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Chinook Salmon Genetic Sampling Along the Alaska Peninsula and Adjacent Areas Results, 2012–2014

by

Mark J. Witteveen

and

Kyle R. Shedd

July 2016

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

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Weights and measures (metric)

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

Weights and measures (English)

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

Time and temperature

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

Physics and chemistry

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

General

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

Mathematics, statistics

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

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by
Mark J. Witteveen
Alaska Department of Fish and Game, Division of Commercial Fisheries, Kodiak

And

Kyle Shedd
Alaska Department of Fish and Game, Division of Commercial Fisheries, Anchorage

Alaska Department of Fish and Game
Division of Sport Fish, Research and Technical Services
333 Raspberry Road, Anchorage, Alaska, 99518-1565

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Mark J. Witteveen
Alaska Department of Fish and Game, Division of Commercial Fisheries,
351 Research Court, Kodiak, AK 99615

and

Kyle Shedd
Alaska Department of Fish and Game, Division of Commercial Fisheries
333 Raspberry Road, Anchorage AK 99518-1565, USA

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ABSTRACT

Recent low runs of Chinook salmon *Oncorhynchus tshawytscha* in Alaska have resulted in an increased interest in developing a more comprehensive genetic baseline throughout the state. An updated genetic baseline will allow for additional spatial resolution when examination of potential impacts of fisheries on Chinook salmon stocks using mixed stock analysis. These sampling efforts resulted in surveys of 33 areas, 27 of which resulted in new Chinook salmon collections, with 15 of those with sufficient samples (>70 individuals) to add representation to the genetic baseline. This work increased the Alaska Department of Fish and Game's knowledge regarding the abundance and distribution of Chinook salmon on the Alaska Peninsula and Kodiak Island.

Key words: Chinook salmon, genetic baseline, Chignik, Alaska Peninsula, Kodiak, sampling, single nucleotide polymorphism, SNP, parental based tagging, mixed stock analysis, MSA

INTRODUCTION

In recent years, Chinook salmon *Oncorhynchus tshawytscha* runs in Alaska have been lower than in the past, causing widespread concern and increased interest in determining the causal factors for the decline. One important tool for examining potential impacts of fisheries on Chinook salmon is mixed stock analysis (MSA) using genetic data. An essential component of MSA is a comprehensive genetic baseline. There are several stocks in the Westward Region that do not have good representation in the genetic baseline, specifically on the north Alaska Peninsula. Previous analysis of baseline samples from the north Alaska Peninsula has indicated that Chinook salmon from this region are 1) genetically distinct from other regions and 2) have a high degree of genetic diversity among populations within the north Alaska Peninsula (Templin et al. 2011). Several stocks on the north side of the Alaska Peninsula have been historically observed during aerial surveys but are not represented in the genetic baseline. These stocks occur in remote locations and are generally small in size and difficult to access. While these stocks may not be large in magnitude, it is important to represent all stocks that may be present in commercial fisheries in this region of high genetic diversity to help determine the causal factors for Chinook salmon declines.

A larger than expected percentage (14–27%) of Chinook salmon caught incidentally in the 2005–2010 Bering Sea pollock fishery were genetically identified as being of north Alaska Peninsula origin (NMFS 2009; Guyon et al. 2010a, 2010b; Guthrie et al. 2012). Since the number of Chinook salmon caught in pollock fishery can be quite large (10,000 to 122,000 annually during 2003–2012; NMFS 2009), the estimated contribution of Chinook salmon of north Alaska Peninsula origin suggests 3 possible explanations: 1) the estimated contribution of north Alaska Peninsula fish to the Bering Sea pollock fishery is biased high because Chinook salmon from adjacent areas are genetically similar, 2) these stocks are more vulnerable than other stocks to bycatch in the Bering Sea pollock fishery, or 3) the putatively small population size of north Alaska Peninsula fish is due to underestimated run sizes or productivity.

Most known stocks in the Kodiak Management Area and the Chignik Management Area have been adequately sampled. There are no known stocks of Chinook salmon on the south side of the Alaska Peninsula other than the Chignik River. The purpose of this project was to obtain additional samples of known Chinook salmon stocks to expand the genetic baseline and to investigate the existence of additional stocks that are not currently known by the Alaska Department of Fish and Game (ADF&G). Prior to 2012, the majority of the Chinook salmon genetic baseline was from the Kodiak area (Table 1).

Pillar Creek Hatchery in Kodiak initially used broodstock from Karluk River to initiate introduced runs at Monashka Creek, American River, and Olds River on the Kodiak road system. In recent years, broodstock has been collected from the 3 introduced runs, and each system is subsequently stocked annually with fry that are raised in the hatchery. The access to hatchery broodstock and/or progeny samples provides an opportunity to assess the potential for parental-based tagging (Anderson and Garza 2006) of the hatchery production in tandem with traditional MSA. Parental-based tagging would allow for the identification of hatchery offspring in all fisheries where Pillar Creek Chinook salmon may be harvested as each progeny is putatively tagged when all parental pairs are genotyped. The potential for this application depends on the ability of single nucleotide polymorphisms (SNP) sets to identify offspring based upon parental genotypes and known mating pairs. The Gene Conservation Laboratory (GCL) is currently investigating a large suite of SNPs for such applications.

Funding to improve the Chinook salmon genetic baseline was approved by the Alaska Legislature in May of 2012, and field operations occurred during the summers of 2012 through 2014.

METHODS

DATA REVIEW

All known sources of information were reviewed including existing literature, the Alaska Department of Fish and Game aerial survey database, Anadromous Waters Catalog, commercial harvests, lodge owners, and colleagues that have worked in the Alaska Peninsula area. The purpose of this data review was to determine both known Chinook salmon distribution and locations in which Chinook salmon were likely to be occur but had not been previously documented.

Previous studies

The Kodiak ADF&G library was reviewed for relevant Chinook salmon distribution data. An internet search for data was also performed. Several relevant documents were found. The Survey of Fishery Resources in the Meshik River Drainage, Alaska (Wagner and Lanigan 1988) detailed adult and juvenile Chinook salmon distribution in the Meshik River on the North Alaska Peninsula. This gave us specific direction as to where to catch adult Chinook salmon and promising locations to set minnow traps.

Adams et al. (1993) provided a comprehensive review of all fish present in 9 lakes and 8 streams in the Izembek National Wildlife Refuge. Despite 5 months of monitoring in 2 separate years, no Chinook salmon were encountered.

