* (5 AAC 47.055). These regional regulations can be modified to comply with management plans, allow increased opportunity for Chinook salmon of Alaska hatchery origin, or establish conservative regulations for the protection of wild SEAK Chinook salmon stocks. The commissioner also may, by EO, change bag and possession limits and annual limits, and alter methods and means in sport fisheries (5 AAC 75.003). These changes may not reduce the allocation of harvest amongst other user groups. An EO may not supersede provisions for increasing or decreasing bag and possession limits or change methods and means specified in regulatory management plans established by the board. Current sport fishing regulations protect Unuk River and Chickamin River Chinook salmon with a year-round closure to salmon fishing in northeastern Behm Canal and contiguous bays.

To reduce the harvest of Unuk River Chinook salmon, management measures have been implemented annually since 2014 in the Ketchikan area sport fisheries. These management measures include expanding the time and area closures in East and West Behm Canal that are currently restricted by regulation, reducing the bag and possession limit in West Behm Canal to 1 fish through June 30, and postponing liberalization of the Ketchikan Sport Terminal Harvest Area (THA) until July 1 (Figure 5). In 2015, time restrictions were extended an additional 2 weeks through July 15, and after meeting the BEG, management measures were relaxed slightly in 2016. The BEG was missed again in 2016, and in response, bag and annual limits were reduced, and time restrictions were substantially extended from April 1 through August 14, 2017. Unuk River Chinook salmon harvest rates in the Ketchikan area sport fisheries were 5% in 2015, 6% in 2016, and 0% in 2017. Despite more conservative measures in 2017, the BEG was not met. Since being listed as a stock of “management concern”, harvest rates in the sport fishery were 2% in 2018 and 4% in 2019. In 2020, the BEG was not achieved and the sport fishery harvest rate was 13%.

The sport fishery was managed from 2018 to 2020 in accordance with the 2018 Unuk River king salmon action plan. Additional management measures beyond those outlined in the action plan were implemented during 2018–2020, which prohibited Chinook salmon retention in the remaining waters of District 1 from April 1 to June 14. In 2021, the waters of Boca de Quadra were added to the Southeast Behm Canal area which prohibited Chinook salmon retention from April 1 to August 14.

COMMERCIAL FISHERIES

Purse Seine Fishery

Regulations allow purse seine fishing in Districts 1 (Sections 1-C, 1-D, 1-E, and 1-F only), 2, 3, 4, 5, 6 (Sections 6-C and 6-D only), 7, 9, 10, 11 (Sections 11-A and 11-D only), 12, 13, and 14. Purse seine fishing is also allowed in hatchery THAs at Neets Bay, Kendrick Bay, Anita Bay, Southeast Cove, Thomas Bay, Deep Inlet, and Hidden Falls (Figure 6). Although the areas specified above are designated purse seine fishing areas, specific open areas and fishing times are established in season by EO.

Chinook salmon are not targeted in traditional purse seine fisheries but are harvested incidentally. Chinook salmon less than 28 inches may be retained but not sold. Chinook salmon greater than 28 inches may only be retained during periods established by EO. Purse seine fisheries can occur in Districts 1, 2, 4, and 7 in early July and in other seine areas in southern SEAK later in July or early August. Regionwide Chinook salmon retention periods typically do not begin until mid- to late (SWs 29 to 30) July but have been delayed in recent years to reduce harvest of Unuk River and Chickamin River Chinook salmon, which have later run timing.

Drift Gillnet Fishery

The 5 traditional drift gillnet fishing areas (Figure 7) are: Tree Point/Portland Canal (District 1); Prince of Wales (District 6); Stikine (District 8); Taku/Snettisham (District 11); and Lynn Canal (District 15). In addition, drift gillnet fisheries occur in several THAs adjacent to hatchery facilities and at remote hatchery release sites throughout the region. Although the THAs are designated drift gillnet fishing areas, specific open areas and fishing times are established in regulation or inseason by EO.

Troll Fishery

The commercial troll fishery in SEAK (Figure 8) occurs in State of Alaska waters and in the Federal Exclusive Economic Zone (EEZ) east of the longitude of Cape Suckling (5 AAC 29.010 and 5 AAC 29.020). All other waters of Alaska are closed to commercial trolling.

There are 3 commercial troll seasons in SEAK, winter, spring, and summer. The winter troll fishery is managed for a guideline harvest level (GHL) of 45,000 non-Alaska hatchery-produced Chinook salmon, with a guideline harvest range of 43,000 to 47,000 non-Alaska hatchery-produced fish, plus the number of Alaska hatchery-produced Chinook salmon harvested during the winter fishery. Under provisions of the 2018 Unuk River king salmon action plan, the winter fishery is conducted from October 11 through March 15. Also provided in the action plan, following the closure of the winter troll fishery, and prior to June 30, spring troll fisheries may open by EO to target Alaska hatchery-produced Chinook and chum (*O. keta*) salmon, but are now limited to outer coastal areas or near hatcheries, hatchery release sites, and in areas of low wild SEAK Chinook salmon abundance (Figure 9 and 10). Terminal area fisheries occur adjacent to hatcheries or at remote release sites. Most of the annual troll Chinook salmon harvest is taken during the general summer troll fishery, beginning July 1, when salmon may be taken throughout most of the SEAK/Yakutat region, including the outside waters of the EEZ. The summer troll Chinook salmon harvest is divided into 2 retention periods. The first retention period targets 70% of the remaining annual troll Chinook salmon allocation after winter and spring troll non-Alaska hatchery-produced harvests are subtracted from the annual troll allocation. Following the first retention period, any remaining portion of the annual troll allocation is harvested in a second Chinook salmon retention period, which typically occurs in mid-August, and follows any closure of the troll fishery for coho salmon (*O. kisutch*) conservation.

Management decisions that potentially result in the reduction of commercially troll caught Chickamin River and Unuk River Chinook salmon included fishery closures, delayed fishery openings, and limited area. The closure of the late winter troll fishery in mid-March is designed to reduce harvest of early run Chinook salmon of all SEAK systems. Both CWT and genetic stock identification (GSI) analyses show these stocks are encountered at increased rates in the troll fishery beginning in late March and early April. Directed spring troll Chinook salmon fisheries in May and June are closed to help reduce harvest of these stocks during the peak migration period.

Implementing nonretention during the first summer troll fishery opening (Figure 11) in the areas adjacent to wild Chinook salmon spawning systems reduces troll harvest on those stocks.

Past Commercial Fishery Management Actions

Commercial salmon fisheries are coordinated regionally by gear type and are opened and closed by EO. Fishery managers adjust time and area, and in some situations, impose gear stipulations for the regularly scheduled openings in response to harvestable surpluses and conservation concerns. Below is an outline of significant additional management measures beyond those outlined in the 2018 action plans in the commercial net and troll fisheries that reduced harvest of Chinook salmon returning to the Chickamin and Unuk Rivers from 2018 to 2020.

Purse Seine Fishery

The purse seine fishery in Southern SEAK begins in terminal harvest fisheries in mid- to late June and traditional common property fisheries typically do not begin until early to mid-July, SW 28. Management measures taken from 2018 to 2020 included:

- Hatchery THA openings were delayed from June 1 to June 15.
- In addition to the 6-day closure of the Neets Bay THA during SWs 24–27, the Neets Bay THA remained closed until June 15 in 2019 and 2020. This resulted in a closure of 10 days during SWs 24–27. Additionally, area closures occurred during SW 25 and SW 27 that kept the outer portion of the Neets Bay THA closed.
- The purse seine fishery was closed to the retention of Chinook salmon throughout the 2018 season, through SW 29 in 2019, and through SW 31 in 2020, in traditional common property fisheries and in hatchery THAs where hatchery Chinook salmon are not released.

Drift Gillnet Fishery

The District 1 drift gillnet fishery was managed in accordance with the 2018 Unuk River king salmon action plan. No additional management measures were taken in 2018 through 2020.

Troll Fishery

The commercial troll fishery was managed in accordance with the 2018 Unuk River king salmon action plan. Management measures that were implemented in addition to those outlined in the action plan included:

2018

- The Mountain Point spring troll king salmon fishery opening date was delayed by 2-weeks, to open in mid-May.
- During the first summer troll king salmon retention period, retention and possession of king salmon in the Neets Bay THA closed between the longitude of the easternmost tip of Bug Island and the longitude of Chin Point.
- The waters of Section 1-E, north of a line from Indian Point to Mike Point were closed to Chinook salmon retention or possession during the first general summer troll Chinook salmon retention period.
- The waters of Section 1-F, enclosed by a line from Lucky Point to Middy Point, continuing to the latitude of Beaver Point, and from Point Rosen to Quadra Point, and in southeast Behm Canal south of a line from a point at 55°11.78' N lat, 131°05.13' W long, located on Point Sykes to a point at 55°12.22' N lat, 131°05.70' W long, located one-half mile

northwest of Point Sykes to Point Alava were closed to Chinook salmon retention or possession during the first general summer troll Chinook salmon retention period.

- Closed District 8 to retention of Chinook salmon for first summer troll opening in July.

2019–2020

- The Mountain Point spring troll Chinook salmon fishery opening date was delayed an additional 2 weeks compared to 2018 and opened the first week of June.
- The Neets Bay THA initial troll opening date was delayed by 6-weeks and did not open until June 15.
- During the first summer troll Chinook salmon retention period, retention and possession of Chinook salmon in the Neets Bay THA was closed between the longitude of the easternmost tip of Bug Island and the longitude of Chin Point.
- The waters of Section 1-E, north of a line from Indian Point to Mike Point were closed to Chinook salmon retention or possession during the first general summer troll Chinook salmon retention period.
- The waters of Section 1-F, enclosed by a line from Lucky Point to Middy Point, continuing to the latitude of Beaver Point, and from Point Rosen to Quadra Point, and in southeast Behm Canal south of a line from a point at 55°11.78' N lat, 131°05.13' W long, located on Point Sykes to a point at 55°12.22' N lat, 131°05.70' W long, located one-half mile northwest of Point Sykes to Point Alava were closed to Chinook salmon retention or possession during the first general summer troll Chinook salmon retention period.

