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Southern Southeast Inside Commercial Sablefish Fishery and Survey Activities in Southeast Alaska, 2013

by

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and

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

Symbols and Abbreviations

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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

FISHERY MANAGEMENT REPORT NO. 14-39

SOUTHERN SOUTHEAST INSIDE COMMERCIAL SABLEFISH FISHERY AND SURVEY ACTIVITIES IN SOUTHEAST ALASKA, 2013

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TABLE OF CONTENTS

Page

LIST OF TABLES

Table **Page**

LIST OF FIGURES

LIST OF APPENDICES

ABSTRACT

This report describes the status of the 2013 Southern Southeast Inside (SSEI) Subdistrict sablefish (*Anoplopoma fimbria*) stock located in Southeast Alaska in Clarence Strait and Dixon Entrance. The Alaska Department of Fish and Game (ADF&G) manages sablefish pot and longline fisheries in the SSEI Subdistrict by using commercial fishery and survey catch per unit effort (CPUE) data, fishery and survey biological data (age, weight, length, and maturity), and stock status trends of sablefish populations in surrounding geographic areas. The ADF&G establishes the SSEI annual harvest objective (AHO) based on these data. This report summarizes the collection and analysis of data sampled during the annual longline survey and pot and longline fisheries in SSEI. No change occurred from 2012 to 2013 in the overall longline fishery CPUE (0.33 round lb per hook), but a decline was observed in the overall longline survey CPUE indices for all size classes of sablefish (0.76 round lb per hook to 0.67 round lb per hook) and for fish ≥520 mm fork length (0.71 round lb per hook to 0.63 round lb per hook). Recruitment has been observed in recent years for the SSEI fisheries; however, a large proportion of immature fish harvested in the SSEI commercial fisheries is still a concern. A declining trend in survey CPUE, record high levels of immature fish, and historic lows in the adjacent federal Gulf of Alaska sablefish longline survey prompted reduction in the 2014 SSEI commercial fisheries AHO.

Key words: Clarence Strait, Dixon Entrance, Southern Southeast Inside Subdistrict, SSEI, sablefish, black cod, Anoplopoma fimbria, longline, pot.

INTRODUCTION

Sablefish, also known as "black cod," are a valuable commercial species with an exvessel value of $3.9 million in Southeast Alaska state-managed fisheries in 2013. The ADF&G manages commercial fisheries in the inside waters in the Southern Southeast Inside Subdistrict (SSEI) (Figure 1) and Northern Southeast Inside (NSEI) Subdistricts. This report discusses the stock status of sablefish in the SSEI Subdistrict where both pot and longline fisheries are allowed by regulation.

SABLEFISH LIFE HISTORY

Sablefish are a member of the Anoplopomatidae family and are distributed in the western and eastern North Pacific Ocean, with adults occurring in deep waters up to 2,740 m and young sablefish occurring in shallower nearshore waters (Mecklenburg et al. 2002). Sablefish are highly migratory. However, tagging data suggest that there may be two stocks in the eastern North Pacific: a northern stock that occurs from the Bering Sea to British Columbia, and a southern stock from Washington to Baja California (Kimura et al. 1997). Stable isotope studies on juvenile sablefish indicate that stocks may be further divided with three different spawning stocks from British Colombia to Oregon (Gao et al. 2004). Genetic and morphometric data suggest differentiation between the northern and southern populations, but genetics do not indicate two discrete stocks in the eastern North Pacific (Tripp-Valdez et al. 2012).

Sablefish are long-lived with a maximum reported age of 97 years for fish caught in Alaskan waters (D. Anderl, National Marine Fishery Service [NOAA Fisheries], personal communication); however, few fish are caught in the Southeast Alaska commercial fisheries that are greater than 20 years of age (Mueter 2010). In the Gulf of Alaska, 50% of male sablefish are mature at approximately 57 cm fork length (FL) (5 years old), whereas50% of females are mature at 65 cm FL (6.5 years old) (Sasaki 1985; Hanselman 2013).

Sablefish spawn at depth in pelagic waters near the edge of the continental slope (Mason et al. 1983). Larvae ascend toward the surface with development (Sigler et al. 2001b). Juveniles

exhibit rapid growth (Sigler et al. 2001b) and reside in bays and nearshore waters for just over two years until they move offshore (Sigler et al. 2001a).

Both adult (Yang and Nelson 2000) and juvenile (K. Coutre, University of Alaska School of Fisheries, personal communication) sablefish are opportunistic feeders that consume teleosts and invertebrates species and scavenge on fish carcasses; yearling sablefish primarily feed on euphausiids (Sigler et al. 2001b). The diet of sablefish >60 cm has a greater composition of fish compared to smaller sablefish that have a diet with more cephalopods, euphausiids, and shrimp (Yang and Nelson 2000). Juvenile sablefish are eaten by coho (*Oncorhynchus kisutch*) and Chinook salmon (*Oncorhynchus tshawytscha*) (Wing 1985). Adult sablefish have been observed in stomachs of sperm whales (*Physeter macrocephalus*) in California (Kawakami 1980), and they are depredated from longline fishing gear by both killer (*Orcinus orca*) and sperm whales in the Gulf of Alaska (Hanselman et al. 2013).

HISTORY OF THE FISHERY

Sablefish have been harvested in the internal waters in Southeast Alaska since the early 1900s, primarily as incidental catch in the halibut fishery (Bracken 1983). Directed fishing for sablefish fluctuated considerably prior to the 1970s (Bracken 1983) with high levels of harvest during World War I and World War II (Holum and Coonradt 2005). Since the 1970s, there has been substantial sablefish harvest due to high market prices (Sayer and Holum 2008). In 1985, 43 permit holders participated in the longline and pot fisheries with the implementation of limited entry. However, on average, only 28 permit holders fished in SSEI in successive years (1985–1996) (Holum and Coonradt 2005). In 1997, the equal quota share (EQS) system was initiated with each eligible permit holder given an equal portion of the annual harvest objective (AHO); a total of 35 permits, 30 longline and five pot, were authorized to participate (Holum and Coonradt 2005). As of 2014, 20 permit holders are eligible to fish in the longline fishery and three in the pot fishery. Four of the longline fishery permit holders are considered interim use; these permits are under review in order to determine whether the permit holder qualifies for permanent status in this fishery. Not all authorized permit holders participate in the fishery each year. Typically, one SSEI longline permit holder does not fish, and another harvests less than 25% of his EQS each year. In 2013, a second fisherman did not harvest any of his EQS; however, this permit is normally fished.

The SSEI longline fishery distribution has shifted over time from Clarence Strait to Dixon Entrance. Prior to the implementation of the EQS system in 1997, the short fishery opening restricted fishermen during unfavorable weather to Clarence Strait—an area in inside waters that is more sheltered than Dixon Entrance, which opens to the Gulf of Alaska. Since 2004, the fishery location has shifted further with an average of 45% of the harvest in Dixon Entrance (Figure 2).

Sablefish harvest in SSEI has been regulated since 1980 with guideline harvest ranges (approximately 198,000–794,000 round lb) based on historical catches (Bracken 1983). After the implementation of the EQS system in 1997, the AHOs were set annually based on SSEI fishery and survey CPUE, SSEI biological data, and sablefish stock status in other Alaskan and Canadian waters (Table 1). The 1997 AHO of 790,000 round lb was lowered in 1998 with a 20% reduction to 632,000 round lb but was raised the following year. The AHO was reduced again in 2000 and 2009. However, it remained above the historic low AHO set in 1998 until 2011 and

was then lowered to 583,280 round lb. For the 2014 SSEI fisheries, the AHO was further reduced to 536,618 round lb (Table 1).

Sablefish fisheries in Southeast Alaska are managed with seasonal openings to protect sablefish stocks during spawning periods. Sablefish fisheries were open year-round to fishing until the 1940s, when declines in CPUE and average weight prompted a December 1–March 15 closure to protect sablefish during the winter spawning season and prevent incidental catch of halibut in early spring fisheries (Holum and Coonradt 2005). In addition, fishery openings were reduced to seven days in the 1980s to prevent the guideline harvest limit (GHL) from being exceeded. The ability of the fishing fleet to harvest the GHL rapidly necessitated the implementation of a limited entry program. However, the GHL was still exceeded in some years (Figure 3), and the number of fishing days continued to decrease to as a few as two days in 1995 and 1996. In 1997, the EQS system was implemented, and separate seasons were established for the longline (1.5 months) and pot fisheries (2.5 months). Prior to the establishment of separate seasons, conflicts occurred between the pot and longline fisheries, such as gear entanglement (Holum and Coonradt 2005). In 2000, the SSEI longline fishery was extended to the same length of the pot fishery. In 2014, the longline fishery will be opened from June 1–August 15 and the pot fishery from September 1–November 15.

SSEI fishery data are currently collected through a mandatory logbook program and fish tickets from each landing. In addition, permit holders are required to register prior to fishing in SSEI. Fishery data were initially collected through voluntary logbooks and skipper interviews. Logbooks became mandatory in 1997 and must include the following information by set: date, gear (type, hook spacing, number of hooks), location (start and end latitude and longitude), depth, and estimated weight for target and incidental catch (5 AAC 28.175). Permit holders must retain dead or visibly injured sablefish; sablefish that are not dead or injured may be released but must be recorded on a logbook (5 AAC 28.170). In addition, fishermen must record, by set, the tag number of any tagged sablefish that are landed (5 AAC 28.175). The State of Alaska requires a copy of each logbook to be returned with the fish ticket for each landing. Fish tickets are created by processing-plant staff, who are required to enter data into the State eLandings database. Fishermen are allowed to harvest a 5% overage, which is removed from their EQS in the following year; proceeds from overages that exceed 5% will be forfeited to the State of Alaska (5 AAC 28.170).

Rockfish (*Sebastes* and *Sebastolobus* spp.) are caught incidentally in the SSEI fisheries. Alaska administrative code (5 AAC 28.171) has required full retention and reporting for rockfish (*Sebastes* spp. only) caught in internal state waters since 2000, and since 2003 it has limited catch of slope (*Sebastes* spp.) and thornyhead (*Sebastolobus* spp.) rockfish to incidental catch only. Proceeds from rockfish in excess of bycatch limits are forfeited to the State of Alaska; no profit can be obtained from rockfish harvested in the pot fishery (5 AAC 28.130).

HISTORY OF THE LONGLINE SURVEY

The ADF&G conducts annual longline surveys in the SSEI Subdistrict, which includes the waters of Clarence Strait and Dixon Entrance, to assess sablefish stock status. Annual surveys have been conducted since 1988 with the exception of 2005 due to budgetary constraints. In 2000, gear (hook spacing), bait (type and size), and soak time were standardized to specifications used on the federal longline survey to facilitate comparisons between federal and state waters.

The hook spacing was from 1.6–1.8 m from 1997–1999; in 2000, spacing was standardized to 2 m.