Anadromous Waters Catalog

The Anadromous Waters Catalog[1] provides a list of streams in which specific species have been observed. We examined the list of streams in which Chinook salmon have been observed along the Alaska Peninsula, and in cases where few observations were made, we examined ADF&G's Aerial Survey Database to explore the possibility of a consistent population in each given stream.

[1] https://www.adfg.alaska.gov/sf/SARR/AWC/index.cfm?ADFG=main.home (Accessed July 5, 2016).

In some cases, inclusion into the database was apparently based on a single observation. The comments in the database occasionally revealed that the observer was unsure of the species ID or the correct name of the river; in these cases, those streams were not considered likely to contain a consistent Chinook salmon population.

Aerial Survey Database

We explored the Aerial Survey Database for all streams in Westward Region in which Chinook salmon were observed on several occasions and in numbers exceeding 10 fish per observation. From those data, we developed a list of streams that were reasonably likely to contain spawning Chinook salmon in any given year. We further explored survey conditions and identified streams in which the water clarity was consistently poor but were of sufficient size to support spawning Chinook salmon populations. These streams were classified as good candidates to explore presence of Chinook salmon through the use of minnow traps.

Commercial harvests

The commercial salmon fishing harvest database was examined to determine discreet harvest areas, likely to be composed of mostly terminal fish that contained large numbers of Chinook salmon harvest. If found, these areas could indicate a nearby Chinook salmon spawning system that may not have been identified by other methods.

SAMPLE COLLECTION

Once known Chinook salmon populations were established, and a list of potential rivers that could contain undocumented populations of Chinook salmon were compiled in the data review, field collections were initiated. The 3 primary methods of sample collection were as follows:

1. beach seining of spawning adults,
2. hook and line capture of returning adults by sport guides, and
3. juvenile sampling with baited minnow traps.

For adult samples, the axillary process was clipped from the left side of each fish using dog toenail clippers and preserved in one 250 ml bottle of ethanol per sampling location. The fish was released, unharmed. As many fish as possible, up to 200 individuals, were sampled from each river.

Juvenile Chinook salmon were captured with baited minnow traps. Depending upon the size of the captured fish, either half or the entire caudal fin was clipped and preserved in ethanol in an individual 1.5 ml vial.

The GPS location, river name, names of samplers, sample size collected and any other pertinent information was recorded for each sampling location. Approximately 24 hours after sampling, the ethanol in each bottle was refreshed with new ethanol.

Adult sample gear

A beach seine was designed and built in 2012 specifically for collecting Chinook salmon samples in the Westward Region. The net was 75 ft long and 10 ft deep, shorter and deeper than most sample collection beach seines. It consisted of 3.5 in stretched measure spectra web to minimize drag in the water. The net was built with 2 pound per fathom lead line, supplemented by external lead weights on both ends to keep the lead line on the substrate in fast currents. The

leadline also had purse rings attached every 3 ft of length and a full length purse line to reduce Chinook salmon escaping under the leadline. The net was designed to fish in the deeper, faster water that Chinook salmon typically inhabit. The beach seine was used to encircle schools of fish or was held in a hook pattern and schools of fish were herded into the net. Once the fish were encircled, the bottom of the net was pursed up to minimize escape and fish were subsequently sampled.

Sport-caught samples

Several sport fishing lodges and guides were contacted to help obtain Chinook salmon genetic samples from some of the more difficult to access locations. Sample kits were distributed to guides on the north side of the Alaska Peninsula and in lower Bristol Bay. Kits included sampling clippers, an instruction sheet, and several sample bottles so that fish from several different rivers could be collected and kept separate. Sampling procedures were demonstrated to each guide to assure proper sampling technique and record keeping. The samples were collected toward the end of the season at the lodges in conjunction with ADF&G's sampling trips.

Juvenile sample gear

Minnow traps constructed with vinyl coated wire 0.25 in mesh, manufactured by Eagle Claw® (9 in by 16 .5 in model), were used to capture juvenile Chinook salmon. The traps were baited with salmon roe (disinfected with iodophor) and were anchored in areas where juvenile Chinook salmon were likely to be holding in the river. Traps were placed in the main stem of targeted rivers in areas of deep water with woody debris to provide cover for fish. The traps were tethered to shore and their GPS coordinates were recorded. The traps were checked after 1–2 hours, depending on the location and previous catch rates.

Field collection

Two sampling trips were planned each summer during this project. Due to the remote location of the targeted Chinook salmon stocks, an R-44 helicopter was chartered for sample collection. In addition, it was necessary for ADF&G fixed-wing aircraft to aid this project by caching fuel in remote locations for the helicopter. Field offices in Cold Bay, Sand Point, Port Moller, Chignik, as well as an Alaska State Trooper facility, provided logistic and lodging support.

The first trip of the season in 2013 and 2014 occurred during late June. The intent of the timing of this trip was to capture rearing juvenile Chinook salmon. Rivers were selected that were either difficult to assess presence or population sizes of adult Chinook salmon with aerial surveys due to turbidity, or rivers that were likely to contain Chinook salmon populations based on river morphology but had not previously documented. In addition to sampling, aerial surveys were performed and sport fishing lodges were visited to advise the public about the project and elicit sport fishing guides to aid with sampling efforts. These trips occurred on rivers between the King Salmon River and the Cold Bay area.

The second trip of the season in 2013 and 2014, and the only trip of the season in 2012, occurred in late July and early August and was scheduled to coincide with the time that returning adult Chinook salmon were available for capture in most Alaska Peninsula and Bristol Bay rivers. Aerial surveys were conducted by management staff prior to this sampling (to maximize sampling efficiency) as well as during the sampling trips by research staff. Adult Chinook salmon were sampled with the beach seine. In addition, sport fishing lodges were visited to gain

knowledge about Chinook salmon concentrations and to retrieve the samples collected by sport fishing guides.

RESULTS

DATA REVIEW

The data review was used to develop a strategy for the field collection trips. From information gathered from the Anadromous Waters Catalog and aerial survey database, a list of known Chinook salmon populations that had no samples representing the genetic baseline but were large enough to warrant sampling was established. These included North, Steelhead, Pumice, Old, Figure 8, Painter, Goblet, Kaye's, Contact, Gertrude, Takayofo, Grassy, and Whale Mountain creeks and Cinder, David's and Sandy rivers as well as multiple tributaries of the Meshik River. Based on comments in individual aerial survey notes and consultation with salmon management biologists and commercial fishermen, a list of rivers that could contain undocumented Chinook salmon populations was compiled including Kanatak, Big (Kodiak Mainland), Alogogshak, Kashvik, Joshua Green, Stepovak, and Big (Area M) rivers. Review of the commercial harvest database did not reveal any obvious locations that suggested Chinook salmon were migrating to rivers where they were not previously documented.