SUBSISTENCE AND PERSONAL USE FISHERIES

The Unuk and Chikamin rivers are subject to personal use regulations; however no personal use Chinook salmon fisheries occur on either system. In SEAK, permits are not issued for the personal use taking of Chinook salmon, but Chinook salmon caught incidentally during permitted personal use fishing are legally taken and possessed. The possession limit for Chinook salmon is 2 fish. There is no personal use harvest of Chinook salmon on record for the Unuk or Chikamin Rivers. The only personal use fishery that occurs in the waters of East or West Behm Canal that has any documented harvest of Chinook salmon is the McDonald Lake personal use sockeye salmon (*O. nerka*) fishery in Yes Bay. The Yes Bay personal use harvest averaged 10 Chinook salmon per year since 1998, and 6 Chinook salmon per year since 2008. This fishery is unique as fishermen target McDonald Lake sockeye salmon with gillnets in saltwater in the mouth of the inlet, well away from the mouth of the stream.

Past Subsistence and Personal Use and Fishery Management Actions

The 2018 Unuk River king salmon action plan prohibited the retention of incidentally harvested Chinook salmon in the Yes Bay and Unuk River personal use fisheries.

MANAGEMENT ACTION PLAN OPTIONS FOR ADDRESSING STOCK OF CONCERN

ACTION PLAN GOAL

The goal of this plan is to rebuild Unuk and Chickamin River Chinook salmon runs to consistently achieve escapements within the respective BEG ranges and to consistently provide harvestable yield.

ACTION PLAN ALTERNATIVES

Draft action plans were presented to the Board of Fisheries at the March 2022 meeting in Anchorage. The draft plans contained different options for each of the fisheries: commercial, sport, personal use, and subsistence. The board chose the options for each fishery that were the least restrictive but gave the department direction to apply more restrictive measures where and/or when appropriate. The board also gave the department direction to relax measures where and/or when the department determined there was opportunity to do so. The following actions for each fishery were the least restrictive actions presented in the draft action plan in Record Comment 4.

ACTION #1—SPORT FISHERY

Background: Unuk River and Chickamin River Chinook salmon are harvested throughout the marine waters of SEAK, primarily in the Ketchikan area. Regionwide regulations for Chinook salmon in the marine sport fisheries in SEAK vary annually. Bag and possession limits and other management measures are set annually as directed by the *Southeast Alaska King Salmon Management Plan* according to the preseason regionwide Chinook salmon allowable catch as determined by the Chinook Technical Committee of the Pacific Salmon Commission.

The Division of Sport Fish used commissioner's EO authority to restrict time and area, reduce bag and possession limits and close areas to sport fishing in the Ketchikan management area from 2014 to 2021.

Specific Action: Continue to manage the sport fishery per the 2018 Unuk River king salmon action plan (Figure 12).

- **North and Northeast Behm Canal:** In Behm Canal and the contiguous bays enclosed to the north by a line from the western entrance of Bailey Bay to the northern tip of Hassler Island, and a line from Fin Point to Dress Point to a line from Cactus Point to Point Eva, January 1–December 31, closed to salmon fishing.
- **West Behm Canal:** In West Behm Canal and the contiguous bays enclosed to the north by a line from the western entrance of Bailey Bay to the northern tip of Hassler Island, and a line from Fin Point to Dress Point, and to the south by a line from Indian Point to Mike Point, April 1–August 14, no retention of king salmon.
- **Southeast Behm Canal and Southern Revillagigedo Channel:** In the waters of southern Revillagigedo Channel enclosed from a line from Lucky Point to Middy Point and enclosed by a line from Kah Shakes Point to Point Rosen including the waters of Boca de Quadra and continuing to Annette Island 3,000 foot boundary at the latitude of Beaver Point and in southeast Behm Canal from Cactus Point to Eva Point, April 1–August 14, no retention of king salmon.
- **Remaining waters of District 1:** In the marine waters of Ketchikan north and east from the International Boundary Line at Dixon Entrance from 54°42.48' N lat, 130°36.92' W long to 54°40' N lat, 131°45' W long, continuing north to Caamano Point and enclosed to the north by a line from Indian Point to Mike Point and to the southeast from Lucky Point to Middy Point, and enclosed by a line from Kah Shakes Point to Point Rosen and continuing to the Annette Island 3,000 foot boundary at the latitude of Beaver Point. April 1–August 14, the

bag and possession limit is one king salmon 28 in or greater in length for all anglers; nonresident annual limit of 3 king salmon or lower.

- **Herring Bay THA:** In the waters of Herring Bay west of a line from the southernmost entrance of Hole-In-The-Wall harbor to ADF&G markers located ½ mile north of Whitman Creek to the fresh/salt water boundary signs located at the mouth of Herring Cove Creek, June 1–July 31, the bag and possession limit is 6 king salmon, with no size limit or annual limit.
- **Neets Bay THA:** East of the longitude of the eastern most tip of Bug Island, June 15–August 14, the bag and possession limit is one king, 28 inches or greater in length for all anglers, annual limit of 3 king salmon or lower.

ACTION #2 –COMMERCIAL FISHERIES

Background: The approach taken by the department has been to reduce encounters during the late winter troll fishery with an early seasonal closure. This action shapes spring troll fisheries in a manner that reduces time and area in the immediate vicinity of the Unuk River and Chickamin River and other regional spring troll areas where CWT recoveries of Unuk and Chickamin River Chinook salmon have occurred. Management actions taken in the purse seine and drift gillnet fisheries have been limited to time and area restrictions in the Neets Bay THA, based on Unuk River Chinook salmon recoveries, and regional nonretention of Chinook salmon over 28 in in length in the purse seine fishery. Based on the most recent tag data available for Chickamin River Chinook salmon, the nonretention period in the purse seine fishery should be extended later in the season, due to the slightly later run timing of Chickamin River Chinook salmon compared to Unuk River Chinook salmon.

Specific Action: Continue to manage the commercial fisheries per the 2018 Unuk River king salmon action plan and include additional measure to reduce the commercial harvest rate of Chickamin River Chinook salmon.

1. Net Gear

- Close Neets Bay THA for 6 days during SWs 24–27. Additional actions taken include keeping the Neets Bay THA closed to all gear groups until June 15.
- Regional nonretention of Chinook salmon over 28 in in length for purse seine fisheries through at least SW 30 (specific to Chickamin River).

2. Troll Fisheries

- Continue to manage the troll fishery per the 2018 Unuk River king salmon action plan:
 - **Winter Troll:** Notwithstanding any remaining seasonal guideline harvest level, the winter troll fishery will be closed by EO in all waters of Southeast Alaska/Yakutat on March 15.
 - **Spring Troll:** Using EO authority, opportunities during May and June spring troll king salmon fisheries will be limited to THAs, waters in close proximity to hatchery facilities or release sites, and in areas that have been identified as having low proportional harvests of wild stock Southeast Alaska/Yakutat king salmon. Spring troll chum fisheries, as provided for in the *District 12 and District 14 Enhanced Chum Salmon Troll Fisheries Management Plan*, will begin June 15, with retention of king salmon prohibited.
 - **Summer Troll:**

- The first retention period for king salmon during the general summer troll fishery will open July 1 to target 70% of the remaining troll king salmon annual allocation, minus the number of treaty king salmon harvested in winter and spring troll fisheries.
- The second summer retention period for king salmon, occurring in August, would open by EO to target any remaining portion of the annual troll allocation following the first retention period.

CONDITIONS FOR REDUCING MANAGEMENT RESTRICTIONS OR DELISTING A STOCK OF CONCERN

1. If the lower bound of the BEG range is met or exceeded in 3 consecutive years or is met in 4 out of 6 consecutive years, the department may recommend removing the Unuk River and/or Chickamin River Chinook salmon stocks as a stock of “management concern” at the first Southeast and Yakutat board meeting after this condition is met.
2. Management measures could be relaxed in specific areas or during specific time periods if updated stock composition and harvest data indicates areas and/or times where and/or when restrictions are no longer needed to ensure the BEG is met.
3. In the event the upper bound of the BEG range is exceeded in 2 consecutive years, management restrictions may be relaxed or set aside.

Stock status, action plan performance (including information on harvest rate, distribution, and timing in commercial fisheries), and escapement goal review will be updated in a report to the board at the 2025 Southeast and Yakutat meeting.

RESEARCH PLAN

PAST AND CURRENT RESEARCH PROJECTS FOR THE UNUK AND CHICKAMIN RIVERS

The department has conducted extensive Chinook salmon research and monitoring projects on the Unuk River, beginning with juvenile tagging studies implemented in 1982. These efforts continued through 1986, and then again from 1992 to present. The Unuk River Chinook salmon stock is included as an escapement and exploitation rate indicator stock of the PSC Chinook Technical Committee. PST obligations include producing the full suite of stock assessment data for Unuk River Chinook salmon: smolt production, overwinter and marine survival, harvest (calendar year) and exploitation (brood year) rates, and estimates of escapement, as well as the age-sex-length composition of those escapements. The following research programs have been and are being conducted to gather detailed information about Unuk River Chinook salmon:

1. The Unuk River stock of Chinook salmon is part of the coastwide Chinook salmon genetic baseline (Shedd et al. 2021); however, identifying wild Unuk River Chinook salmon is complicated because these fish are used as brood stock for hatchery releases in SEAK. In addition, the Unuk River Chinook salmon cannot be distinguished from other SEAK wild stocks at this time. Bolstering the genetic baseline and conducting additional analyses would be necessary to inform these questions.
2. Standardized aerial and foot escapement surveys have been conducted annually since the 1970s (Richards and Frost 2017).