The SSEI survey was originally conducted in Clarence Strait in three statistical areas (325531, 315502, and 315432) and designed as a random stratified survey with each statistical area considered a separate stratum. Survey stations were first added in Dixon Entrance in 1996; however, it is unclear what stratification design was intended for this area. In 2013, the SSEI survey was redesigned to reflect shifts in the commercial fishery harvest from Clarence Strait to Dixon Entrance (Figure 2). This change in the fishery distribution over time resulted in less overlap with the SSEI survey station distribution because few survey stations were located in Dixon Entrance (Figure 4). For the redesign, survey stations were proportionally allocated in relationship to the area of sablefish habitat by strata (Table 2), with statistical areas included in the design that had 3% or more of the commercial fishery harvest on average from 2003–2012. As a result, the northern Clarence Strait statistical area of 325533 was added as a new stratum, and the small eastern Dixon entrance statistical area 315401 was removed. The overall number of survey stations was decreased from 37 to 29 stations to maintain both the proportional allocation scheme by strata and to accommodate the additional time needed to survey the more exposed Dixon Entrance area (Figure 5). The intent of this survey redesign was to improve the spatial coverage of the survey relative to the fishery and to increase the minimum distance between stations (stations close together may not be independent if sablefish are attracted to bait at more than one station) while not significantly increasing the number of sablefish harvested in the survey.

BIOLOGICAL DATA

Biological data have been collected from sablefish in SSEI management area since the annual longline survey began in 1988. Sablefish samples have been collected from the SSEI commercial fisheries opportunistically since 1998 and on a regular basis in the longline fishery beginning in 2001 and the pot fishery in 2007. Sablefish are currently sampled for length, weight, sex, age, and maturity.

METHODS

LONGLINE SURVEY

Survey Operations

The 2013 longline survey was conducted from the chartered commercial longline vessels F/V *Providence* and F/V *Viking Maid* from May 13–20, 2013, and was scheduled to correspond with the timing of previous surveys and favorable tides. The chartered vessels fished simultaneously to survey all of SSEI in a short time period. The F/V *Providence* fished 15 stations in the northern and middle of Clarence Strait and eastern Dixon entrance, and the F/V *Viking Maid* fished 14 stations in southern Clarence Strait and western Dixon entrance.

A longline set was performed at each station surveyed in SSEI in 2013. Sets were performed in the same direction as the tidal current; however, haul direction depended on the tide, wind direction, and currents. Sets were soaked for 3–11 hours and consisted of 25 skates each with 45 #13/0 Mustad[1] circle hooks with 2 m hook spacing. Hooks were attached to gangions that were

[1] Product names are used for completeness but do not constitute endorsement.

secured to beckets tied to the groundline and were placed 38 cm from the groundline (the length of the gangion plus becket). At the end of each set was 150 fm (274 m) of running line with a 60 lb longline anchor, buoys, and a "high flyer" attached, and at the end of each skate was 5 m of bare groundline with a 3 kg lead ball attached. Gear consisted of gangions composed of medium lay #60 nylon round braided twine, beckets of medium lay #72 nylon becket twine, and groundline of medium lay 1 cm nylon American Line SSR 100. Each year, all new hooks are attached to each skate prior to the survey. Bent, straightened, and missing hooks were replaced after each set as the gear was baited. Squid (*Illex argentinus*) cut into 3.8–5.0 cm pieces were used as bait. Bait was thawed within 24 hours of use and only the squid body was used (head and tentacles discarded).

Survey Design

The goal of the survey redesign in 2013 was to improve overlap in the distribution between the SSEI longline fishery and survey. The new design consists of six strata, one for each of the statistical areas in Clarence Strait (325533; 325531, 315502, 315432) and two for the Dixon entrance statistical areas, which includes one for western Dixon entrance (325401 and 325431) and one for eastern Dixon entrance (315431) (Figure 5). The number of stations for each stratum were proportionally allocated based on the area of sablefish habitat (Table 2). Stations were randomly located in each stratum within the delineated sablefish habitat while maintaining a minimum distance between random points of 5,400 m; this distance was set based on the average set length of 3,000 m and a bait odor of 1,200 m, which is the minimum distance sablefish can detect bait odor after one hour of soaking (Sigler 2000). Department staff worked with contracted fishermen during the 2013 survey to adjust sets prior to setting if there were problems with station locations (e.g., current direction, too-shallow depth, or bottom feature that would make it difficult to set or retrieve gear). After the survey, department staff reviewed comments by contracted fishermen regarding station locations and noted five survey stations set in 2013 that were not in sablefish habitat or too close to underwater cables; as a result, these stations will be replaced in 2014 with nearby survey stations that were fished prior to 2013.

The area of sablefish habitat was estimated for each stratum using bathymetry data and/or commercial fishery logbook data. Point bathymetry data were interpolated to a continuous surface and depths greater than or equal to 200 fm were selected as sablefish habitat for Clarence Strait in locations where bathymetry data were available; 200 fm is typically the minimum depth associated with sablefish catches in Chatham and Clarence Strait. For Dixon Entrance, bathymetry point data were unavailable and examination of fishery logbook data indicated sablefish in this area were caught in depths shallower than 200 fm. As a result, we delineated sablefish habitat in Dixon Entrance based on the presence of SSEI commercial fishery longline sets from 2003 to 2013.

Survey Data Collection

Set information was collected at each station and included date and time of set and haul, start and end latitude and longitude, deployment depth of each anchor and skate, haul-back direction, wind direction and speed, and bottom substrate (Appendix A–B). Substrate was evaluated based on the skipper's interpretation of sounder information and whether any of the substrate was attached to fishing gear (i.e., mud on the anchors). Problems with gear or other factors potentially affecting CPUE, such as the presence of sharks and whales, were recorded.

For each set, an observer performed accounting of all hooks; fish species were enumerated and hooks without fish were recorded as "bare," "bait," or "invalid," which included hooks that were bent, broken, missing, or associated with a snarl. Fish breaking the water surface attached to a hook were identified to the lowest possible taxonomic group and tallied. All species other than sablefish, rockfish, and Pacific cod were immediately released. *Sebastes* rockfish were retained, because their closed swim bladder can result in mortality from barotrauma. However, shortspine thornyhead rockfish (*Sebastolobus alascanus*) were released immediately after sampling if fish appeared healthy; their open swim bladder allows more resilience to pressure changes that occur during fishing. Halibut were retained only if the survey vessel skipper had halibut individual fishing quota. Additional information was noted for captured sablefish as follows. If sablefish were not landed but broke the water surface attached to a hook, were recorded as "lost." Sablefish less than approximately 45 cm were recorded as "small" and immediately released unless the fish was selected as a random biological sample. Non-marketable sablefish were released with the discard reason reported as "flea," "shark," or "general"; sablefish with evidence of hagfish (*Eptatretus deani*) damage were reported under the "general" discard category.

BIOLOGICAL DATA (SURVEY AND FISHERY)

In 2013, sablefish biological samples were collected at sea during the longline survey and from longline and pot fishery landings in Ketchikan. Sablefish were sampled randomly throughout fishery landings and systematically on the survey (first sablefish of each set and every 10th sablefish thereafter from the first 23 skates of each set) for fork length (nearest cm), weight (nearest 0.1 kg), sex, maturity, and otoliths. No otoliths were sampled from the pot fishery, because only three pot fishery permit holders resulted in a high sampling rate for each landing. On the survey, additional fork length samples were collected from every 11th sablefish from the first 23 skates of each set. Sablefish sex and maturity were assessed for both males and females from visual observation of the gonads based on a 6-stage macroscopic maturity key (Table 3). Otoliths were cleaned, hand-dried, and sent to the ADF&G Age Determination Unit in Juneau for aging using the break-and-burn technique (Williams and Bedford 1974). In 2013, weights collected at sea were measured using Marel motion compensation scales; however, if seas were too rough to obtain repeatable weights during a haul, fish were not weighed. After sampling, all sablefish were cleaned and dressed to industry standards by ADF&G staff.

On the SSEI longline survey biological data were also collected from *Sebastes* and *Sebastolobus* rockfish species. *Sebastes* rockfish were sampled for fork length (nearest cm), weight (nearest 0.1 kg), and sex, which was determined by examination of the urogenital papillae. *Sebastolobus* spp. were measured for fork length only and released alive. All rockfish were identified to the species level.

CPUE (SURVEY AND FISHERY)

A random stratified estimator was used to calculate CPUE for the SSEI survey from 1997 to 2013, weighting each stratum based on the proportion of sablefish habitat. Survey data prior to 1997 were excluded because the survey methodology for soak time had not yet been standardized.

Fishery CPUE was not estimated using a random stratified estimator. ADF&G staff apportions fish ticket pounds to each statistical area using logbook catch by set. Fishery data prior to 1997 were excluded because information was collected through interviews at port; consequently, data

accuracy would be reduced compared to logbook data that was recorded immediately after fishing at sea. Longline fishery gear types were pooled for CPUE analysis, because a multiple regression indicated there was no significant difference between conventional fixed and snap-on gears. Longline fishery sets with killer whale depredation, auto-baiter problems, bad snarls, and clotheslining were excluded.

For the survey CPUE analyses, only valid skates were included that contained < 12 broken, bent, or snarled hooks in a 45-hook skate, and skates with killer whale depredation were excluded. The SSEI longline survey CPUE was calculated for two different sets of data: all fish sampled in the survey and fish ≥ 520 mm. CPUE analyses were performed for the subset of fish ≥ 520 mm to compare with the CPUE for the SSEI longline fishery; few fish < 520 mm are landed in the commercial longline fishery. The CPUE in round lb per hook for an individual stratum was calculated by multiplying the fish per hook for a stratum by the average weight of all fish sampled within that stratum. The CPUE for each stratum was then weighted (multiplied) by the proportion of sablefish habitat in that stratum relative to the total sablefish habitat in statistical areas surveyed in SSEI (Table 2). The overall CPUE for each year was then calculated by summing the weighted CPUEs for all strata. The CPUE for fish ≥ 520 mm was calculated in the same way, with the additional step of multiplying CPUE in round lb per hook for each stratum by the proportion of fish ≥ 520 mm for that stratum prior to weighting.

Fishery and survey CPUE were standardized for hook counts in order to account for variable hook spacing, because sablefish catch per hook increases with hook spacing (Sigler and Lunsford 2001). In order to directly compare SSEI fishery and survey CPUE, all hook spacing was standardized to 1 m using the following formula:

$$N_{std} = N_{unstd}\, C_{\infty}\, (1 - \exp(-kh))$$

where N = the number of hooks and h = hook spacing (Skud and Hamley 1978). This equation suggests that there is an increase in catch per hook with an increase in hook spacing but at a rate that is less than proportional to hook spacing. NOAA Fisheries performed hook spacing experiments to develop the following parameters in order to apply this equation to the directed sablefish longline fishery: $C_{\infty} = 2.2$ and $k = 0.57$. These experiments indicate that sablefish catch per unit hook is close to its maximum at a spacing of 4 meters (Sigler and Lunsford 2001).

RESULTS

SURVEY

A total of 5,575 sablefish were captured on the SSEI longline survey; of these, 5,364 sablefish were retained and sold. Approximately 3% of sablefish were lost before landing, and <1% were discarded because they were too small. The remainder of captured sablefish were discarded due to shark, hagfish, or flea damage.

In addition to sablefish, a total of 2,923 fish and 11 other marine invertebrates were caught during the 2013 survey. Halibut was the most abundant non-targeted species and composed 24% of the incidental catch; skates (*Raja rhina* and *Bathyraja* spp.) made up a substantial portion of the incidental catch with 21%. Shortspine thornyhead rockfish composed 18% of the incidental catch and black hagfish 12%. Other species made up ≤7% of the incidental catch and included the following in descending order of catch: spotted ratfish (*Hydrolagus colliei*), spiny dogfish (*Squalus suckleyi*), arrowtooth flounder (*Atheresthes stomias*), Dover sole (*Microstomus*

pacificus), Pacific cod (*Gadus macrocephalus*), redbanded rockfish (*Sebastes babcocki*), shortraker rockfish (*Sebastes borealis*), rougheye rockfish (*Sebastes aleutianus*), and walleye pollock (*Gadus chalcogrammus*). The proportion of each fish species captured on the longline survey as incidental catch was consistent over time (2000–2013) with the exception of a declining trend in the proportion of dogfish captured and an increasing trend in the proportion of hagfish captured from 2000–2006 (Figure 6).