2012 SAMPLING

Funding for this project was not available until July 1, 2012, so sampling was limited to 1 sampling trip on the Alaska Peninsula during 2012 targeting returning adults. Priority was given to rivers in which Chinook salmon were known to occur but where existing genetic samples were below the desired amount necessary to adequately characterize population-specific allele frequencies. The logistics required to sample the Chinook salmon rivers were initiated including helicopter fuel caching, property access permission, capture gear, and remote lodging.

ADF&G staff deployed to the Alaska Peninsula July 22–July 29 and sampled streams between Cinder River in the north and North Creek in the south (Figure 1). Samples were collected from Black Hills, Landlocked (Meshik River), and Steelhead creeks (Table 2). In general, Chinook salmon abundance was low on the Alaska Peninsula; however, when encountered, the crew was successful at catching fish.

To obtain more recent samples at the Karluk and Ayakulik weirs, the weir crews to collected samples in those drainages. Fish were captured in the weir traps in conjunction with the regular sockeye salmon sampling. ADF&G staff also floated a portion of Ayakulik River sampling with a beach seine to supplement the samples taken at the weir (Table 2).

Only 25 of the 204 Chinook salmon for the Pillar Creek Hatchery broodstock were caught in the Old's River and were sampled by the Division of Sport Fish staff, so parental-based tagging is not possible for 2012.

2013 SAMPLING

The late June sampling trip in 2013 utilized a largely exploratory strategy of minnow trapping in both turbid rivers and rivers where adults had been difficult to observe and catch. Staff also took advantage of the trip to contact sport fishing guides and lodge owners to outfit them for Chinook salmon sampling. ADF&G staff was deployed to Chignik and efforts focused mostly in the Meshik, Cinder, and Joshua Green rivers (Figure 2). A lot of effort was put into determining

where and how the traps were the most effective, but sufficient numbers of fish were caught in the Cinder and Meshik rivers (Table 3). A sufficient number of fish were caught in the Joshua Green River; however, species identification was difficult and after dissecting fish later, it was determined that the fish caught in the Joshua Green River were likely coho salmon *O. kisutch*. Further results from the GCL's genetic species ID procedure indicated that all samples taken from the Joshua Green River were indeed coho salmon. Several lodges were visited and several sample kits per lodge were deployed. Sport fishing guides seemed very willing to help with the sampling effort and were supportive of the project.

The second sampling trip in 2013 was initiated in late July from the community of King Salmon. Populations in the King Salmon River (Egegik Drainage) including Kaye's, Gertrude, and Contact creeks were sampled (Table 3). Discussions with biologists in King Salmon revealed several small and intermittently surveyed populations in the south area of Bristol Bay that encouraged further investigation (Appendix A). Upon relocating operations from King Salmon to Chignik, a sufficient number of Chinook salmon were spotted in Grassy Creek (Ugashik Drainage) and 83 fish were sampled. Painter Creek was surveyed for Chinook salmon; however, local knowledge revealed that recent volcano activity had changed the habitat and Chinook salmon no longer entered the river; none were observed on the survey. The effort for the remainder of the trip focused on Meshik and Cinder rivers and Ridgerunner Creek. Previously deployed sport fishing guide sample kits were retrieved from the lodges and yielded additional samples from Sandy and Nelson rivers and North Creek.

Broodstock for the Chinook salmon project at the Pillar Creek Hatchery was collected at Monashka Creek and American and Old's rivers. Division of Sport Fish staff sampled all 143 fish used for the broodstock.

2014 SAMPLING

The late June sampling trip in 2014 began in the community of King Salmon with the intent to explore rivers in the Bristol Bay and south side of the Alaska Peninsula in which Chinook salmon had not been observed, but river clarity may have hindered aerial survey efforts in the past. Poor weather conditions in the Bristol Bay area hampered most efforts during this portion of the trip; however, Kashvik and Alogogshak on the south side of the Alaska Peninsula were sampled with minnow traps for juveniles with no Chinook salmon captured. Attempts to sample Swikshak and Big rivers in the Kodiak mainland area were unsuccessful due to poor weather.

After working out of King Salmon, field staff relocated to the Chignik field office as their center of operations. Efforts again focused juvenile trapping on the Meshik and Cinder rivers to increase sample numbers for those collections (Figure 3; Table 4). Pumice Creek was sampled to determine if Chinook salmon were present, and while low numbers of fish were caught, it encouraged further sampling later in the season when adults were expected to be present. Ridgerunner Creek and Milky River (just downstream of the Ridgerunner Creek tributary) were sampled with minnow traps. Ridgerunner Creek provided little flow or rearing habitat, and no Chinook salmon were caught in it. A total 10 fish were captured and sampled from the Milky River. The Milky River fish are assumed to be rearing Chinook salmon from Ridgerunner Creek; however, since the Milky River is chronically turbid, no other Chinook salmon distribution is available from other areas of the river. Traps were deployed in the Stepovak and Big rivers in Stepovak Bay on the south side of the Alaska Peninsula, but only coho salmon and Dolly Varden *Salvelinus malma* were caught. The large sample of 116 fish was captured at North Creek in a

couple days of effort was particularly valuable, as the North Creek Chinook salmon population appears to be small and is difficult to sample. Additionally, the North Creek Chinook salmon population is currently the southernmost known population on the Alaska Peninsula.

The later July sampling trip for adult Chinook salmon followed a similar strategy to 2013, beginning in the community of King Salmon and initially focusing on stocks in the King Salmon River (Egegik Drainage). Sufficient numbers of samples were collected in Contact, Kaye's, Gertrude, and Takayofo creeks. Following sampling in the Bristol Bay area, the base of operation was moved to the Chignik weir field office, and Chinook salmon were observed in Grassy Creek during the flight. Efforts were then focused on the Meshik Drainage and 100 fish were sampled in Plenty Bear Creek. To facilitate sampling in the remote area between Chignik and Bristol Bay, the crew deployed to an Alaska State Trooper cabin and sampled Figure 8, Pumice, and Old creeks, with sufficient sample sizes from each (Table 4). Fish were also observed in Goblet Creek (Appendix A; Ugashik Drainage), but fuel constraints precluded sampling efforts.

Sampling efforts then focused further south, and after several years of surveying, Chinook salmon were observed in David's River (Nelson River Drainage). The fish were in low concentrations in difficult areas to trap fish, so no attempts were made to capture them. Due to weather conditions, effort refocused on Cinder and Meshik rivers and samples were taken in Wiggly Creek (Cinder) and Braided Creek (Meshik). Poor weather hampered survey and sample efforts for the remainder of the trip.