3. Mark–recapture studies to estimate total escapement of Unuk River Chinook salmon (Johnson 2013).
4. Age, sex, and length composition, CWT, and escapement sampling are conducted annually (Richards and Frost 2017).
5. Marine harvest sampling of commercial and sport fisheries is conducted by the department annually throughout SEAK. These programs include CWT and genetic sampling and various studies designed to estimate catch, harvest, and fishing effort and biological parameters such as age, sex, and size (Jaenicke et al. 2015; Buettner et al. 2017).

The department has conducted extensive Chinook salmon research and monitoring projects on the Chickamin River, beginning with juvenile tagging efforts implemented in 1983. These efforts were continued annually through 1988, and then again from 2001 to 2008. Standardized aerial surveys have been conducted annually since 1975. The Chickamin River Chinook salmon stock was included as an escapement indicator stock of the PSC Chinook Technical Committee from 1999 to 2018; however, it was removed as an indicator stock prior to the current Treaty annex period. Current stock assessment data includes estimates of escapement as well as the age, sex, and length compositions of those escapements. The following research programs have been or are being conducted to gather detailed information about Chickamin River Chinook salmon:

1. The Chickamin River stock is part of the coastwide Chinook salmon genetic baseline (Shedd et al. 2021); however, identifying wild Chickamin River Chinook salmon is convoluted because these fish are used as brood stock for hatchery releases in SEAK. In addition, Chickamin River Chinook salmon cannot be distinguished from other SEAK wild stocks at this time. Bolstering the genetic baseline and conducting additional analyses would be necessary to inform these questions.
2. Standardized aerial and foot escapement surveys have been conducted annually since the 1970s (Richards and Frost 2017).
3. Mark–recapture studies to estimate total escapement were conducted in 1996, and from 2001 to 2005 (Weller et al. 2007).
4. Age, sex, and length composition and escapement sampling are conducted annually (Richards and Frost 2017).
5. Marine harvest sampling of commercial and sport fisheries is conducted by the department annually throughout SEAK. These programs include CWT and genetic sampling and various studies designed to estimate catch, harvest, and fishing effort and biological parameters such as age, sex, and size (Jaenicke et al. 2015; Buettner et al. 2017). This sampling continues to occur, though Chickamin River Chinook salmon juveniles are no longer tagged.

REFERENCES CITED

- ADFG (Alaska Department of Fish and Game). 2013. Chinook salmon stock assessment and research plan. Alaska Department of Fish and Game Special Publication No. 13-01. Anchorage, AK
- Buettner, A. R., A. M. Reynolds, and J. R. Rice. 2017. Operational Plan: Southeast Alaska and Yakutat salmon commercial port sampling 2016–2019. Alaska Department of Fish and Game, Regional Operational Plan ROP.CF.1J.2017.01, Douglas.
- Der Hovanisian, J., S. McPherson, E. Jones, P. Richards, R. Chapell, B. Elliott, T. Johnson, and S. Fleischman. 2011. Chinook salmon status and escapement goals for stocks in Southeast Alaska. Alaska Department of Fish and Game, Special Publication No. 11-19, Anchorage.
- Fried, S. M. 1994. Pacific salmon spawning escapement goals for Prince William Sound, Cook Inlet, and Bristol Bay areas of Alaska. Alaska Department of Fish and Game, Commercial Fisheries Management and Development Division, Special Publication No. 8, Juneau.
- Frost, N., Jones, E., Richards, P., Peterson, R., and Johnson, T. *In prep.* Production of Chickamin River Chinook salmon from the 2000–2005 broods, escapement from 2009–2012. Alaska Department of Fish and Game, Fishery Data Series, Anchorage.
- Heinl, S. C., E. L. Jones III, A. W. Piston, P. J. Richards, and L. D. Shaul. 2014. Review of salmon escapement goals in Southeast Alaska, 2014. Alaska Department of Fish and Game, Fishery Manuscript Series No. 14-07, Anchorage.
- Heinl, S. C., E. L. Jones III, A. W. Piston, P. J. Richards, L. D. Shaul, B. W. Elliott, S. E. Miller, R. E. Brenner, and J. V. Nichols. 2017. Review of salmon escapement goals in Southeast Alaska, 2017. Alaska Department of Fish and Game, Fishery Manuscript Series No. 17-11, Anchorage.
- Heinl, S. C., E. L. Jones III, A. W. Piston, P. J. Richards, J. T. Priest, J. A. Bednarski, B. W. Elliott, S. E. Miller, R. E. Brenner, and J. V. Nichols. 2021. Review of salmon escapement goals in Southeast Alaska, 2020. Alaska Department of Fish and Game, Fishery Manuscript Series No. 21-03, Anchorage.
- Hendrich, C. F., J. L. Weller, S. A. McPherson, D. R. Bernard. 2008. Optimal production of Chinook salmon from the Unuk River. Alaska Department of Fish and Game, Fishery Manuscript No. 08-03, Anchorage.
- Jaenicke, M. J., D. Tersteeg, and S. J. H. Power. 2015. Southeast Alaska marine boat sport fishery harvest studies, 2015–2016. Alaska Department of Fish and Game, Regional Operational Plan SF.1J.2015.06, Anchorage.
- Jaenicke, M., D. Tersteeg, and S. J. H. Power. 2017. Operational Plan Amendment: Southeast Alaska marine boat sport fishery harvest studies, 2015–2017. Alaska Department of Fish and Game, Regional Operational Plan SF.1J.2017.02, Anchorage.
- Johnson, T. A. 2013. A mark-recapture experiment to estimate the escapement of Chinook salmon in the Unuk River, 2013. Alaska Department of Fish and Game, Regional Operational Plan No. SF.1J.2013.09, Anchorage.
- McPherson, S. A., and J. Carlile. 1997. Spawner-recruit analysis of Behm Canal Chinook salmon stocks. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report IJ97-06, Juneau.
- Lum, J. L., and L. Fair. 2018. Unuk River king salmon stock status and action plan, 2018. Alaska Department of Fish and Game, Regional Information Report No. 1J18-04, Douglas.
- Nichols, J. K. Schroder, B. Frenette, J. Williams, A. Crupi, and K. Smikrud. 2013. A user guide for performing stream habitat surveys in Southeast Alaska. Alaska Department of Fish and Game, Special Publication No. 13-04, Anchorage.
- Pahlke, K. A. 1997. Abundance and distribution of the Chinook salmon escapement on the Chickamin River, 1996. Alaska Department of Fish and Game, Fishery Data Series No. 97-28, Anchorage.
- Pahlke, K. A. 1998. Escapements of Chinook salmon in Southeast Alaska and transboundary rivers in 1997. Alaska Department of Fish and Game, Fishery Data Series No. 98-33, Anchorage.
- Richards, P., and N. Frost. 2017. Production and harvest of Unuk River Chinook salmon, 2017–2018. Alaska Department of Fish and Game, Regional Operational Plan No. ROP.SF.1J.2017.05, Anchorage.

REFERENCES CITED (Continued)

- Shedd, K. R., D. F. Evenson, and J. V. Nichols. 2021. Mixed stock analysis of Chinook salmon harvested in Southeast Alaska commercial troll and sport fisheries, 2017. Alaska Department of Fish and Game, Fishery Data Series No. 21-02, Anchorage.
- USFS Southeast Alaska Drainage Basin (SEAKDB). 2019. <https://hub.arcgis.com/datasets/seakgis::usfs-southeast-alaska-drainage-basin-seakdb-watersheds> [Accessed 12/21/20].
- Weller J. L., D. J. Reed, and G. M. Freeman. 2007. Spawning abundance of Chinook salmon in the Chickamin River in 2005. Alaska Department of Fish and Game, Fishery Data Series No. 07-63, Anchorage.
- Weller, J. L., and D. G. Evans. 2012. Production of Unuk River Chinook salmon through 2009 from the 1992–2006 broods. Alaska Department of Fish and Game, Fishery Data Series No. 12-85, Anchorage.

TABLES AND FIGURES

Table 1.—Unuk River large Chinook salmon escapement and harvest rate estimates of \geq age-1.2 fish, 2011–2020.

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	5-year Average	10-year Average
Escapement ^a	3,195	956	1,135	1,691	2,623	1,463	1,203	1,971	3,115	1,135	1,777	1,849
Harvest	1,867	2,548	1,826	1,423	3,605	1,376	511	845	664	560	791	1,523
Total Run	5,062	3,504	2,961	3,114	6,228	2,839	1,714	2,816	3,779	1,695	2,569	3,371
<u>Harvest Rate</u>												
Troll Winter	0.02	0.33	0.01	0.04	0.01	0.07	0.11	0.00	0.01	0.01	0.04	0.06
Troll Spring	0.16	0.10	0.17	0.19	0.20	0.14	0.10	0.03	0.06	0.02	0.07	0.12
Troll Summer R1 ^b	0.01	0.02	0.01	0.04	0.05	0.02	0.00	0.04	0.01	0.03	0.02	0.02
Troll Summer R2 ^b	0.01	0.01	0.13	0.00	0.04	0.00	0.05	0.00	0.01	0.00	0.01	0.03
Troll All	0.20	0.47	0.31	0.27	0.31	0.23	0.26	0.08	0.08	0.07	0.14	0.23
Sport Early ^c	0.11	0.13	0.18	0.06	0.05	0.06	0.00	0.02	0.04	0.13	0.05	0.08
Sport Late ^c	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sport All	0.13	0.13	0.18	0.06	0.05	0.06	0.00	0.02	0.04	0.13	0.05	0.08
Net All	0.03	0.13	0.13	0.13	0.22	0.19	0.04	0.20	0.05	0.14	0.12	0.13
U.S. All	0.36	0.73	0.62	0.46	0.58	0.48	0.30	0.30	0.18	0.33	0.32	0.43
Canada All	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	0.37	0.73	0.62	0.46	0.58	0.48	0.30	0.30	0.18	0.33	0.32	0.43

^a The BEG range for the Unuk River is 1,800 to 3,800 large (\geq 660 MEF) Chinook salmon. Gray cells in this row indicate escapements that were below the lower bound of the BEG.