Biological data on length, weight, and sex were collected for *Sebastes* species in 2013; however, sample sizes were small. A total of 33 redbanded rockfish, 23 rougheye rockfish, and 36 shortraker rockfish were sampled for length, weight, and sex. A total of 483 shortspine thornyhead rockfish were sampled for fork length only. The average fork length was 39 cm for shortspine thornyhead rockfish. Sample sizes were too small to obtain a meaningful average length or weight for *Sebastes* species.

FISHERY

In 2013, 23 permit holders were authorized to fish in SSEI fisheries, 20 in the longline and three in the pot fishery. One longline fisherman did not fish his permit in 2013. A total of 10 pot and 44 longline landings occurred with logbooks and fish tickets collected for each landing.

The SSEI commercial fisheries harvested a total of 505,599 round lb in 2013; the longline fishery harvested 429,259 round lb with an exvessel value of $1,117,189, and the pot fishery harvested 76,340 round lb with an exvessel value $190,550.

The longline commercial fishery was distributed throughout Clarence Strait and Dixon entrance in 2013, with 55% of the harvest occurring in Dixon Entrance and 38% in the lower two statistical areas in Clarence Strait (315432 and 315502) (Figure 2 and Figure 7). The pot fishery was prosecuted in the middle of Clarence Strait (315502) and in Behm Canal (315502), with 67% of the harvest occurring in the middle of Clarence Strait (315502).

BIOLOGICAL DATA (SURVEY AND FISHERY)

In 2013, biological data were collected from sablefish in SSEI during the longline survey, longline fishery, and pot fishery. Length, weight, sex, and maturity data were collected from 448 sablefish from the SSEI longline survey, 449 from the longline fishery, and 553 from the pot fishery. Additional length data were collected from 438 sablefish on the longline survey for a total of 886 length measurements. Otoliths were collected from 447 sablefish on the longline survey and 463 sablefish from the longline fishery; no otoliths were collected from the pot fishery.

In 2013, the average size of sablefish was highest for the longline fishery (63 cm, 2.8 kg) and similar for the pot fishery (59 cm, 2.2 kg) and longline survey (59 cm, 2.1 kg) (Table 4). The length distribution of sablefish varies by sex and between the longline survey and longline and pot fisheries. The female length distribution is shifted to the right with larger females caught compared to males; the male and female length distribution is slightly different for the longline survey and distinctly different for the longline and pot fisheries with a sharp peak in male lengths compared to a more spread out distribution for females (Figure 8). Females had a larger average size in the SSEI survey and fisheries compared to males; the average size of males (61 cm, 2.4 kg) and females (66 cm, 3.1 kg) was largest in the longline fishery compared to the longline survey and pot fishery, which had similar average sizes of males (survey: 58 cm, 2.1 kg; pot

fishery: 57 cm, 2.0 kg) and females (survey: 60 cm, 2.3 kg; pot fishery: 60 cm, 2.4 kg). A larger proportion of males (55%) compared to females were captured on the longline survey; however, a smaller proportion of males were captured in the longline (46%) and pot (37%) fisheries. The average age of sablefish sampled in the longline survey was 7.8 years (Table 5); no otoliths collected from the longline fishery were aged at the publishing of this report.

The 2013 length and age distributions have a single mode and do not indicate any new strong year classes as appear in other length and age distributions (i.e., the 2010 and 2012 survey lengths). However, there were some new recruits to the 2013 SSEI fisheries (Figures 9–11).

Sablefish sampled on the 2013 longline survey were from similar length classes across the survey area with mostly large fish ≥ 620 mm captured. In other years, such as in 2010, the distribution of sablefish by size varied with mostly large fish (≥ 620 mm) captured in the north and small fish (< 520 mm) in the south (Figure 12).

Macroscopic maturity data indicate that the majority of sablefish harvested in the SSEI survey and fisheries are immature, which includes fish that were classified as "immature" and "maturing juvenile." In 2013, the SSEI survey and fisheries had ≥ 73% immature females and > 59% immature males (Table 6; Figure 13). The majority of mature fish had ovaries classified in the inactive state of "spent" or "resting" during the longline survey (98% females; 68% males). During the longline fishery the majority of mature females were inactive (79%); however, the majority of mature males were "mature/developing" (78%). On the pot survey, the majority of mature males (89%) and females (94%) were both "mature/developing" (Figure 14). No spawning females were observed in the fisheries or survey, and only a few males (2%) were observed spawning on the survey and none in the fisheries (Figure 14).

CPUE (SURVEY AND FISHERY)

For the 2013 longline survey, less than 2% of skates (57 skates) were considered invalid and were removed from CPUE analyses. This included sets with killer whale depredation (skates 13–25 from set 4 and all skates from set 5).

Longline fishery CPUE remains stable in recent years with the 2013 estimate similar to the 5-year average; however, the CPUE indices for the last 5 years have remained below the 10-year average (Table 7). The pot fishery CPUE has been variable since 1997. In 2013, the pot fishery CPUE (round lb/pot) declined after 3 years of an increasing trend and is the same as the 5-year average and just above the 10-year average.

A large decline in survey CPUE occurred from 2006 through 2010; CPUE appeared to have stabilized in 2011 and 2012 but declined again in 2013 (for CPUE calculated both with and without the five stations that will be replaced in the 2014 survey) (Figure 15). The 2013 SSEI longline survey CPUE (all fish and subset of fish ≥ 520 mm) was below the 5- and 10-year averages (Table 7); however, when the five stations that will be replaced in 2014 were excluded from the analyses, the 2013 survey CPUE was still below the 10-year average but similar to the 5-year average (Table 7). The 2013 survey CPUE declined for all indices, CPUE measured in round lb and fish per hook for all fish and the subset of fish ≥ 520 mm with and without the five stations that will be replaced in the 2014 survey (Figure 15).

Both survey and fishery CPUE in western Dixon Entrance are higher and more variable than in other strata, especially for the survey CPUE (Figure 16 and Figure 17). For simplicity, the 2013 survey CPUE indices by area are presented only with the five stations excluded that will be

replaced in 2014. A decline in the 2013 survey CPUE in lb per hook was driven by sharp decreases in CPUE in both western Dixon Entrance (325401/325431) and lower Clarence Strait (315432) (Figure 16). However, in eastern Dixon entrance (315431) there was an increase in survey CPUE in 2013, and in other areas CPUE remained fairly consistent. For the longline fishery, there was no change in the overall CPUE for 2013; however, there was a decrease in CPUE for the statistical areas in the northern (325533 and 325531) and middle (315502) parts of Clarence Strait and an increase in lower Clarence Strait (315432) and Dixon entrance (315401, 315431, 325401, and 325431) (Figure 17). The survey CPUE appears to sharply decline in western Dixon entrance while the fishery CPUE slightly increases (Figure 16 and Figure17).

DISCUSSION

BIOLOGICAL DATA

The average size and age of sablefish differs among the SSEI survey and pot and longline fisheries, with the oldest and largest fish (on average) captured in the longline fishery (Table 4 and Table 5). Longline fishermen are probably discarding small fish or targeting fishing locations with larger sablefish. The smaller average age and size of fish captured in the pot fishery compared to the longline fishery may be due to differences in selectivity between gear types.

Before 2010, the sablefish age composition in SSEI had been compressed, with few old sablefish captured and no substantial recruitment of new year classes. However, recruitment was observed in the 2010 SSEI longline survey length and age distributions and was then observed in the 2011 age and length distributions for the SSEI pot and longline commercial fisheries (Figure 10 and Figure 11). These influxes of small fish may appear later in the commercial longline and pot fisheries due to discards of small fish by the commercial fleet. Another recruitment pulse was observed in the 2012 survey but is smaller than in 2010 (Figure 9); these fish may be contributing to the 2013 pot and longline fisheries as indicated by some smaller fish in the fisheries length histograms (Figures 10–11). Recent sablefish recruitment was also observed in the NSEI Subdistrict (Stahl and Baldwin 2013) and the Gulf of Alaska federal trawl survey (Hanselman et al. 2013). The SSEI survey is considered to be a good indicator of future recruitment strength to populations in other areas, specifically Chatham Strait (Bracken et al. 1997). Sablefish tagged in Clarence Strait have higher migration rates than sablefish tagged in other areas of the eastern Gulf of Alaska (D. Hanselman et al. *In prep*) and are recovered over a broad geographic area, including Chatham Strait, the continental slope in the Gulf of Alaska, the Aleutian Islands, and along west coast of Canada (Figure 18). However, no tagging has been performed in Dixon entrance, where migration patterns may differ with Clarence Strait as indicated by variation in size classes in some years (Figure 12).

Historically, a greater proportion of immature fish are typically harvested in the SSEI commercial pot and longline fisheries than in the NSEI or Gulf of Alaska commercial fisheries. On average, 43% of females sampled in SSEI were immature in the SSEI longline fishery and 74% in the SSEI pot fishery since 2001 (Table 6; Figure 13). The percent of immature females sampled from the SSEI survey and commercial fisheries steadily increased from 2008 through 2012; in 2013, it continued to increase in the longline fishery but declined for the pot fishery and longline survey. In 2013, 76% of females sampled in SSEI were immature in the longline survey, 73% in the commercial longline fishery, and 76% in the commercial pot fishery (Table 6; Figure 13). The high proportion of immature females harvested in recent years may be due to recent

recruitment to these fisheries (Figures 9–11). However, the proportion of immature females harvested was the highest recorded in the commercial pot fishery in 2012 and in the longline fishery in 2013. The proportion of immature males in the SSEI fisheries and survey has also generally been increasing in recent years; however, this trend has not been as steady of an increase as it has been with females. The proportion of immature males in the pot fishery increased since 2005 to a peak of 80% in 2011 and then declined in the last two years. The proportion of immature males in the longline survey and fishery increased overall from 2009 to 2013; in the last year, the proportion of immature males increased for the fishery but declined for the survey (Figure 13). This increase in the proportion of immature males and females in the 2013 longline fishery is probably due to the contribution of the pulse of small fish observed in the 2012 survey. Differences in trends between males and females are not surprising; males generally mature at a younger age and size than females. Another hypothesis for the increase in the proportion of small fish in the longline fishery is the shift in commercial harvest from Clarence Strait to the Dixon Entrance area (Figure 2). The survey data indicate that larger, more mature fish are found in the northern part of Clarence Strait (Figure 12), and if the proportion of commercial harvest from this region has decreased, younger, immature fish caught in other areas may contribute disproportionately to the overall harvest.