A low number of Chinook salmon were available for broodstock for the Pillar Creek Hatchery in 2014, and only 6 fish were caught and sampled from the Old's River by Division of Sport Fish staff.

DISCUSSION

In total, 2,036 Chinook salmon were sampled during this project, more than doubling the number of baseline samples from the Westward Region and southern Bristol Bay. In addition, 9 populations that were unrepresented in the pre-2012 baseline are now well represented, and 4 populations that had low sample numbers are now well represented (Figure 4). Despite the existence of many streams that are chronically turbid—precluding effective aerial surveys—no previously undocumented Chinook salmon populations were located in southern Bristol Bay or on the Alaska Peninsula. Juvenile trapping was an effective method of catching Chinook salmon in remote streams that are known to contain spawning Chinook salmon; therefore, it is reasonable to assume that if no juveniles were caught, that Chinook salmon spawning is either not present or present in low numbers.

While the Chinook salmon genetic baseline was widely expanded, there are still known populations that have either not been sampled or do not have sufficient samples collected for statistical analysis—including Old Creek, Goblet Creek, Shosky Creek, and Whale Mountain Creek (Appendix A).

ACKNOWLEGEMENTS

A large number of people participated in sampling Chinook salmon during this project. Helicopter pilots Will Lawrence and Larry Larrivee from Pollux Aviation safely piloted sampling crews all over the Alaska Peninsula and actively participated in sampling efforts. Tyler

Dann handled project coordination from the GCL, with assistance from Judy Berger in preparing sampling kits and archiving tissues and Eric Lardizabal for maintaining records in the GCL database LOKI. A multitude of ADF&G staff helped sampling efforts, including Mary Beth Loewen, Birch Foster, Stig Ignve, Melanie Bakker, Ross Weatherbee, Brad Furst, Lauren McNeeley, David Besh, Taylor Ritter, Travis Elison, Sara Gilk-Baumer, Will Jasper, Michelle Stratton, Lucas Stumpf, Linda Junge, Mike Knudson, Nat Nichols, and Charlie Russel. ADF&G pilots Steve Hakala and Paul Horn were invaluable providing logistics, caching fuel, and providing local knowledge. Staff from ADF&G field offices in King Salmon, Sand Point, Chignik, Port Moller, and Cold Bay also provided valuable local knowledge and logistic and lodging support, including Paul Salomone, Lisa Fox, Matt Keyse, Todd Andersen, Bob Murphy and Dawn Wilburn. Sport fishing guides were also especially valuable in collecting hard-to-sample populations, including guides from Hoodoo Lake Lodge, Sandy River Lodge, Wildman Lake Lodge, Bear Lake Lodge, and Alaska Fly Anglers. Funding for this baseline sampling project was provided by the Alaska Legislature as a capital improvement project.

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TABLES AND FIGURES

Table 1.–Sampling information for samples archived at the ADF&G GCL and available for a Chinook salmon genetic baseline for Westward Region prior to 2012. Note that the GCL recommends a minimum of 70 individuals per collection location to adequately represent allele frequencies for SNPs.

Location	No. Sampled	Sample date	Lat.	Long.	Comment
Meshik River	43	6/21/2006	56°43.1532′	158°33.1014′	
Sandy River	31	2006	56°4.741′	159°41.07′	
Milky River (Bear River Tributary)	67	2006	56°5.5746′	160°18.018′	
King Salmon River (near Bear Lake)	60	6/04/2006	56°6.1644′	160°27.5496′	
Nelson River	243	1995, 2006	55°58.872′	161°8.4′	Juveniles and adults
Steelhead Creek	103	7/24/2006	55°48.6366′	161°56.682′	
Black Hills Creek	126	2006, 2007	55°46.2834′	162°5.268′	
Chignik River	116	1995, 2006	56°16.326′	158°39.75′	
Ayakulik River weir	346	1993,2006, 2007	57°11.772′	154°32.232′	
Karluk River	267	1993, 2006, 2007	57°34.206′	154°27.618′	
Total	1,402				

Table 2.–Sampling information for samples collected in 2012, delivered to the GCL, and available for Chinook salmon genetic baseline from A. ADF&G Adult Collections, B. Sport Guide Adult Collections, and C. Pillar Lake Hatchery Adult Samples.

A. ADF&G Adult Collections

Location	No. sampled	Sample date	Lat.	Long.	Collection type	Samplers
Landlocked Creek	21	7/24/2012	56°41.9256′	158°55.536′	ADF&G Beach Seine	Witteveen, Kuriscak, Laravie
Steelhead Creek	95	7/26/2012	55°48.7458′	161°56.736′	ADF&G Beach Seine	Witteveen, Jasper, Laravie
Black Hills River	62	7/27/2012	55°46.293′	162°4.938′	ADF&G Beach Seine	Witteveen, Stratton, Laravie
Ayakulik River Weir	16	June/July	57°11.6978′	154°31.7343′	Weir Trap	Ingve, Bakker
Ayakulik River	62	7/8/2012	57°12.7324′	154°27.9551′	ADF&G Beach Seine	Witteveen, Foster
Karluk River Weir	25	June/July	57°33.7842′	154°22.9675′	Weir Trap	Weatherbee, McNeeley, Furst
Total	281					

B. Sport Guide Adult Collections

Location	No. sampled	Sample date	Lat.	Long.	Collection type	Samplers
Sandy River	4	July	56°4.741′	159°41.07′	Sport gear	Sandy River Lodge guides
Nelson River	48	July	55°49.6994′	161°16.6150′	Sport gear	Hoodoo Lake Lodge guides
David′s River	1	July	55°50.688′	161°25.881′	Sport gear	Hoodoo Lake Lodge guides
North Creek	2	July	55°36.5257′	162°21.4178′	Sport gear	Hoodoo Lake Lodge guides
Chignik River	66	June/July	56°15.7955′	158°42.1506′	Sport gear	Chignik Sport guides/ADF&G staff
Total	121					

C. Pillar Creek Hatchery Adult Samples

Location	No. sampled	Sample date	Lat.	Long.	Collection type	Samplers
Olds River	25	August	57°34.922′	152°27.728′	Sport Gear	ADF&G Division of Sport Fish staff
Annual Total	427					

Table 3.–Sampling information for samples collected in 2013, delivered to the GCL, and available for Chinook salmon genetic baseline from A. ADF&G Adult Collections, B. Sport Guide Adult Collections, C. ADF&G Juvenile Collections, and D. Pillar Lake Hatchery Adult Samples.