^b Troll Summer R1 (retention period 1) occurs in July of the current year; Troll Summer R2 (retention period 2) occurs from August through September of the prior year.

^c Sport Early period occurs April through July of the current year; Sport Late period occurs in August of the prior year.

Table 2.—Escapement of large Chinook salmon in the Chickamin River, 2011–2020.

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	5-year Average	10-year Average
Escapement ^a	4,052	2,109	2,223	3,097	2,760	964	722	2,052	1,610	2,280	1,526	2,187

^a The BEG range for Chickamin River Chinook salmon is 2,150 to 4,300 large (≥ 660 MEF) Chinook salmon. Gray cells in this row indicate escapements that were below the lower bound of the BEG.

Table 3.—Chickamin River large Chinook salmon escapement and harvest rate estimates by gear group of \geq age-1.2 fish, 2006–2009. These are the only return years from the 2000–2005 broods that are complete for calendar year harvest rate analysis.

	2006	2007	2008	2009	2006–2009 Average
Escapement ^a	6,318	4,242	5,277	2,902	4,685
Harvest	3,730	3,103	1,147	2,886	2,717
Total Run	10,048	7,345	6,424	5,788	7,401
<u>Harvest Rate</u>					
Troll Winter	0.05	0.06	0.04	0.04	0.05
Troll Spring	0.05	0.07	0.05	0.03	0.05
Troll Summer R1 ^b	0.03	0.05	0.05	0.10	0.06
Troll Summer R2 ^b	0.05	0.05	0.00	0.01	0.03
Troll All	0.18	0.22	0.14	0.18	0.18
Sport Early ^c	0.10	0.17	0.00	0.21	0.12
Sport Late ^c	0.01	0.01	0.00	0.00	0.005
Sport All	0.11	0.18	0.00	0.21	0.12
Net All	0.05	0.01	0.03	0.11	0.05
U.S. All	0.34	0.41	0.17	0.49	0.35
Canada All	0.03	0.01	0.01	0.01	0.02
Total	0.37	0.42	0.18	0.50	0.37

^a The BEG range for the Chickamin River is 2,150 to 4,300 large (\geq 660 MEF) Chinook salmon.

^b Troll Summer R1 (retention period 1) occurs in July of the current year; Troll Summer R2 (retention period 2) occurs from August through September of the prior year.

^c Sport Early period occurs April through July of the current year; Sport Late period occurs in August of the prior year.

Note: Harvest rates reported in Frost et al. (*In prep*) differ from harvest rates presented here as Frost et al. (*In prep*) reports harvest rates calculated using escapement of \geq age-1.2 fish whereas this table reports harvest rates calculated using escapement by the large size class.

Table 4.—Unuk and Chickamin River Chinook salmon calendar year harvest rate estimates of (\geq age-1.2) fish, 2006–2009. These are the only return years from the 2000–2005 Chickamin broods that are complete for calendar year harvest rate comparison analysis between the Unuk and Chickamin Rivers.

	2006	2007	2008	2009	2006–2009 Average
Unuk River	0.35	0.29	0.21	0.26	0.28
Chickamin River	0.37	0.42	0.18	0.50	0.37

Note: Harvest rates reported in Frost et al. (*In prep*) differ from harvest rates presented here as Frost et al. (*In prep*) reports harvest rates calculated using escapement of \geq age-1.2 fish whereas this table reports harvest rates calculated using escapement by the large size class.

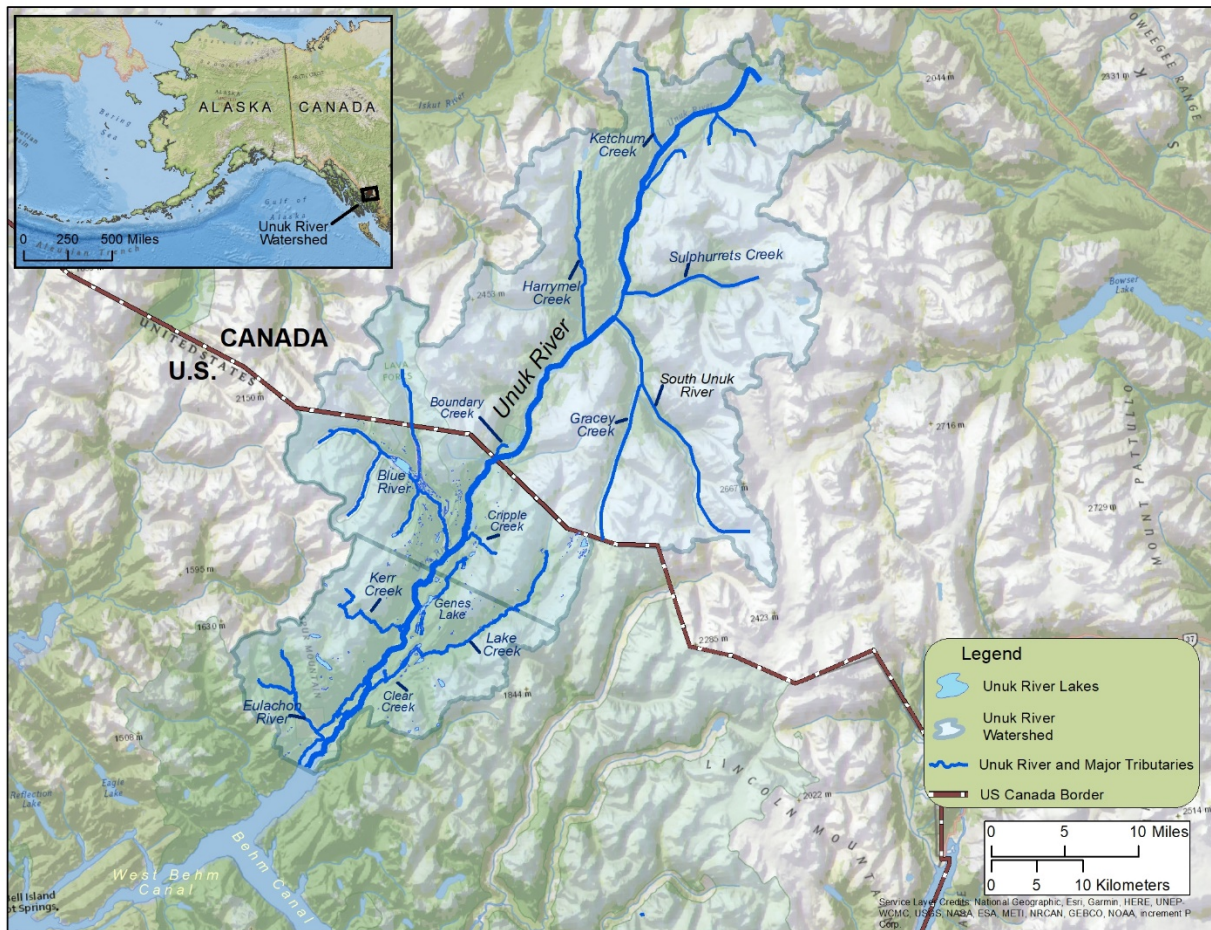


Figure 1.—Map of the Unuk River watershed showing primary Chinook salmon spawning tributaries in the Alaska portion of the watershed.

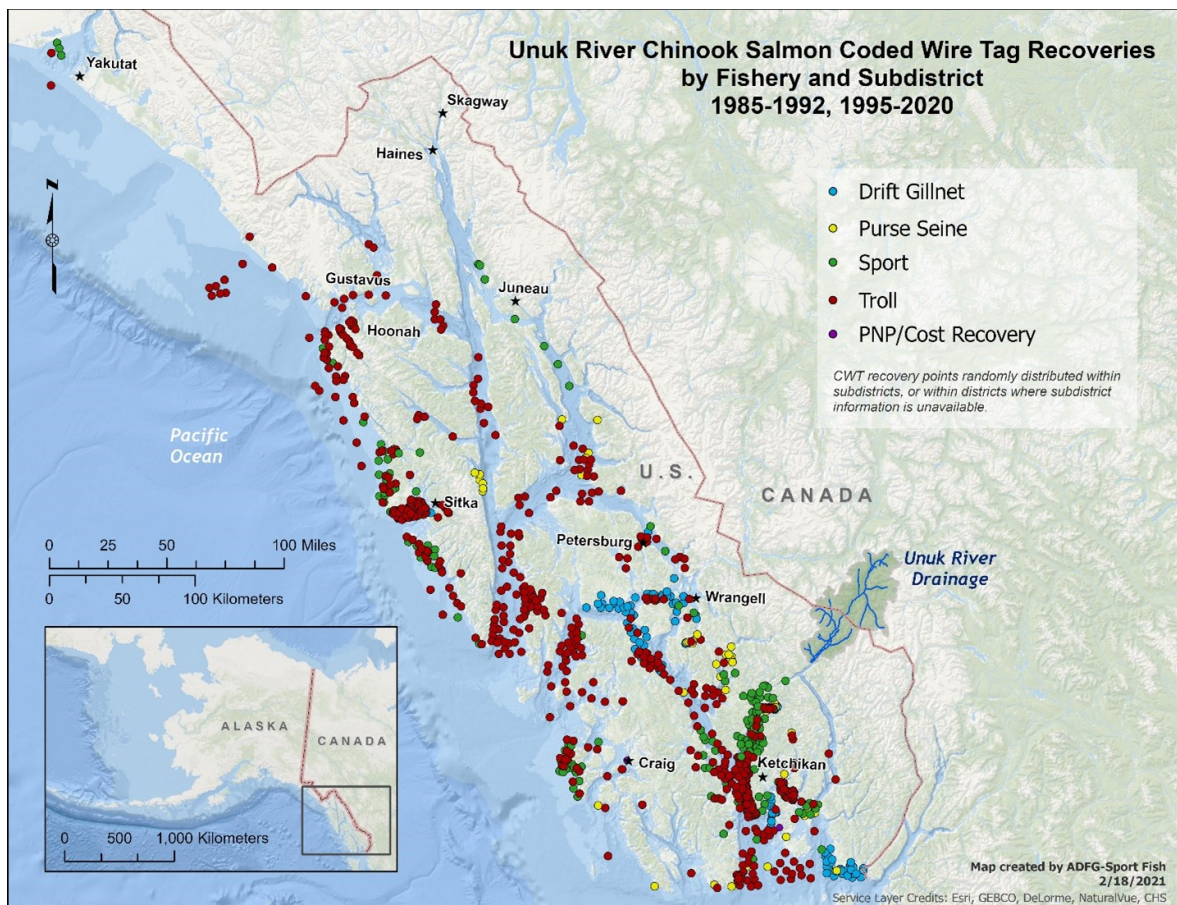


Figure 2.—Map of Unuk River Chinook salmon coded wire tag recoveries in SEAK fisheries from 1985 to 1992 and 1995 to 2020.