Some misclassification of mature fish as immature is possible with macroscopic maturity staging, especially for samples collected further away from the spawning season; however, analysis indicates misclassification rates in SSEI are minimal. It is possible that small ovaries from mature inactive ("spent" or "resting") fish and those from immature ("immature" and "maturing juvenile") fish may appear similar to inexperienced samplers. However, ovaries from fish that have not spawned before will be translucent compared to opaque ovaries for mature individuals; in addition, some follicle structure from spawned oocytes (eggs) may also be noticeable in mature inactive ovaries (Table 3). An indication that misclassification rates may be minimal in SSEI is that sablefish preparation for spawning progresses as sampling occurs closer to the winter spawning season, with fewer fish staged as "inactive" during the pot fishery that occurs in the fall (Aug. 15–Nov. 15) compared to the longline survey that occurs in May. If high rates of misclassification were occurring with inactive fish staged as immature, then a decline in the proportion of inactive fish as sampling occurs closer to the spawning season might not be observed. In 2013, the proportion of fish staged as inactive decreased as the proportion of "mature/developing" (stage when gonads become large with developing eggs or sperm) fish increased, with the majority (98% females; 68% males) of mature fish sampled on the longline survey at inactive stages and with few (5% females; 11% males) mature fish at inactive stages in the pot fishery (Figure 14). During the summer longline fishery (June 1–Aug. 15), which occurs between the longline survey and pot fishery, the majority (79%) of females were still inactive, but the majority (78%) of males were "mature/developing" (Figure 14). The change in the proportion of inactive females (98% to 5%) between the longline fishery and pot fishery was more dramatic than for male sablefish (68% to 11%), with female preparation for spawning lagging behind males (Figure 14).

CPUE

The general decline in survey CPUE since 2006 is cause for concern (Figure 15). Although the fishery CPUE is currently stable, it is still below the 10-year average (Table 7). In addition, fishery CPUE may remain stable while biomass declines if fishing is concentrated in preferred habitat where fish are at higher densities. For example, Northeast Arctic cod, *Gadus morhua,*

stocks declined while CPUE remained stable when fish concentrated in warmer waters during a cooling period of the Barents Sea (Nakken 2008). The decline in the survey CPUE in 2013 appears to be driven by a decline in CPUE in western Dixon entrance (325431/325401) and at the mouth of Clarence Strait (315432) while the fishery CPUE increased slightly in these areas (Figure 16 and Figure 17). Both the survey and fishery CPUE in western Dixon entrance (325431/325401) have been higher and more variable than other areas, especially for the survey CPUE (Figure 16 and Figure 17). Some of the variability in CPUE for Dixon Entrance may be explained by the increased movements of fish in this area, as evidenced by the large differences in size classes observed in the survey stations in this area between 2010 and 2012 (Figure 12). The differences in the size classes of sablefish among the years are greater than interannual growth alone could explain and are probably due to high levels of migration of different size classes of fish in and out of Dixon Entrance. However, some of the variability in the survey CPUE prior to 2013 may have been due to the low number of survey stations that were allocated in this area (Figure 4). Fishery CPUE may have been more stable in western Dixon entrance due to the high proportion of commercial fishery harvest in this area (Figure 7 and Figure 17). With the 2013 survey redesign, the number of stations in western Dixon Entrance was increased (from three to seven stations) in order to reflect the fishery distribution and the area of sablefish habitat available in this region. The 2013 SSEI survey CPUE remained higher in western Dixon entrance than other areas (Figure 16); after a few years of data collection, we will be able to determine if the increased number of survey stations in this area will reduce the variability of CPUE or if this variability is characteristic of this fish population.

The decline in the pot fishery CPUE in 2013 may be another indication that the sablefish biomass is declining in SSEI. However, the limited participation in this fishery (three to five permit holders) may result in the performance of an individual permit holder overly influencing the CPUE. In addition, the pot fishery CPUE may have greater sensitivity to recruitment than the longline fishery, because younger and smaller fish are typically harvested in the pot fishery compared to the longline fishery (Table 4 and Table 5). This is demonstrated by the high CPUE in 2012 that occurred with the influx of small fish to the area.

MANAGEMENT

For the 2014 SSEI fisheries, an AHO of 536,618 round lb was recommended with an 8% decrease from the 2013 AHO. This decrease was prompted by several factors: a declining trend in the SSEI longline survey CPUE for the past several years, record high harvest of immature sablefish in the SSEI survey and commercial fisheries in the past two years, and historic lows in the adjacent federal Gulf of Alaska sablefish longline survey abundance indices (Hanselman et al. 2013). Incoming year classes of sablefish first observed in the 2010 and 2012 SSEI surveys (Figure 9) and later in the pot and longline fisheries (Figure 10 and Figure 11) are encouraging for future improvements in stock status, but a large proportion of immature female fish continue to be observed in the survey and fishery (Table 6 and Figure 13). There has been record harvest of immature female fish in the fisheries in the last two years (> 60% immature in the 2012 and 2013 longline fishery and > 75% in the 2012 and 2013 pot fishery) (Table 6). For the past several years, the department has been concerned about the large proportion of sablefish that are harvested in the SSEI commercial fisheries before spawning. In the Eastern Gulf of Alaska, the proportion of immature sablefish caught on the federal longline survey also increased in 2011 (64% immature females), probably due to incoming recruitment; by 2013, only 14% of the survey catch was immature (Cara Rodgeveller, NOAA Fisheries, personal communication).

Sablefish caught in the NSEI fishery and survey are typically > 90% mature. However, the proportion of immature fish in the SSEI survey and fishery has remained high despite the fact that these fish should be maturing and recruiting to the fishery over the years. These concerns about the spawning biomass of the SSEI stock contributed to the recommendation to reduce the 2014 AHO.

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REFERENCES CITED

Bracken, B. 1983. The history of the U.S sablefish fishery in the Gulf of Alaska, 1902–1982. Alaska Sea Grant Report 83-8. 41–47.

Bracken, B. E., D. A. Gordon, and D. Carlile. 1997. Sablefish, *Anoplopoma fimbria*, stock assessment in the inside waters of Southeast Alaska. NOAA Technical Report NMFS 130: 195–206.

Gao, Y., S. H. Joner, R. A. Svec, and K. L. Weinberg. Stable isotopic comparison in otoliths of juvenile sablefish (*Anoplopoma fimbria*) from waters off the Washington and Oregon coast. Fisheries Research 68: 351–360.

Hanselman, D. H., C. Lunsford, and C. Rodgveller. 2013. Chapter 3: Assessment of the sablefish stock in Alaska. Pages 267–376 [*In*] Stock assessment and fishery evaluation report for the groundfish resources of the GOA and BS/AI. North Pacific Fishery Management Council, Anchorage.

Holum, D. D., and E. E. Coonradt. 2005. The Southeast Alaska Southern Southeast Inside sablefish fishery information report with outlook to the 2005 fishery. Alaska Department of Fish and Game, Fishery Management Report No. 05-26, Anchorage.

Kawakami, T. 1980. A review of sperm whale food. Scientific Reports of the Whales Research Institute 32: 199–218.

Kimura, D. K., A. M. Shimada, and F. R. Shaw. 1997. Stock structure and movement of tagged sablefish, *Anoplopoma fimbria*, in offshore northeast Pacific waters and the effects of El Niño-Southern Oscillation on migration and growth. Fishery Bulletin 96: 462–481.

Mason, J. C., R. J. Beamish, and G. A. McFarlane. 1983. Sexual maturity, fecundity, spawning, and early life history of sablefish (*Anoplopoma fimbria*) off the Pacific coast of Canada. Canadian Journal of Fisheries and Aquatic Sciences 40: 2126–2134.

Mecklenburg, C. W., T. A. Mecklenburg, and L. K. Thorsteinson. 2002. Fishes of Alaska. American Fisheries Society, Bethesda, Maryland.

Mueter, F. 2010. Evaluation of stock assessment and modeling options to assess sablefish population levels and status in the Northern Southeast Inside (NSEI) management area. Alaska Department of Fish and Game, Special Publication No. 10-01, Anchorage.

Nakken, O. 2008. Fluctuations of Northeast Arctic cod catches: a review of possible sources. Resiliency of Gadid Stocks to Fishing and Climate Change. Alaska Sea Grant College Program AK-SG-08-01, University of Alaska Fairbanks.

Sasaki, T. 1985. Studies on the sablefish resources in the North Pacific Ocean. Bulletin 22: 1–108, Far Seas Fishery Laboratory. Shimizu, Japan.

Sayer, A., and D. Holum. 2008. The Southeast Alaska Southern Southeast inside sablefish fishery information report with outlook to the 2008 fishery. Alaska Department of Fish and Game, Fishery Management Report No. 08-44, Anchorage.

Skud, B. E., and J. M. Hamley. 1978. Factors affecting longline catch and effort: I. General review II. Hook-spacing III. Bait loss and competition. International Pacific Halibut Commission. Scientific Report No. 64.

Sigler, M. F. 2000. Abundance estimation and capture of sablefish (*Anoplopoma fimbria*) by longline gear. Canadian Journal of Fisheries and Aquatic Sciences 57: 1270–1283.

Sigler, M. F., and C. R. Lunsford. 2001. Effects of individual quotas on catch efficiency and spawning potential in the Alaskan sablefish fishery. Canadian Journal of Fisheries and Aquatic Sciences 58:1300–1310.

Sigler, M. F., C. R. Lunsford, S. A. Lowe, and J. T. Fujioka. 2001a. Alaska sablefish assessment for 2002. In stock assessment and fishery evaluation report for the groundfish resources of the Gulf of Alaska. North Pacific Fisheries Management Council, Anchorage, AK.

Sigler, M. F., T. L. Rutecki, D. L. Courtney, J. F. Karinen, and M.-S. Yang. 2001b. Young of the year sablefish abundance, growth, and diet in the Gulf of Alaska. Alaska Fishery Research Bulletin 8(1): 57–70.

REFERENCES (Continued)

Stahl, J., and A. Baldwin. 2013. 2012 NSEI (Northern Southeast Inside Subdistrict) sablefish mark-tag survey. Alaska Department of Fish and Game, Fishery Data Series No. 13-29, Anchorage, AK.

Tripp-Valdez, M. A., F. J. García-de-León, H. Espinosa-Pérez, and G. Ruiz-Campos. 2012. Population structure of sablefish *Anoplopoma fimbria* using genetic variability and geometric morphometric analysis. Journal of Applied Ichthyology 28: 516–523.

Williams, T., and B. C. Bedford. 1974. The use of otoliths for age determination. [*In*] T. B. Bagenal, editor. The ageing of fish. Proceedings of an international symposium. Unwin Brothers Limited, Surrey, England.

Wing, B. L. 1985. Salmon stomach contents from the Alaska troll logbook program 1977–1984. NOAA Technical Memorandum NMFS F/NWC-91.

Yang, M. S., and M. W. Nelson. 2000. Food habits of the commercially important groundfishes in the Gulf of Alaska in 1990, 1993, and 1996. NOAA Technical Memorandum NMFS-AFSC-112.

TABLES AND FIGURES

Table 1.–Annual harvest objective, equal quota share, and reported harvest (round lb), along with exvessel value and effort for the directed commercial SSEI sablefish fishery since the equal quota share was established in 1997.