A. ADF&G Adult Collections

Location	No. sampled	Sample date	Lat.	Long.	Collection type	Samplers
Contact Creek	49	7/29/2013	58°11.25′	155°57.9364′	ADF&G Beach Seine	Witteveen, Loewen, Lawrence
Kaye's Creek	18	7/28/2013	58°8.0479′	155°56.6226′	ADF&G Beach Seine	Witteveen, Loewen, Will Lawrence
Gertrude Creek	48	7/29/2013	58°9.4379′	156°10.5634′	ADF&G Beach Seine	Witteveen, Loewen, Lawrence
Grassy Creek	83	7/30/2013	57°29.8135′	157°4.8679′	ADF&G Beach Seine	Witteveen, Loewen, Lawrence
Wiggly Creek (Cinder)	8	8/4/2013	56°59.1497′	157°40.1404′	ADF&G Beach Seine	Witteveen, Loewen, Lawrence
Plenty Bear Creek (Meshik)	26	7/31/2013	56°42.3505′	158°17.9819′	ADF&G Beach Seine	Witteveen, Loewen, Lawrence
Ridgerunner Creek (Bear)	1	8/1/2013	56°8.4961′	160°16.8439′	ADF&G Beach Seine	Witteveen, Loewen, Lawrence
Total	233					

B. Sport Guide Adult Collections

Location	No. sampled	Sample date	Lat.	Long.	Collection type	Samplers
Sandy River	63	July	56°13.3905′	160°4.1739′	Sport gear	Wildman Lake and Sandy River guides
Nelson River	78	July	55°49.6994′	161°16.6150′	Sport gear	Hoodoo Lake Lodge guides
North Creek	17	July	55°36.5257′	162°21.4178′	Sport gear	Hoodoo Lake Lodge guides
Total	158					

C. ADF&G Juvenile Collections

Location	No. sampled	Sample date	Lat.	Long.	Collection type	Samplers
Cinder River (Main Stem)	57	6/26/2013	57°7.7900′	157°52.8809′	Minnow Trap	Witteveen, Loewen, Lawrence, Russel, Junge
Meshik River (Main Stem)	18	7/31/2013	56°40.6856′	158°17.3236′	Minnow Trap	Witteveen, Loewen, Lawrence
Joshua Green River	59	8/2–3/2013	55°22.7678′	162°29.0662′	Minnow Trap	Witteveen, Loewen, Lawrence
Total	133					

D. Pillar Creek Hatchery Samples

Location	No. sampled	Sample date	Lat.	Long.	Collection type	Samplers
Monashka River	–	August	57°50.588′	152°27.491′	Sport Gear	ADF&G Division of Sport Fish staff
American River	–	August	57°38.086′	152°32.514′	Sport Gear	ADF&G Division of Sport Fish staff
Olds River	–	August	57°34.922′	152°27.728′	Sport Gear	ADF&G Division of Sport Fish staff
Total combined	143					
Annual Total	667					

Table 4.–Sampling information for samples collected in 2014, delivered to the GCL, and available for Chinook salmon genetic baseline from A. ADF&G Adult Collections, B. Sport Guide Adult Collections, C. ADF&G Juvenile Collections, and D. Pillar Lake Hatchery Adult Samples.

A. ADF&G Adult Collections

Location	No. Sampled	Sample date	Lat.	Long.	Collection type	Samplers
Contact Creek	32	7/27–7/28/2014	58°11.0435′	155°58.6780′	ADF&G – Beach Seine	Witteveen, Lawrence, Elison
Takayofo Creek	74	7/28,7/30/2014	58°7.9019′	155°43.3411′	ADF&G – Beach Seine	Witteveen, Lawrence, Elison
Kaye's Creek	35	7/28,7/29/2014	58°9.1001′	155°58.0618′	ADF&G – Beach Seine	Witteveen, Lawrence, Elison
Gertrude Creek	72	7/29/2014	58°9.2459′	156°9.2230′	ADF&G – Beach Seine	Witteveen, Lawrence, Elison
Figure 8 Creek	108	8/01/2014	57°19.0370′	156°47.3795′	ADF&G – Beach Seine	Witteveen, Loewen, Lawrence
Old Creek	26	8/02/2014	57°8.8461′	157°36.7776′	ADF&G – Beach Seine	Witteveen, Loewen, Lawrence
Pumice Creek	104	8/02/2014	57°6.2590′	157°39.0518′	ADF&G – Beach Seine	Witteveen, Loewen, Lawrence
Wiggly Creek	58	8/04/2014	56°59.1330′	157°40.1266′	ADF&G – Beach Seine	Witteveen, Loewen, Lawrence
Plenty Bear Creek	100	7/31/2014	56°42.9561′	158°17.0947′	ADF&G – Beach Seine	Witteveen, Loewen, Lawrence
Braided Creek	46	8/04/2014	56°36.1869′	158°30.2737′	ADF&G – Beach Seine	Witteveen, Loewen, Lawrence
Ridgerunner (Bear)	31	8/03/2014	56°7.8369′	160°14.5844′	ADF&G – Beach Seine	Witteveen, Loewen, Lawrence
Total	686					

B. Sport Guide Adult Collections

Location	No. Sampled	Sample date	Lat.	Long.	Collection type	Samplers
Contact Creek	10	7/13,7/14/2014	58°11.0435′	155°58.6780′	Sport Guide	Alaska Fly Anglers
Takayofo Creek	11	7/16,7/17/2014	58°7.9019′	155°43.3411′	Sport Guide	Alaska Fly Anglers
Kay's Creek	9	7/15–7/18/2014	58°9.1001′	155°58.0618′	Sport Guide	Alaska Fly Anglers
Gertrude Creek	7	7/19,7/20/2014	58°9.2459′	156°9.2230′	Sport Guide	Alaska Fly Anglers
Meshik Main Stem	6	06/30/2014	56°43.0537′	158°32.8249′	Sport Guide	Wildman Lake Lodge
Meshik Main Stem	3	July	56°43.0537′	158°32.8249′	Sport Guide	Wildman Lake Lodge
Sandy River	15	July	56°14.3696′	160°5.1718′	Sport Guide	Sandy River Lodge
North Creek	16	7/15–7/16/2014	55°36.6892′	162°21.2356′	Sport Guide	Hoodoo Lodge
Chignik River	12	07/11/2014	56°15.3042′	158°44.7460′	Sport Guide	Wildman Lake Lodge
Total	89					

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Table 4.–Page 2 of 2.