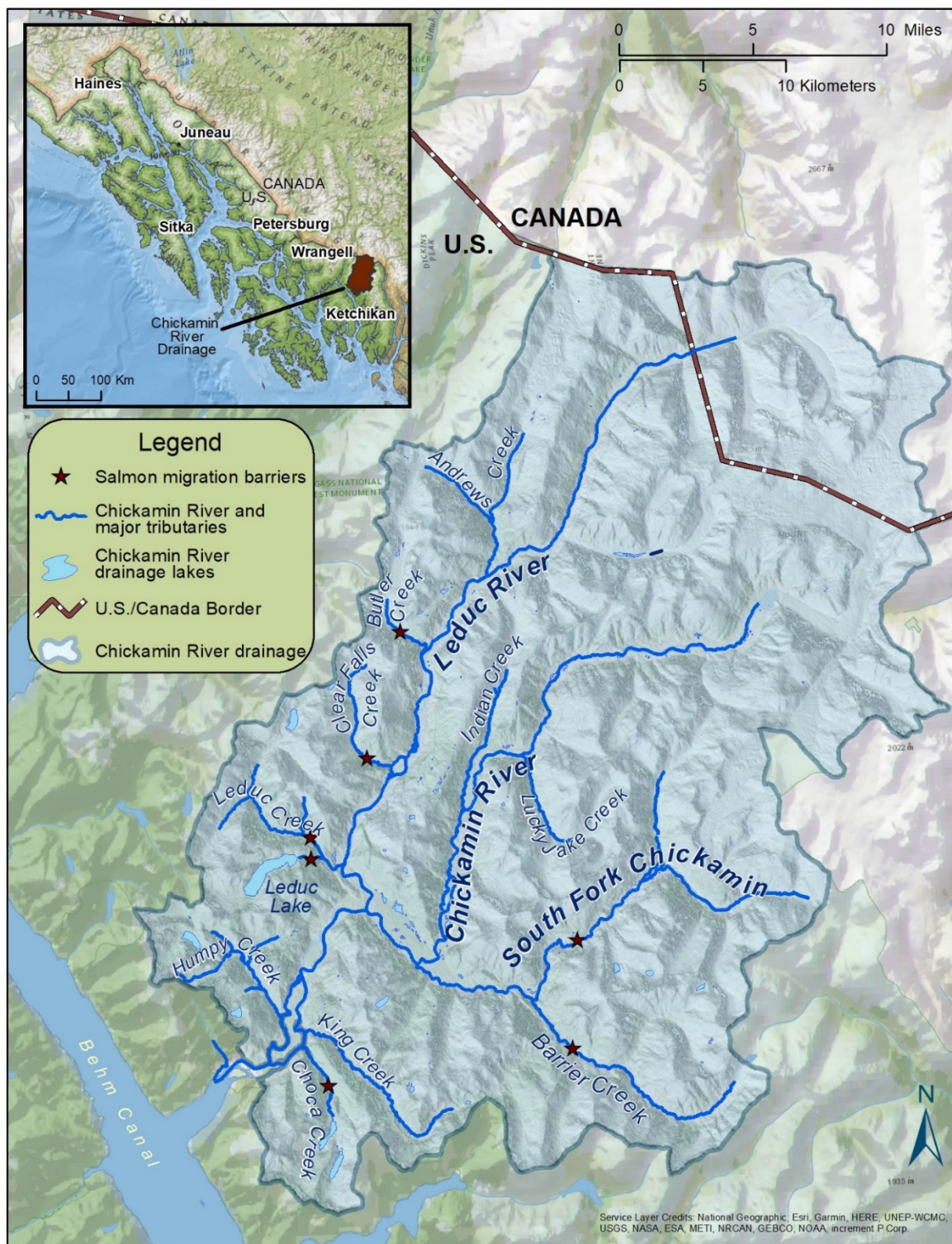


Figure 3.—Map of Chickamin River watershed showing location of major tributaries and barriers to fish migration.

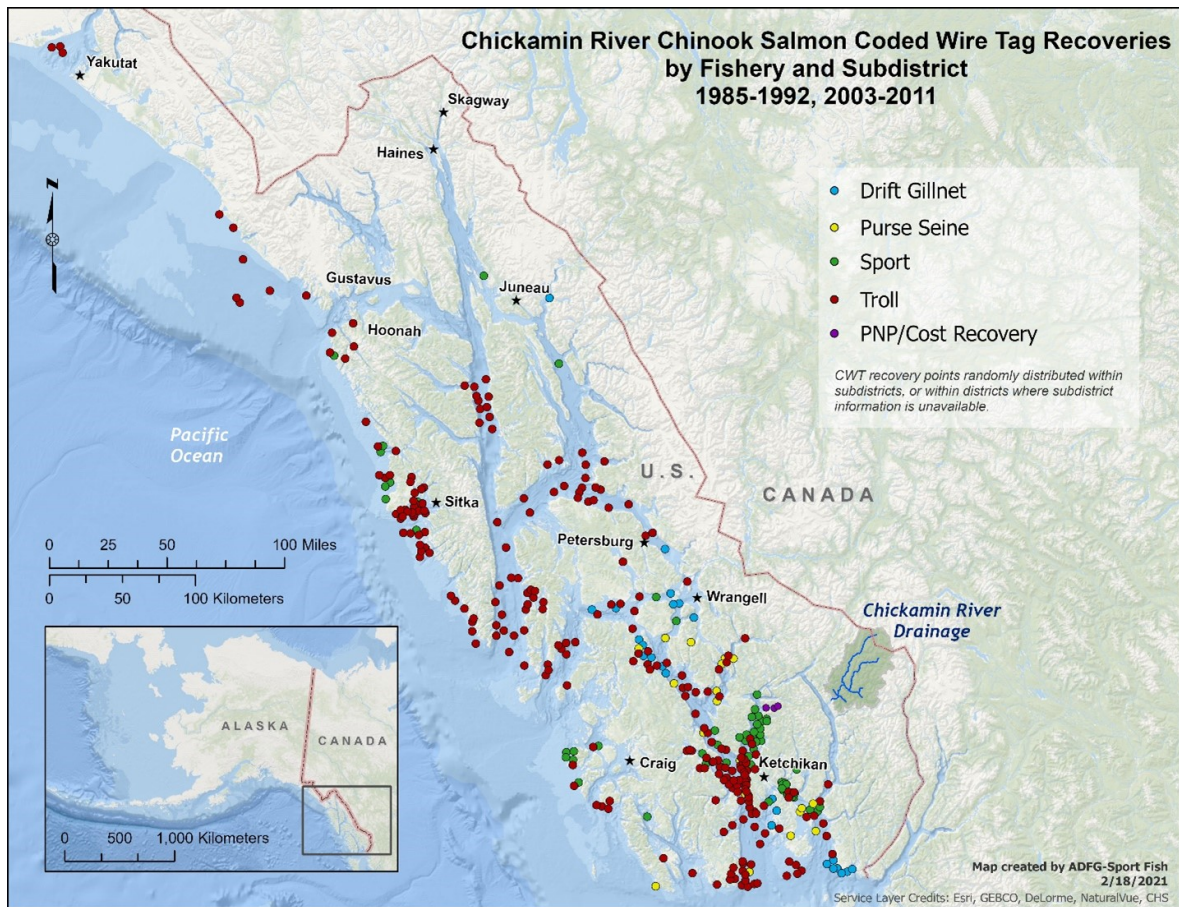


Figure 4.—Map of Chickamin River Chinook salmon coded-wire tag recoveries in SEAK fisheries from 1985 to 1992 and 2003 to 2011.