				Longline Fishery			Pot Fishery		
Year	Annual harvest objective	Total Harvest	Equal share quota	Harvest	Exvessel value	No. of permits	Harvest	Exvessel value	No. of permits
1997	790,000	725,067	23,200	608,786	$1,345,423	30	116,281	$256,981	5
1998	632,000	578,056	20,400	496,210	$699,656	29	81,846	$113,765	4
1999	720,000[a]	661,424	24,000	565,190	$1,006,038	26	96,234	$193,430	4
2000	696,000	590,815	24,000	494,528	$989,056	25	96,287	$187,760	4
2001	696,000	650,678	24,000	554,490	$1,064,621	25	96,188	$184,679	4
2002	696,000	650,339	24,000	554,074	$1,074,904	25	96,265	$212,746	4
2003	696,000	656,936	24,860	557,102	$1,286,906	24	99,834	$219,635	4
2004	696,000	648,845	24,860	550,472	$871,689	24	98,373	$158,986	4
2005	696,000	639,719	24,860	539,251	$1,127,483	24	100,468	$223,957	4
2006	696,000	624,832	21,750	537,812	$1,224,134	28	87,020	$210,605	4
2007	696,000	620,168	21,750	533,130	$1,306,573	28	87,038	$207,780	4
2008	696,000	618,033	21,750	531,866	$1,598,097	28	86,167	$256,300	4
2009	634,000	595,748	22,650	525,534	$1,553,838	25	70,214	$210,766	3
2010	634,000	558,633	23,400	488,449	$1,790,478	24	70,184	$258,553	3
2011	583,280	540,931	23,300	472,070	$2,309,949	22	68,861	$333,128	3
2012	583,280	521,825	25,360	445,678	$1,564,129	20	76,147	$198,906	3
2013	583,280	505,599	25,360	429,259	$1,117,189	20	76,340	$190,550	3
2014	536,618		23,331			20			3

[a] An AHO of 696,000 round lb was intended by managers; however, a miscalculation occurred by the CFEC with an additional permit holder added after the AHO and EQS were released to the public. As a result, ADF&G increased the total AHO to 720,000 round lb to maintain the 24,000 round pound EQS.

Table 2.–The area and proportion of sablefish habitat by stratum. Proportion of sablefish habitat was used to weight the survey CPUE for each stratum.

Stratum	Sablefish habitat (km^2)	Sablefish habitat/total area
325533	177	0.06
325531	215	0.08
315502	484	0.18
315432	687	0.25
315431	492	0.18
325401/325431	694	0.25
Total	2,748	1.00

Table 3.–Macroscopic maturity used to assess maturity for male and female sablefish in Southeast Alaska.

Maturity stage	Male description	Female description
Immature	Testes very narrow, parallel, flat and ribbon-like, almost clear in color. Longitudinal creases are easily discernable.	Ovaries appear as two narrow (slender) ovoids. May be veined.
Maturing Juvenile	Testes enlarging, not ribbon-like, with four discernable creases running full length. Light pink in color. Has not spawned before.	Ovaries enlarging, translucent and pinkish to clear; eggs not yet discernable. Has not spawned before. Will spawn coming year. More veined. Cloudy, but not necessarily throughout.
Mature/Developing	Testes large and white, each with four distinct lobes. No milt present.	Ovaries large and becoming white to yellowish white with developing eggs discernable and firmly attached.
Spawning	Testes very large and white, extruding milt freely under slight pressure or when cut.	Ovaries very large with large translucent eggs loose within ovary or extruding from the oviduct.
Spent/Post Spawning	Testes large, shriveled, often wrinkled and bloodshot. No milt present.	Ovaries shriveled and opaque, soft and flaccid, often reddish in color.
Resting	Testes large and firm, light brown to off-white in color. No milt present. Has spawned previously. May have wrinkles.	Ovaries large, firm and opaque, not shriveled. No eggs discernable. Has spawned previously. Noticeable follicle structure.

Table 4.–Average fork length (cm) of sablefish sampled in SSEI and NSEI.

	SSEI survey	SSEI longline fishery	SSEI pot fishery
1997	57	No data	No data
1998	57	No data	59
1999	57	No data	59
2000	58	No data	No data
2001	58	63	No data
2002	57	61	No data
2003	58	61	No data
2004	59	62	No data
2005	No data	63	No data
2006	61	66	61
2007	60	63	61
2008	62	66	63
2009	61	65	62
2010	57	64	61
2011	58	63	58
2012	58	63	58
2013	59	63	59
Mean	59	63	60

Table 5.–Average age in years of sablefish sampled in SSEI.

	SSEI survey	SSEI longline fishery	SSEI pot fishery
1997	9.2	No data	No data
1998	8.6	No data	No data
1999	5.8	No data	4.6
2000	8.2	No data	No data
2001	9.5	11.5	No data
2002	7.7	9.9	No data
2003	No data	8.3	No data
2004	8.2	9.2	No data
2005	No data	9.7	No data
2006	9.2	9.4	7.0
2007	8.5	9.7	7.2
2008	10.6	11.8	8.6
2009	10.9	10.7	7.1
2010	7.4	10.7	6.8
2011	8.2	10.6	No data
2012	6.8	8.4	No data
2013	7.8	Not yet aged	No data
Mean	8.5	10.0	6.9

Table 6.–Percent of immature fish in the SSEI longline survey and fisheries.

Year	SSEI survey % females immature	SSEI survey % males immature	SSEI LL fishery % females immature	SSEI LL fishery % males immature	SSEI pot fishery % females immature	SSEI pot fishery % males immature
1988	49%	53%	No data	No data	No data	No data
1989	35%	21%	No data	No data	No data	No data
1990	34%	30%	No data	No data	No data	No data
1991	59%	37%	No data	No data	No data	No data
1992	54%	48%	No data	No data	No data	No data
1993	47%	50%	No data	No data	No data	No data
1994	53%	40%	No data	No data	No data	No data
1995	61%	46%	No data	No data	No data	No data
1996	54%	48%	No data	No data	No data	No data
1997	47%	62%	No data	No data	No data	No data
1998	71%	61%	No data	No data	No data	No data
1999	88%	74%	No data	No data	50%	47%
2000	67%	65%	No data	No data	No data	No data
2001	74%	77%	27%	36%	No data	No data
2002	72%	72%	38%	52%	No data	No data
2003	50%	67%	42%	60%	No data	No data
2004	52%	71%	43%	65%	No data	No data
2005	No data	No data	35%	46%	No data	No data
2006	39%	56%	30%	45%	75%	42%
2007	53%	61%	40%	62%	69%	45%
2008	41%	51%	29%	59%	54%	41%
2009	50%	48%	30%	41%	64%	51%
2010	64%	65%	50%	55%	73%	51%
2011	78%	61%	60%	66%	89%	80%
2012	83%	76%	61%	58%	96%	66%
2013	76%	69%	73%	67%	76%	59%
Mean	58%	56%	43%	55%	72%	54%

Table 7.–CPUE for the longline survey and fishery in round lb/hook and for the pot fishery in round lb/pot from 1997–2013.

Year	Survey CPUE all fish	Survey CPUE ≥ 520 mm	LL Fishery CPUE	Pot Fishery CPUE
1997	0.49	0.40	0.36	34
1998	0.56	0.48	0.35	46
1999	0.78	0.65	0.44	91
2000	0.74	0.69	0.38	45
2001	0.58	0.54	0.31	41
2002	0.71	0.64	0.41	50
2003	0.80	0.73	0.45	69
2004	0.83	0.78	0.40	36
2005	No survey	No survey	0.51	32
2006	0.95	0.92	0.50	36
2007	0.77	0.70	0.49	37
2008	0.81	0.80	0.37	18
2009	0.75	0.71	0.31	19
2010	0.48	0.33	0.33	26
2011	0.79	0.73	0.38	50
2012	0.76	0.71	0.33	71
2013	0.60	0.56	0.33	41
2013	0.67[a]	0.63		
5-year mean (09–13)	0.68	0.61	0.34	41
10-year mean (04–13)	0.75	0.69	0.39	37
5-year mean (09–13)	0.69[a]	0.62		
10-year mean (04–13)	0.76[a]	0.70		

[a] Five stations that will be replaced in 2014 were excluded in these 2013 CPUE calculations.

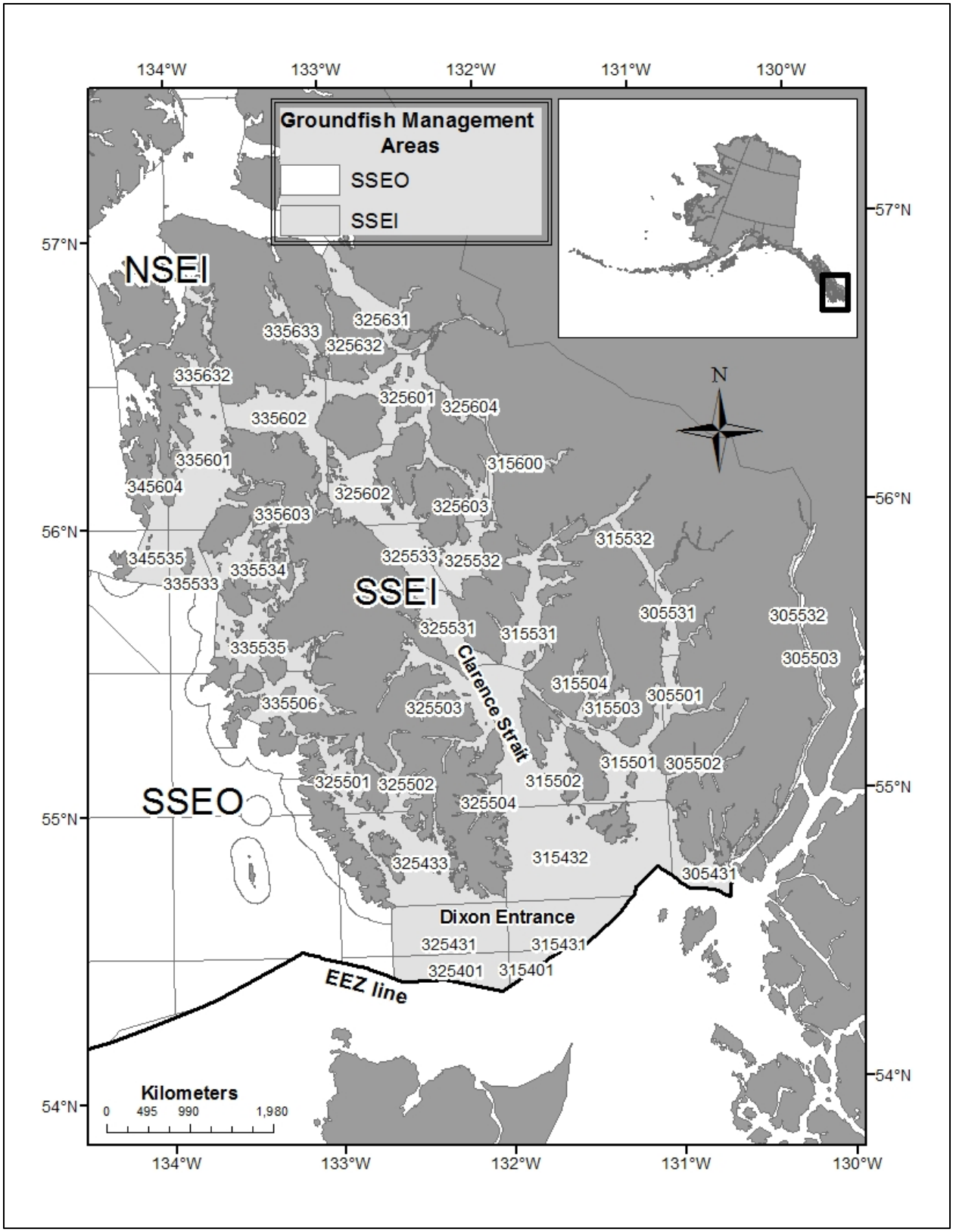

Figure 1.–SSEI Subdistrict with groundfish statistical areas open to fishing.