C. ADF&G Juvenile Collections

Location	No. Sampled	Sample date	Lat.	Long.	Collection type	Samplers
Pumice Creek	2	06/22/2014	58°11.0541′	157°47.1817′	Minnow Trap	Witteveen, Shedd, Lawrence
Cinder River	30	06/21/2014	57°7.8179′	157°53.0539′	Minnow Trap	Witteveen, Shedd, Lawrence
Meshik River	3	06/19/2014	56°41.0669′	158°13.4967′	Minnow Trap	Witteveen, Shedd, Lawrence
Milky River	10	06/26/2014	56°10.1809′	160°22.0111′	Minnow Trap	Witteveen, Shedd, Lawrence
North Creek	116	06/25/2014	55°35.5389′	162°22.6859′	Minnow Trap	Witteveen, Shedd, Lawrence
Total	161					

D. Pillar Lake Hatchery Adult Samples

Location	No. Sampled	Sample date	Lat.	Long.	Collection type	Samplers
American River	6	August	57°38.086′	152°32.514′	Sport gear	ADF&G Division of Sport Fish staff
Annual total	942					

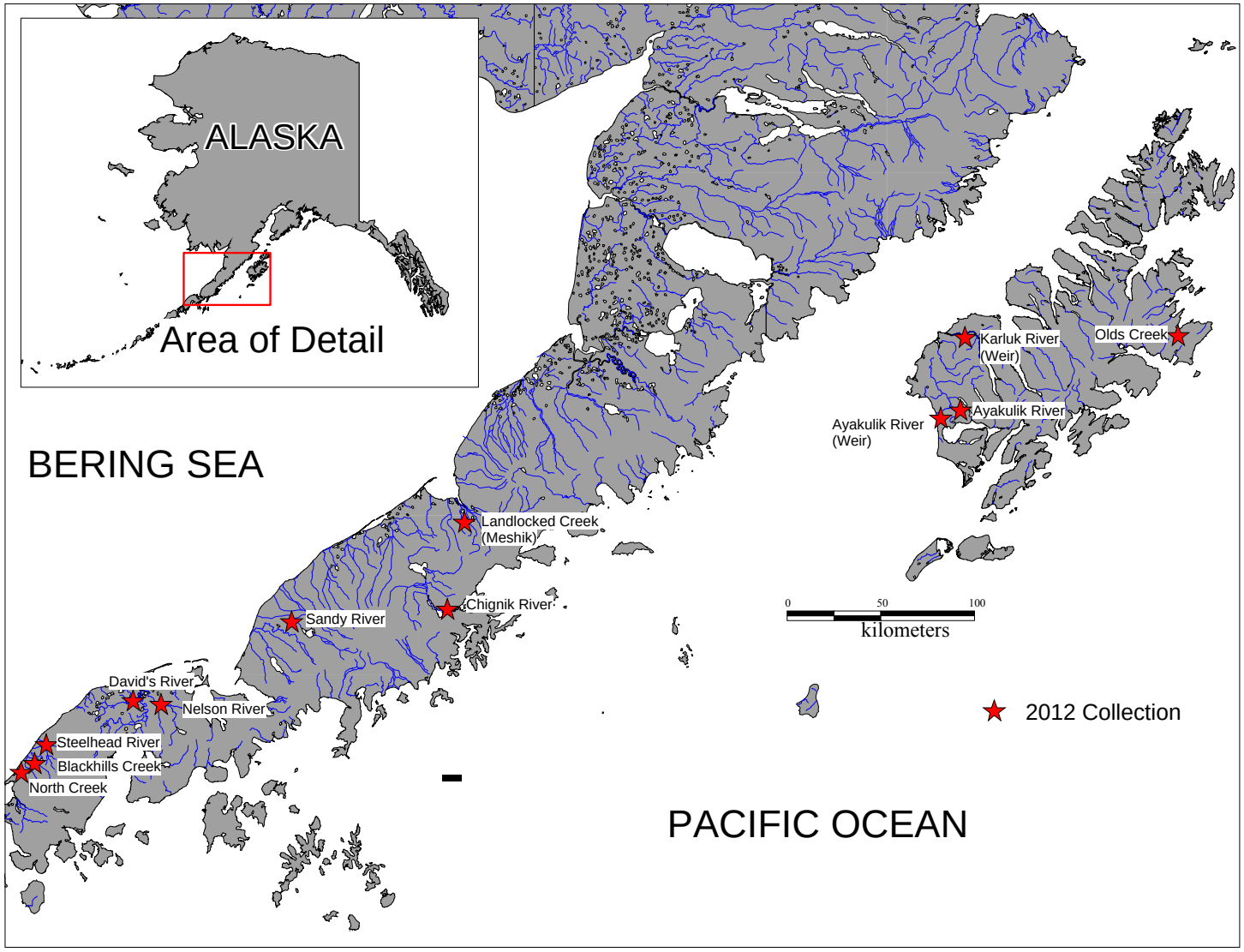

Figure 1.–Sampling locations during the 2012 season for Chinook salmon collections available for a GCL genetic baseline.