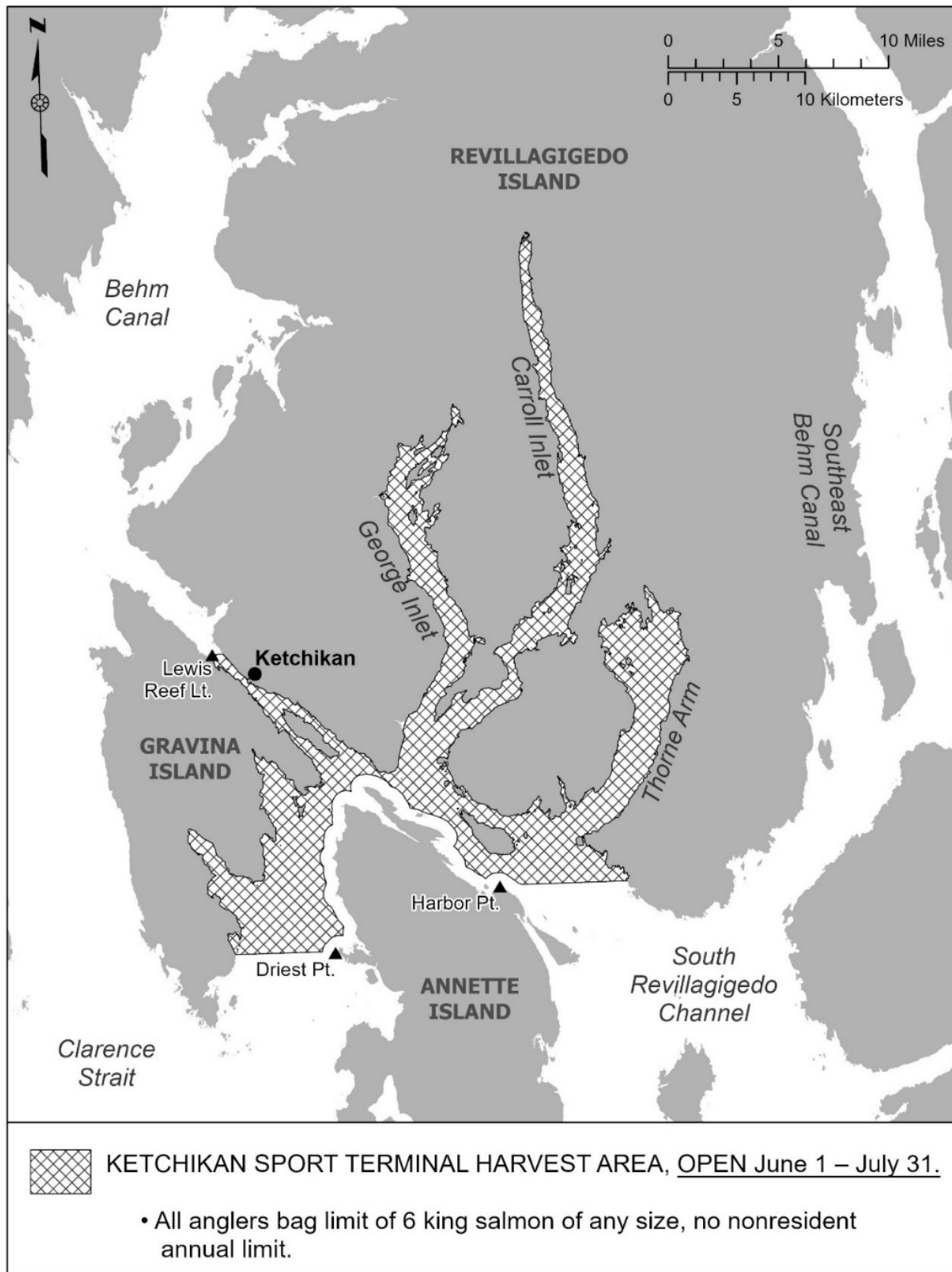


Figure 5—Map of the Ketchikan Sport Terminal Harvest Area. Beginning in 2014, regionwide regulations applied through June and liberalization of bag and size limits were postponed until July 1.

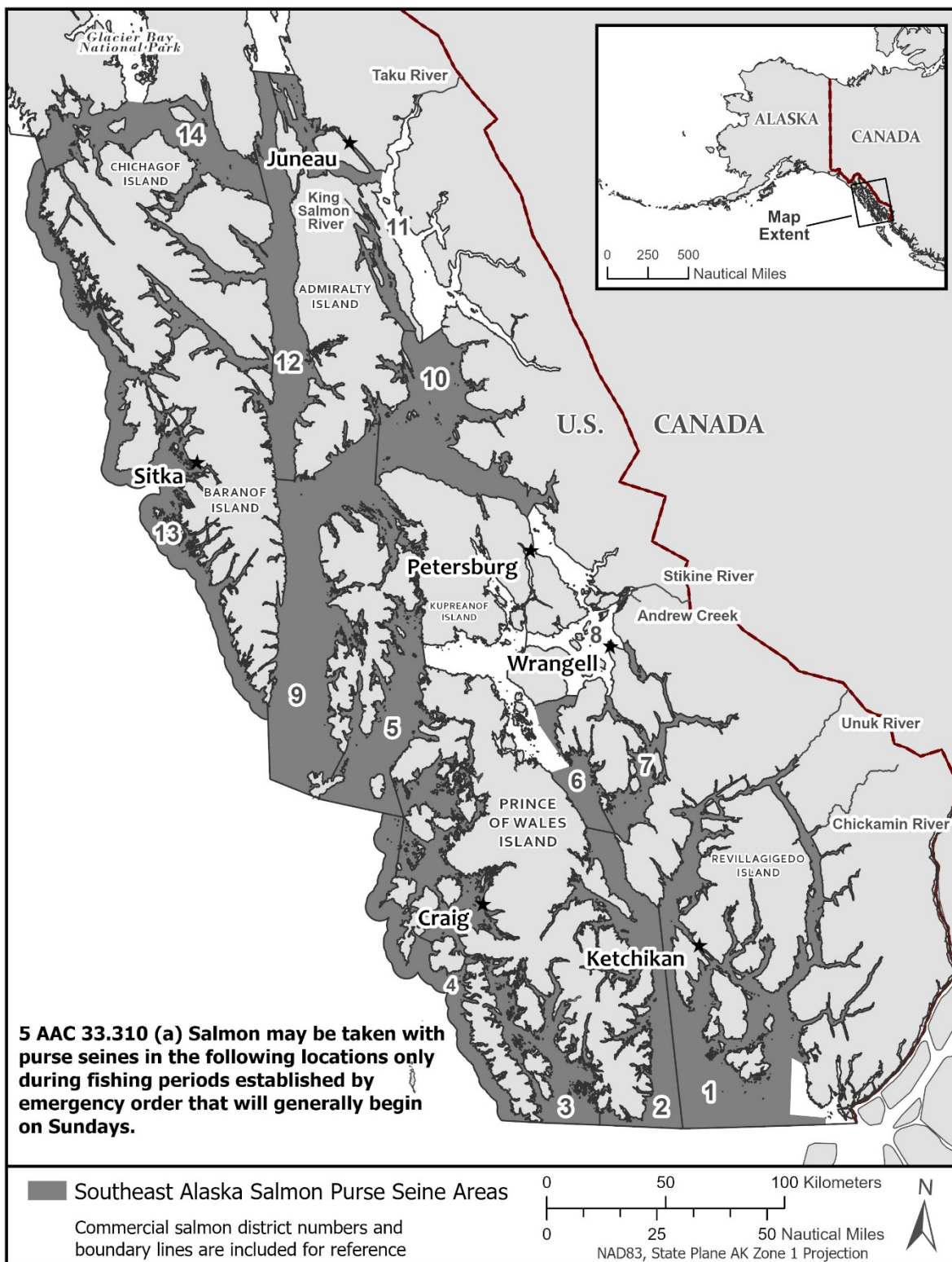


Figure 6.—Map of Southeast Alaska commercial purse seine fishing areas.

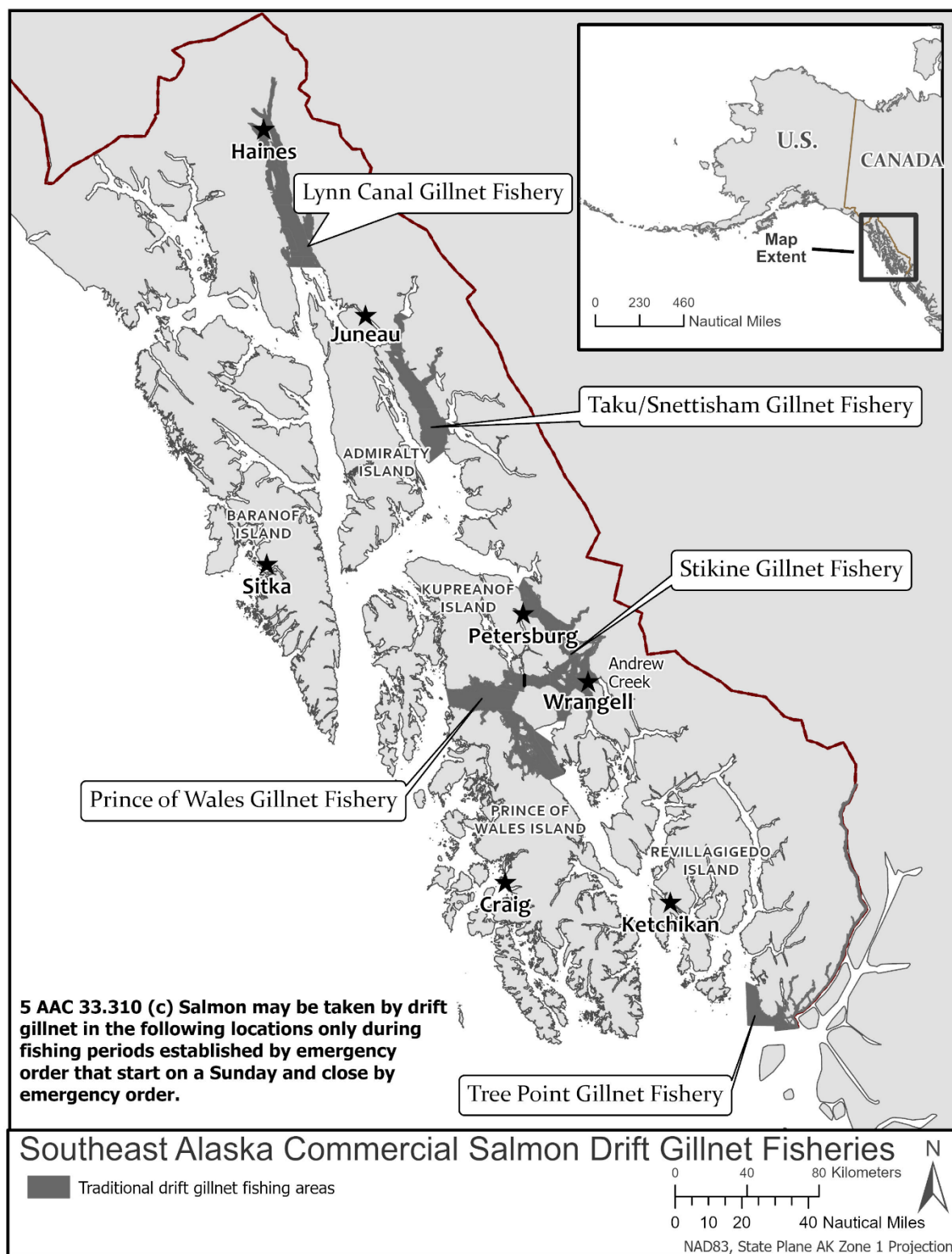


Figure 7.—Map of traditional commercial drift gillnet fishing areas in Southeast Alaska.