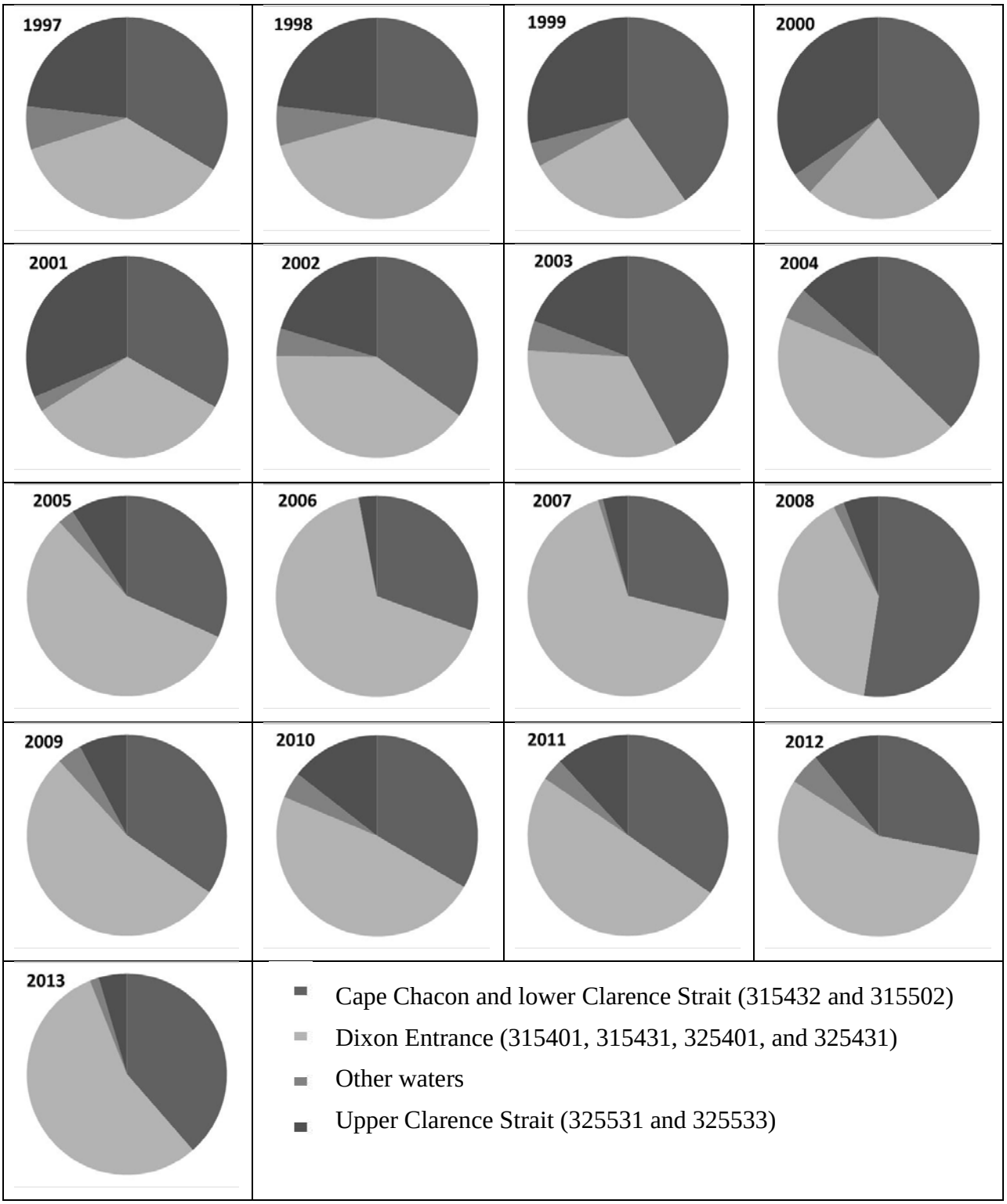

Figure 2.–Harvest distribution by area for the SSEI sablefish commercial longline fishery.

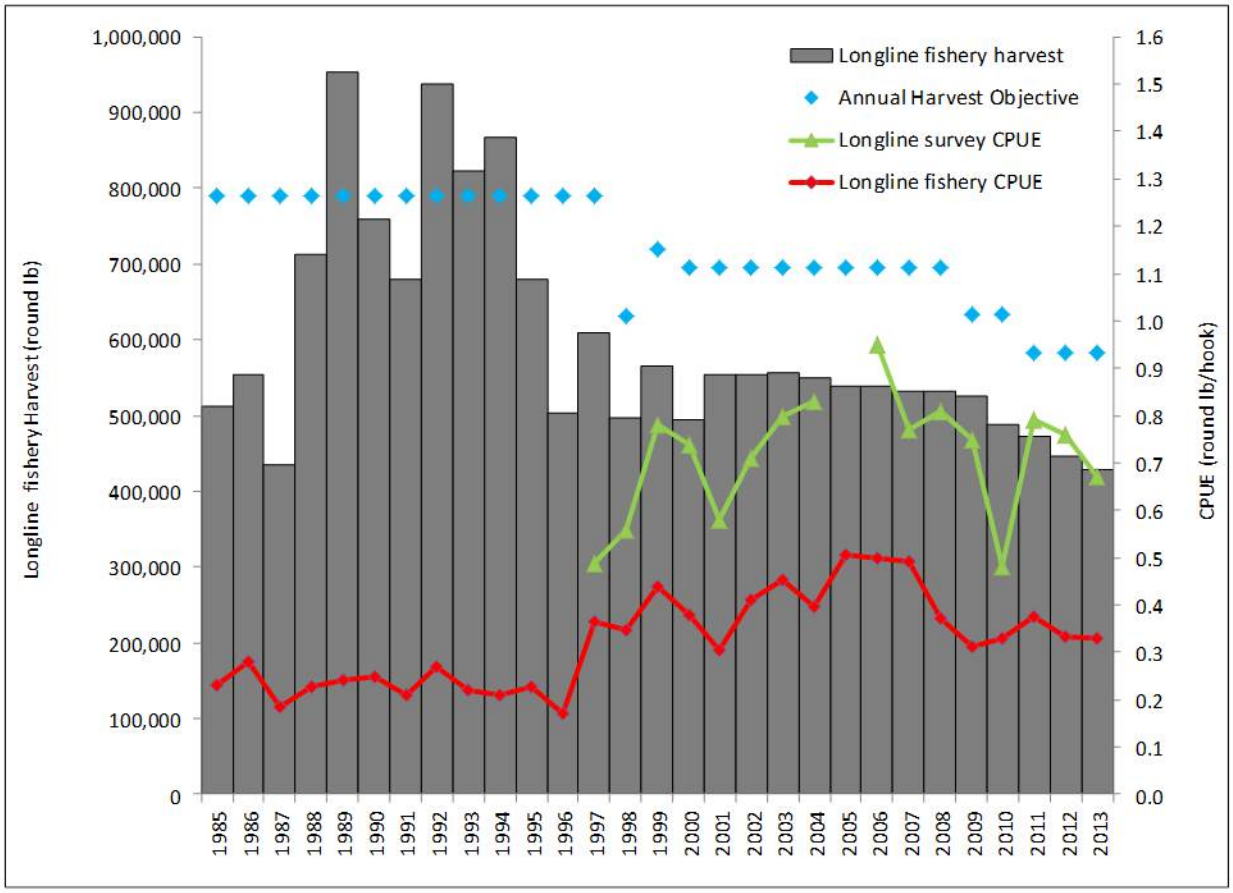

Figure 3.–SSEI longline fishery and survey CPUE and longline fishery harvest with the annual harvest objectives. Survey CPUE is presented since 1997, when survey soak times were standardized. For the 2013 survey CPUE estimate, stations that will be replaced in the 2014 survey were excluded.

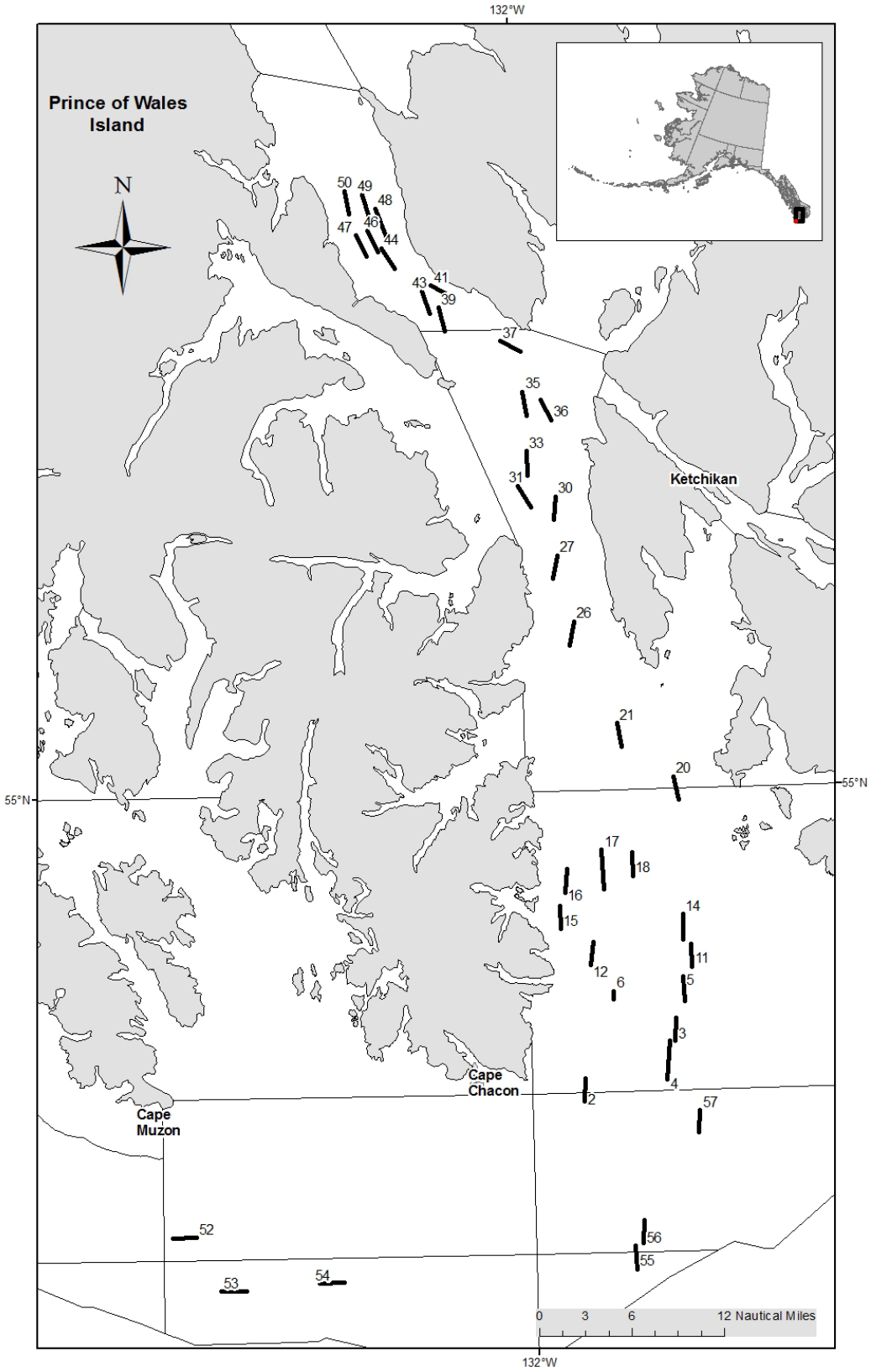

Figure 4.–SSEI longline survey stations fished prior to 2013 redesign.