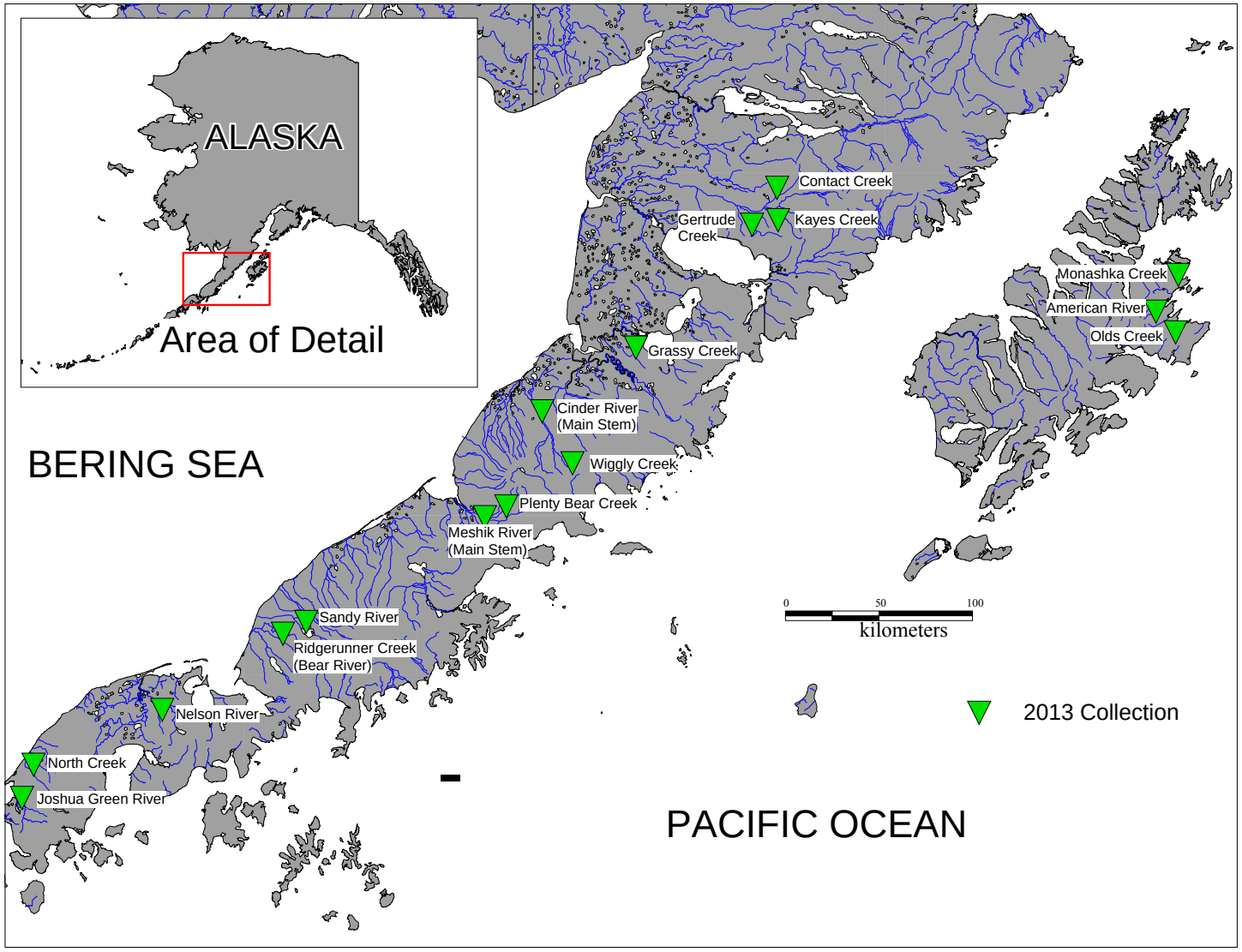

Figure 2.–Sampling locations during the 2013 season for Chinook salmon collections available for a GCL genetic baseline.

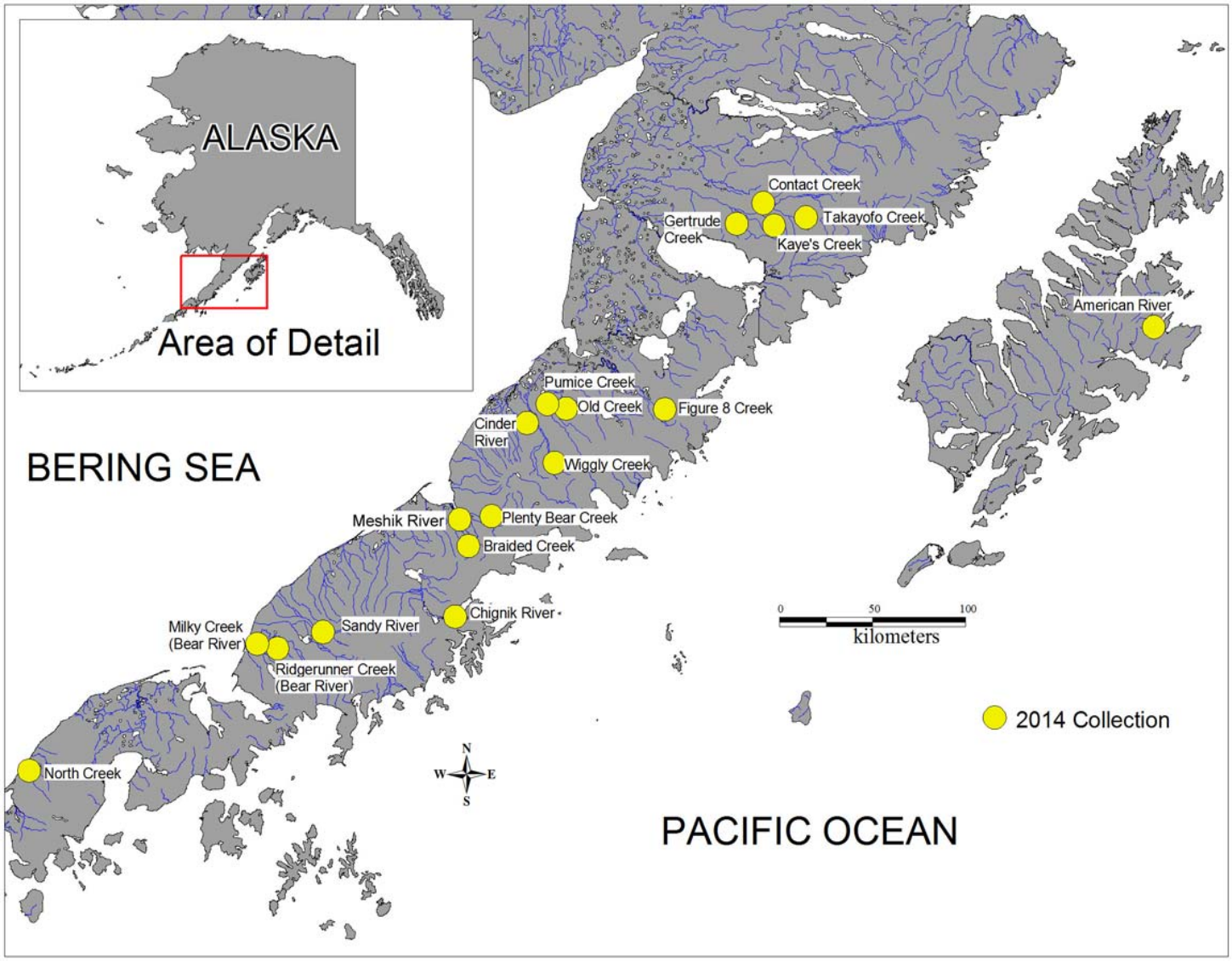

Figure 3.–Sampling locations during the 2014 season for Chinook salmon collections available for a GCL genetic baseline.