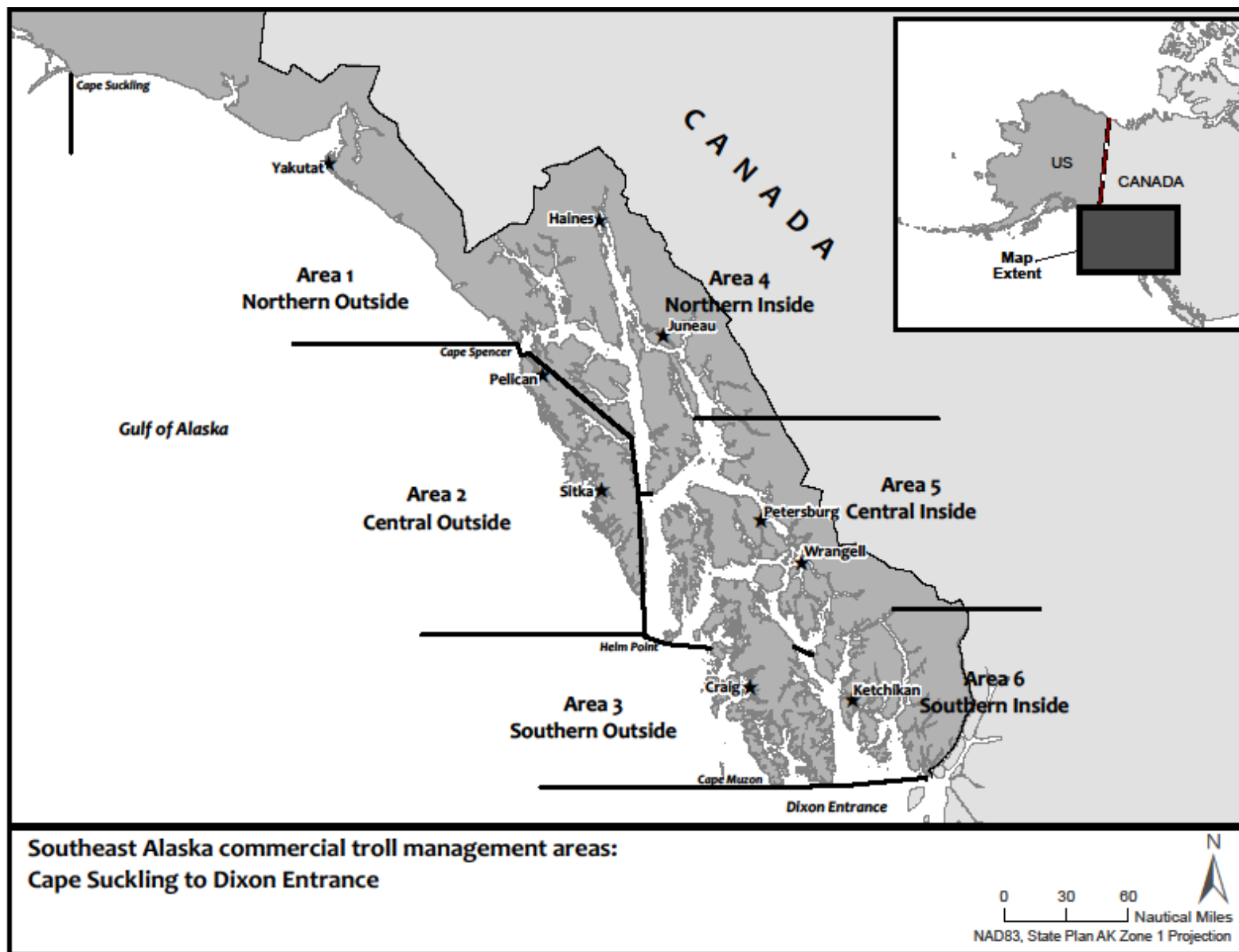


Figure 8.—Map of Southeast Alaska commercial troll fishing and Big Six management areas, Cape Suckling to Dixon Entrance.

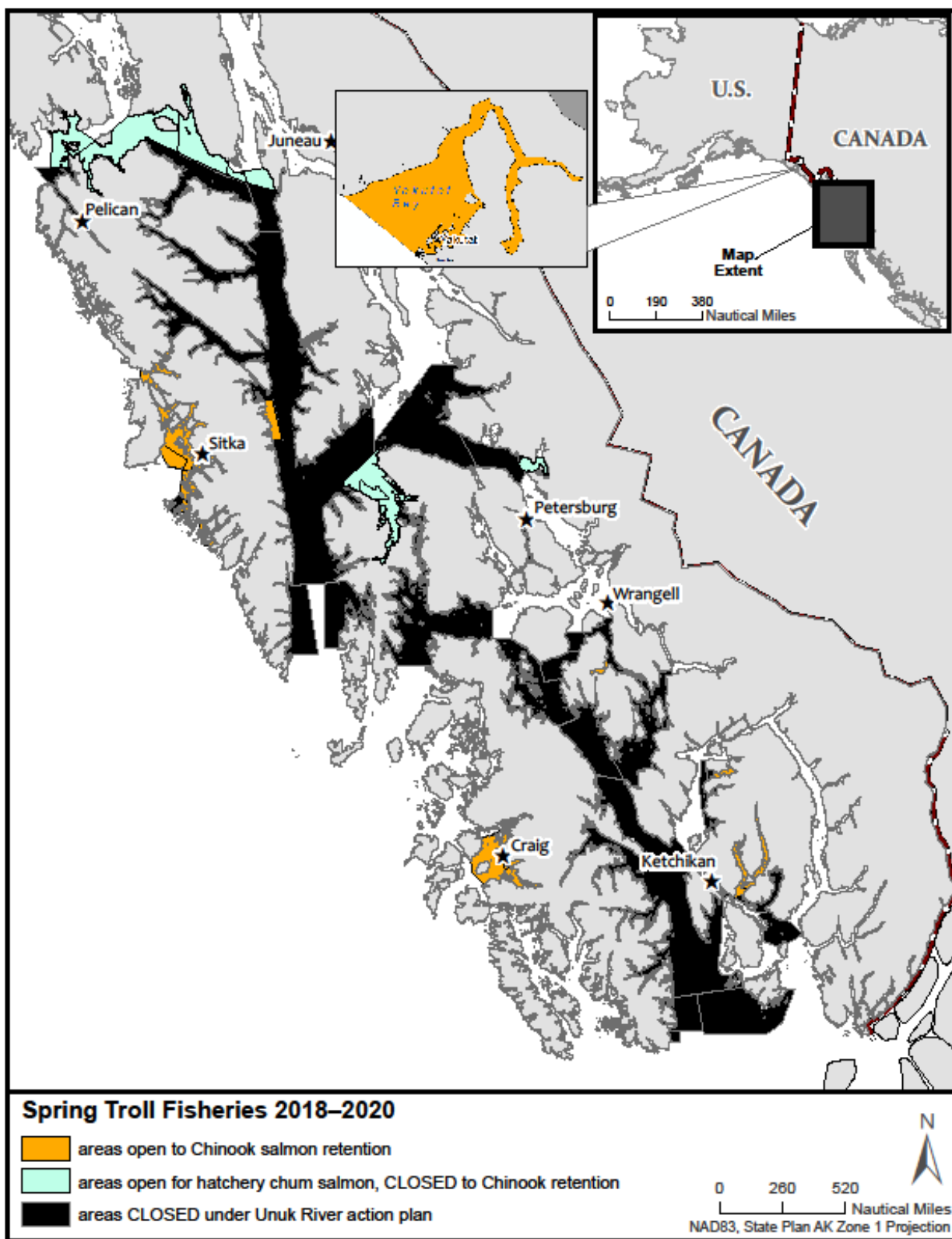


Figure 9.—Map of spring commercial troll fishing areas in Southeast Alaska.