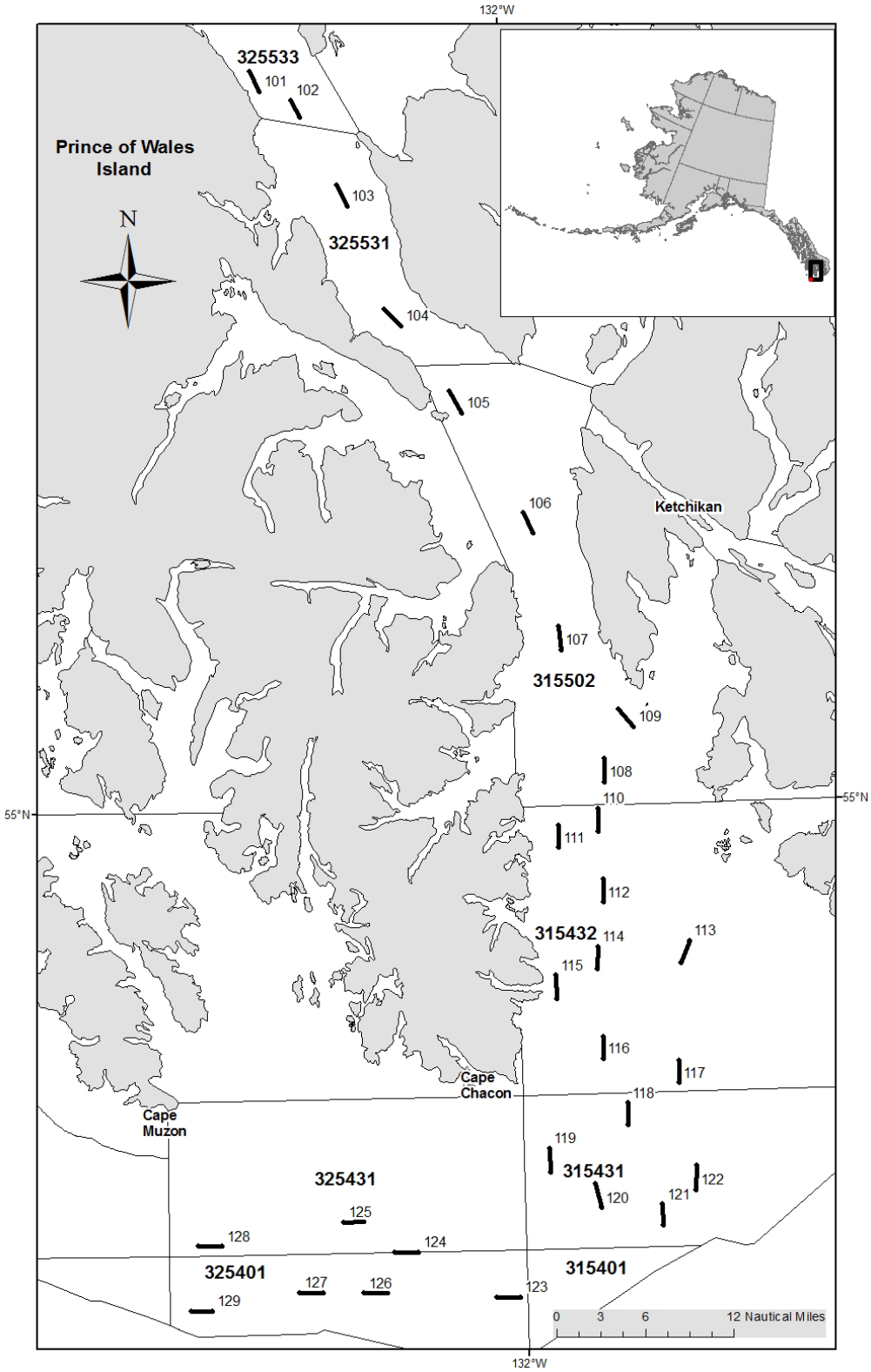

Figure 5.–SSEI Longline survey stations fished during 2013 redesigned survey.

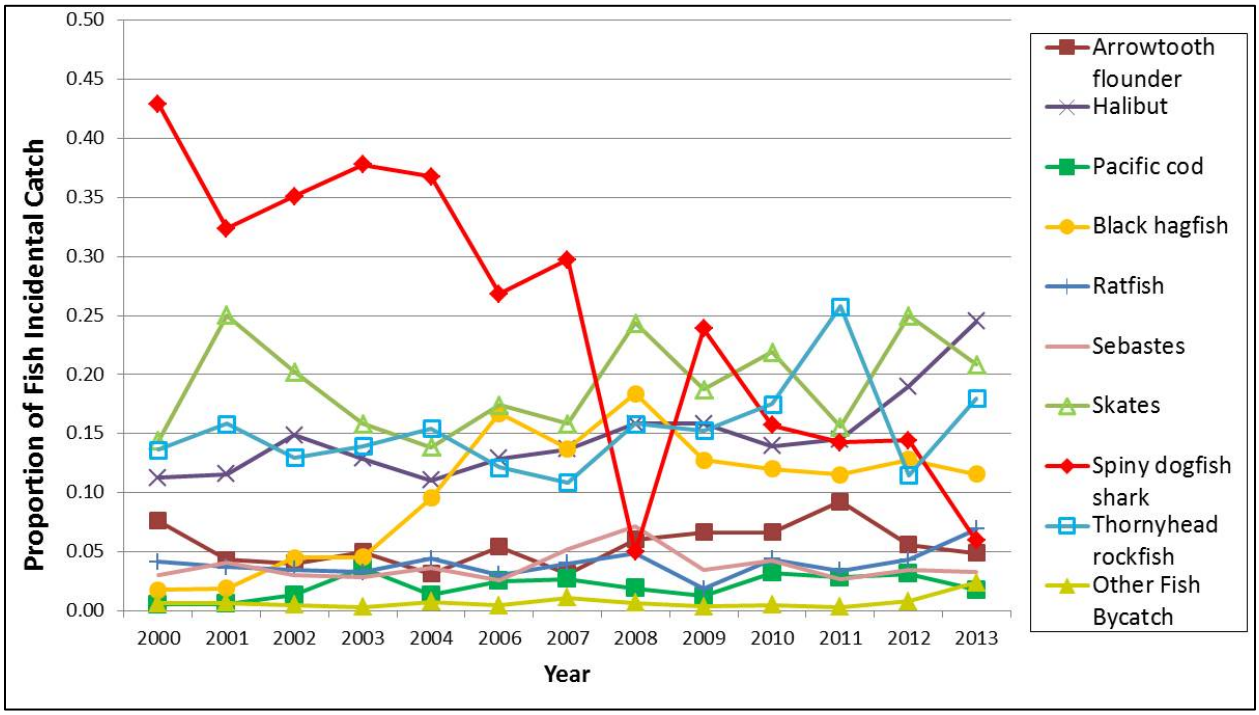

Figure 6.–Incidental catch of fish landed in the SSEI longline sablefish survey, 2000–2013.

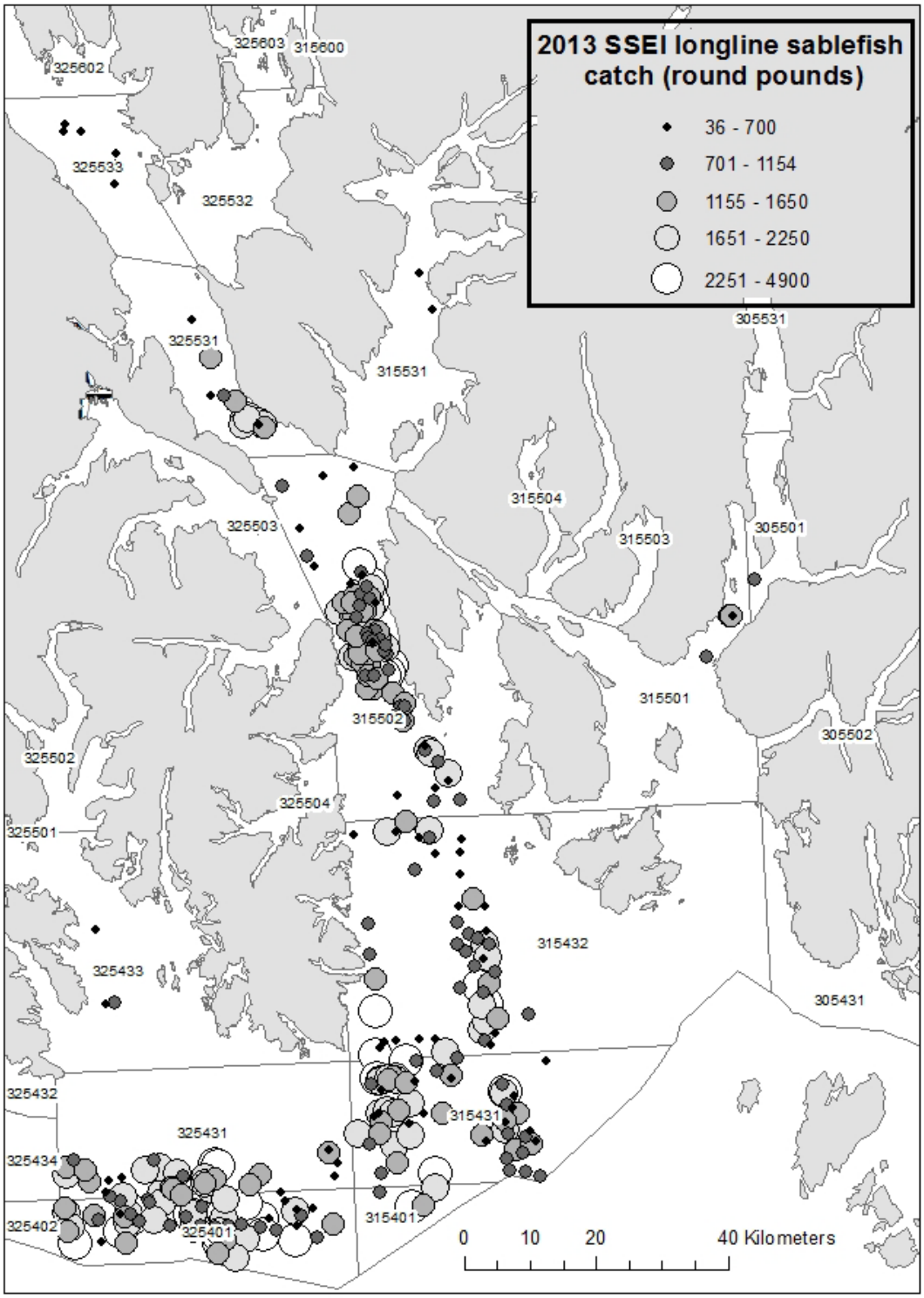

Figure 7.–SSEI 2013 commerical longline fishery catch in round lb and distribution by statistical area.