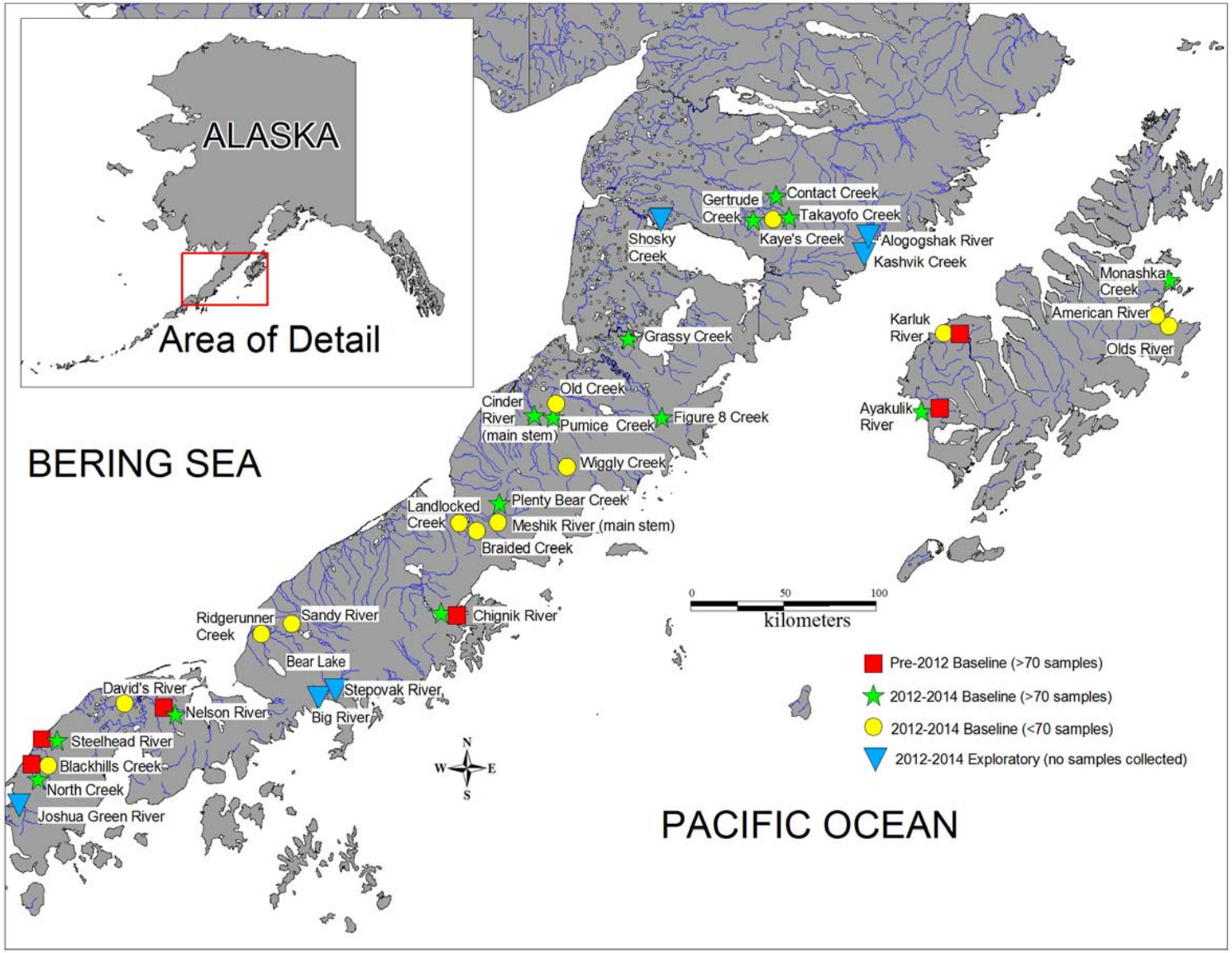

Figure 4.–Current collection status for Chinook salmon collections of the Westward Region available for a GCL genetic baseline.

APPENDIX A

Appendix A.–Locations explored for presence of Chinook salmon.

Location	Dates of observation	Chinook observed	Method of observation	Lat.	Long.	Comment
Whale Mountain Creek	7/30/2013	0	Aerial Survey	58°13.2399′	156°35.828′	Chinook salmon reported to be observed in past years.
Shosky Creek	7/30/2013–6/17/2014	0	Aerial Survey Juvenile Trap	58°8.92′	156°49.806′	Chinook salmon reported to be observed in past years.
Goblet Creek	8/1/2014		Aerial Survey	57°17.507′	156°54.943′	Unable to sample due to fuel constraints.
Painter Creek	7/30/2013	0	Aerial Survey	57°8.85′	157°22.62′	Chinook salmon previously observed. Locals note absence after volcanic activity.
Meloy Creek (Cinder)	7/23/2012	3	Aerial Survey	56°55.8′	157°47.724′	Chinook salmon noted in aerial survey database
Lava Creek (Cinder)	7/29/2012	0	Aerial Survey	57°4.44′	157°51.69′	Chinook salmon noted in aerial survey database
Tributary M (Meshik)	7/24/2012	3	Aerial Survey	56°45.666′	158°33.402′	Chinook salmon noted in aerial survey database
Birthday Creek	7/24/2012	0	Aerial Survey	56°51.084′	158°29.646′	Chinook salmon noted in the Anadromous Waters Catalog, only 1 occurrence in aerial survey database
Blue Violet Creek (Meshik)	7/29/2012	0	Aerial Survey	56°38.04′	158°16.098′	Chinook salmon noted in aerial survey database
Red Bluff Creek (Meshik)	7/22/2012	0	Aerial Survey	56°40.386	158°48.612	Chinook salmon noted in aerial survey database
Yellow Bluff Creek (Meshik)	7/22/2012	2	Aerial Survey	56°41.556′	158°43.506′	Chinook salmon noted in aerial survey database
Charles Creek	7/29/2012	0	Aerial Survey	56°45.24′	158°53.16′	Chinook salmon noted in aerial survey database
David's Creek	8/3/2014	20	Aerial Survey	55°47.202′	161°42.606′	Historically contained Chinook salmon; too few and spread out to sample
Joshua Green	8/2/2013–6/24/2014	0	Aerial Survey Juvenile Trap	55°22.632′	162°28.896′	Historically contained Chinook salmon
Alogogshak Creek	6/18/2014	0	Juvenile Trap	58°1.116′	155°4.488′	Exploratory, turbid river
Kaskvik Creek	6/18/2014	0	Juvenile Trap	57°56.874′	155°10.8′	Exploratory, turbid river
Stepovak River	6/23/2014	0	Juvenile Trap	55°53.801′	159°36.501′	Exploratory, turbid river
Big River	6/23/2014	0	Juvenile Trap	55°2.342′	159°45.697′	Exploratory, turbid river