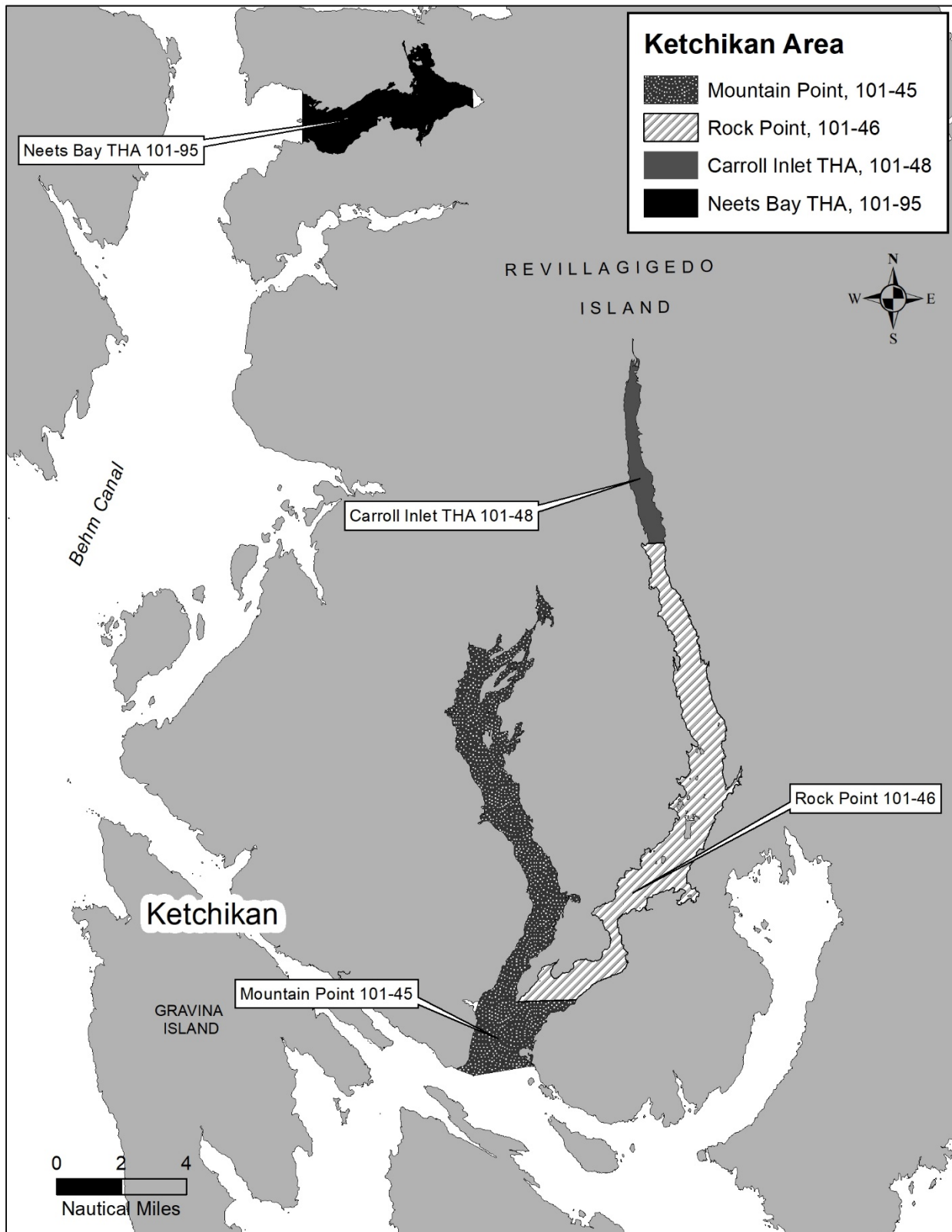


Figure 10.—Map of spring troll and Terminal Harvest Area (THA) fisheries in Ketchikan vicinity.

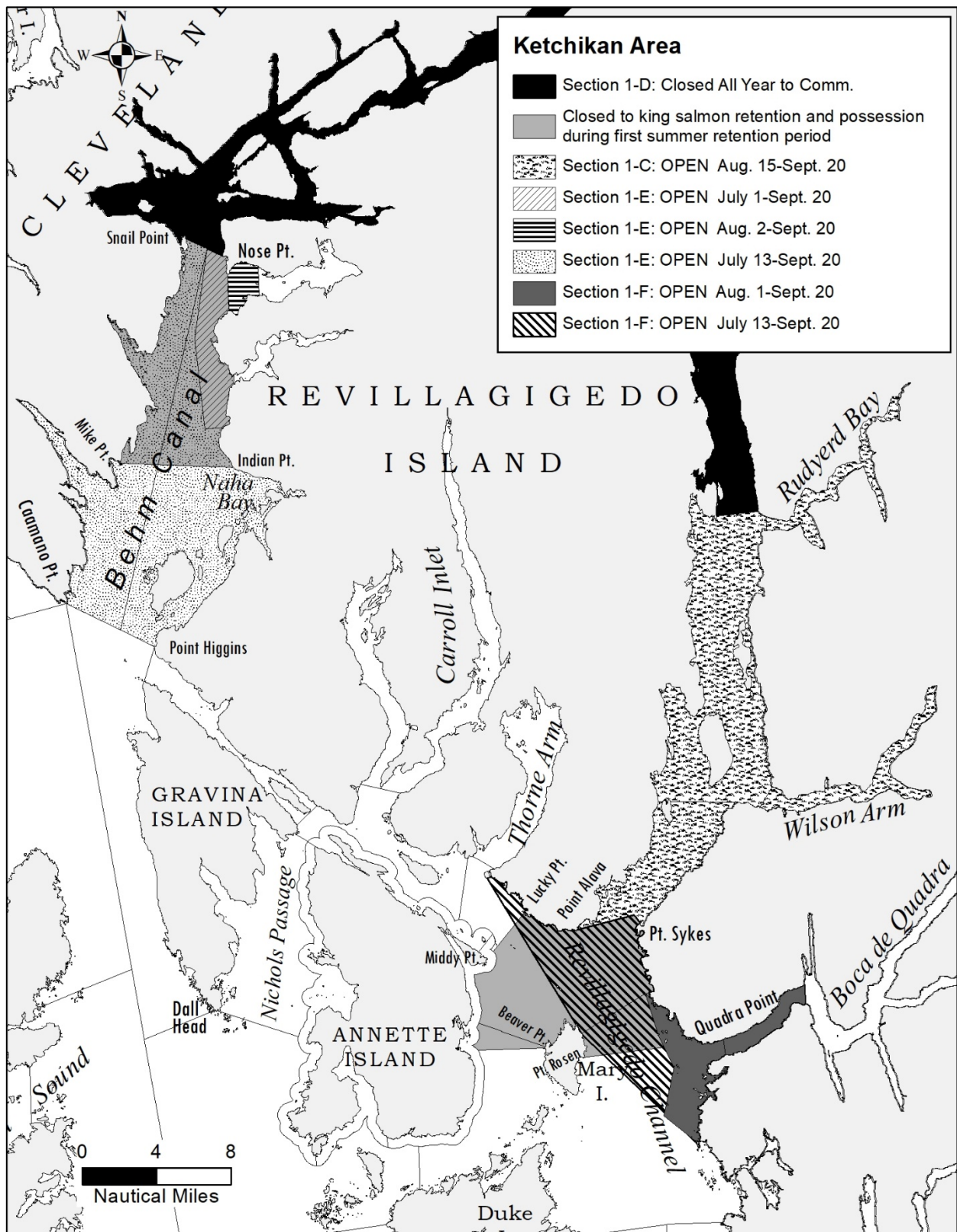


Figure 11.—Map of Ketchikan area troll restrictions during the summer troll fishery, July 1–Sept 20.

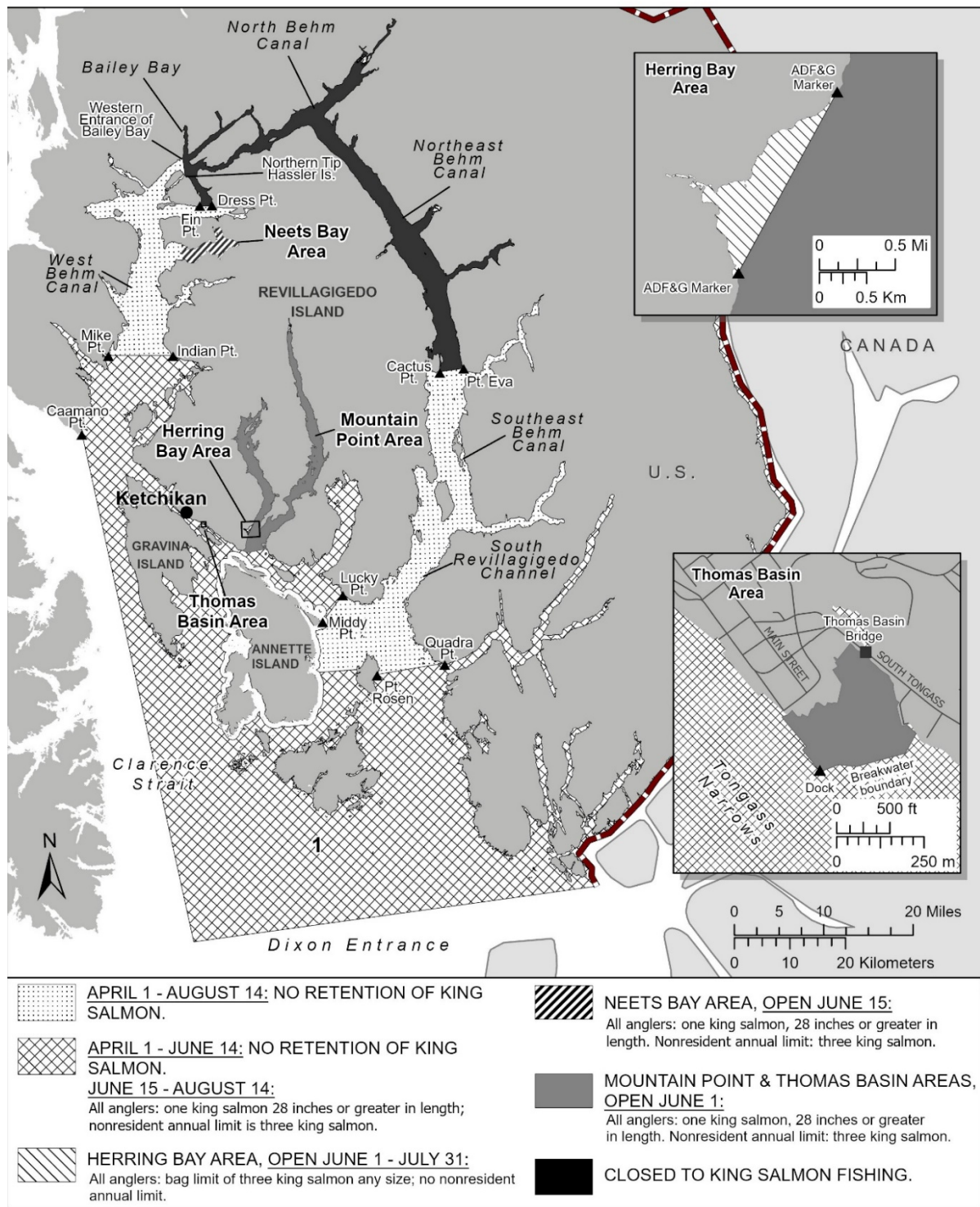


Figure 12.—Map depicting the sport fishery regulations implemented by EO per the 2018 Unuk River king salmon action plan. In addition to the action plan measures, king salmon nonretention was implemented in District 1 through June 14, except in hatchery access areas.