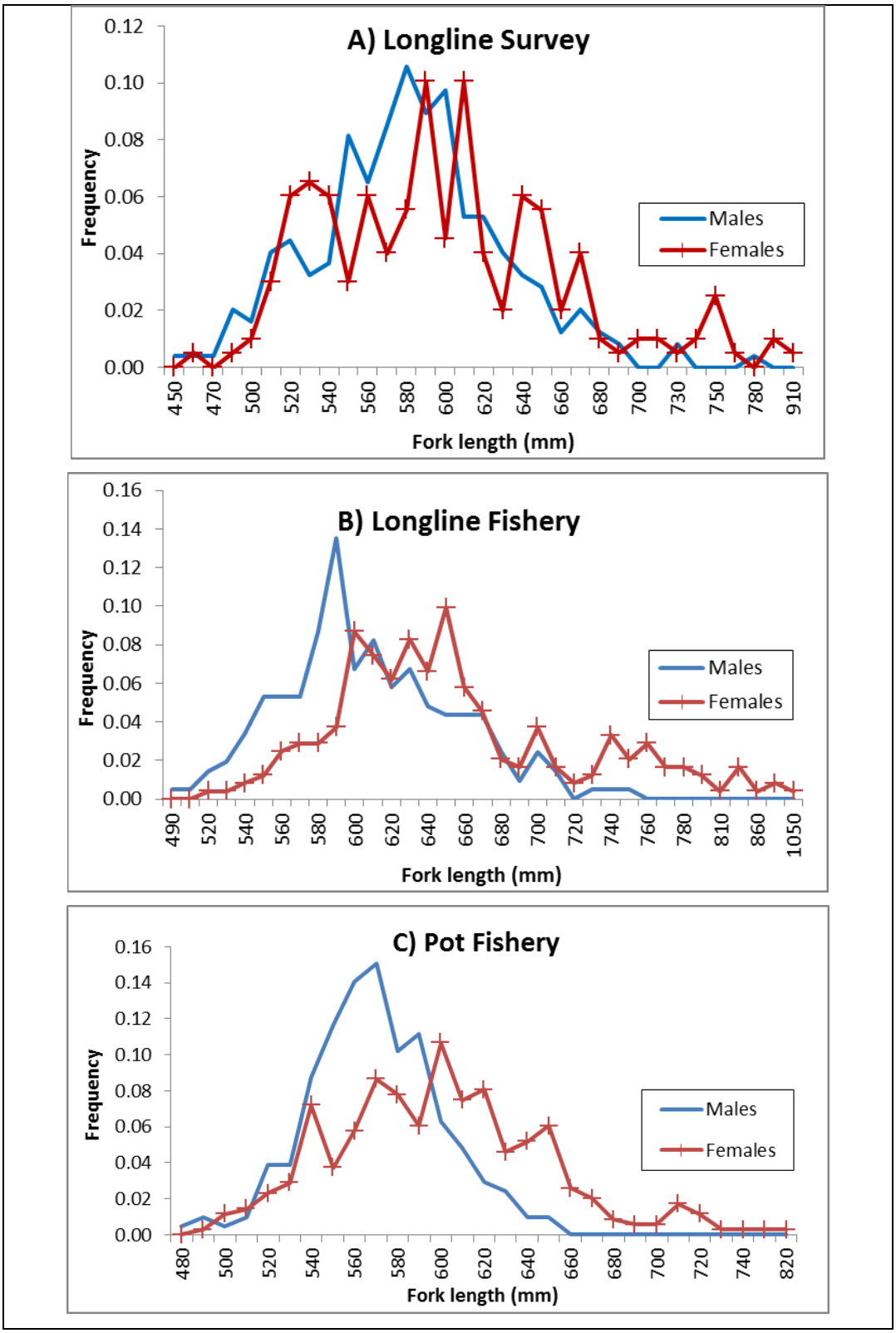

Figure 8.–Length frequency of sablefish by sex from A) longline survey, B) longline fishery, and C) pot fishery.

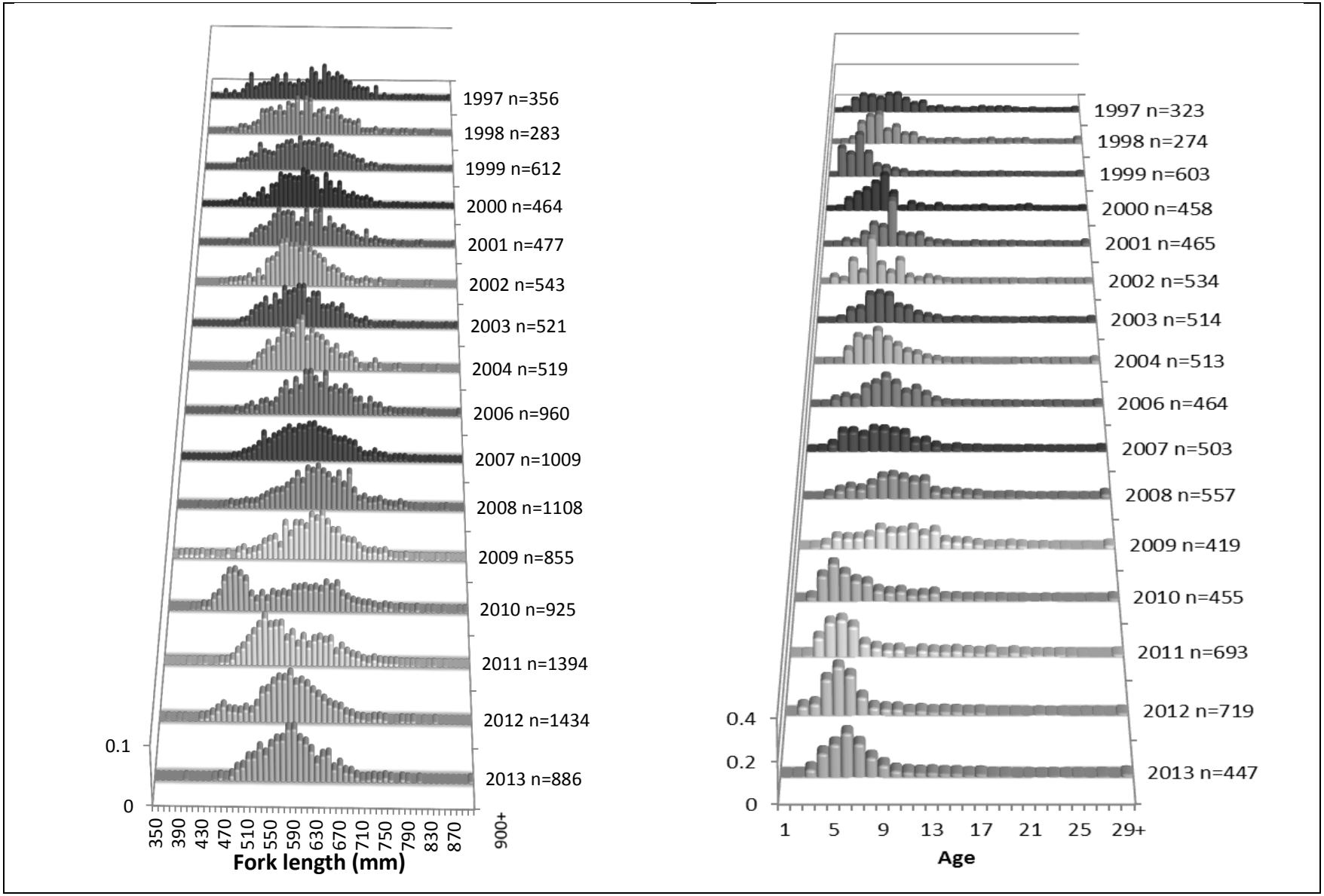

Figure 9.–SSEI longline survey sablefish length and age frequency histograms from 1997 to 2013.

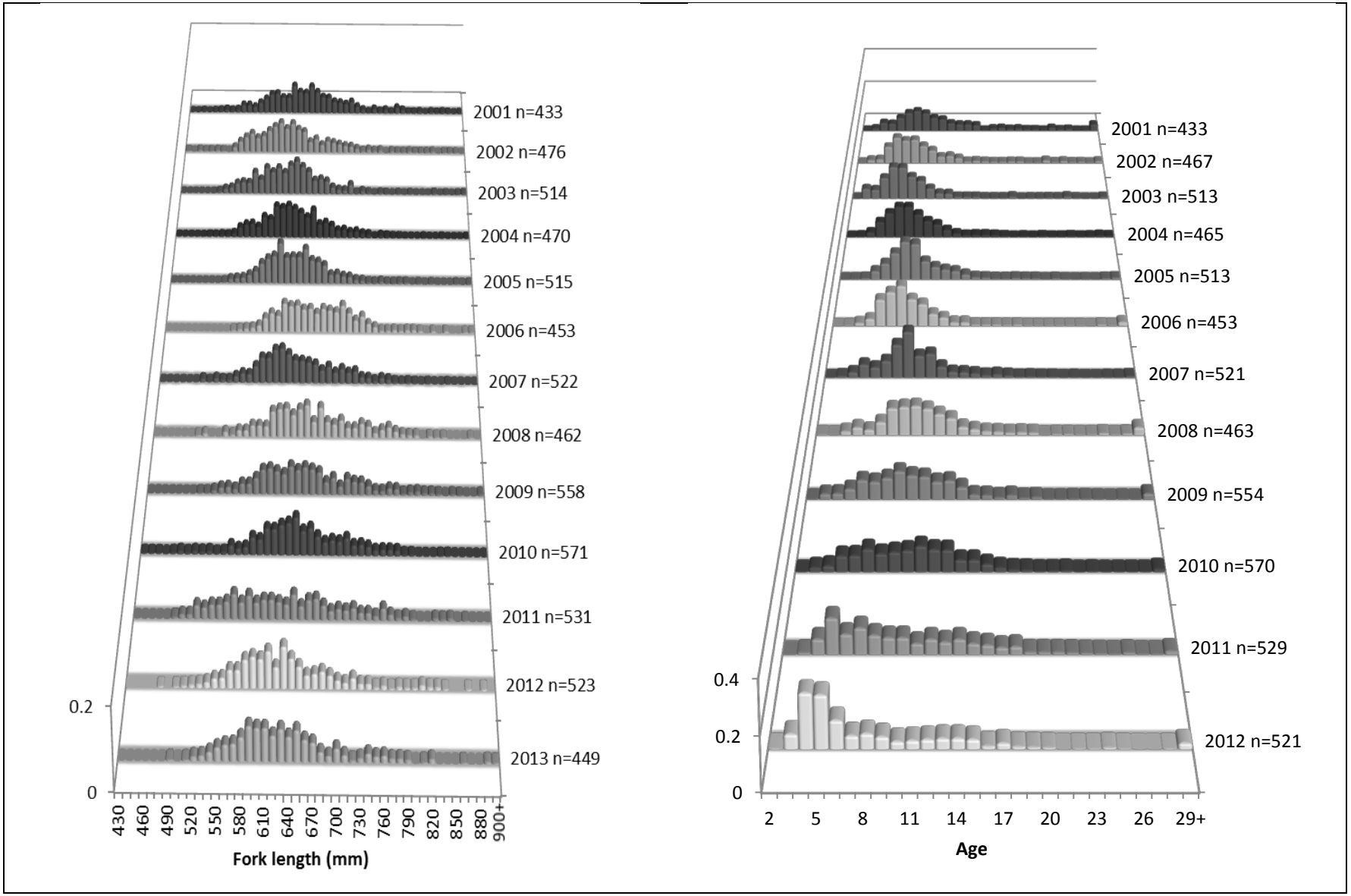

Figure 10.–Sablefish length and age distributions for the commercial SSEI longline fishery from 2001 to 2013.

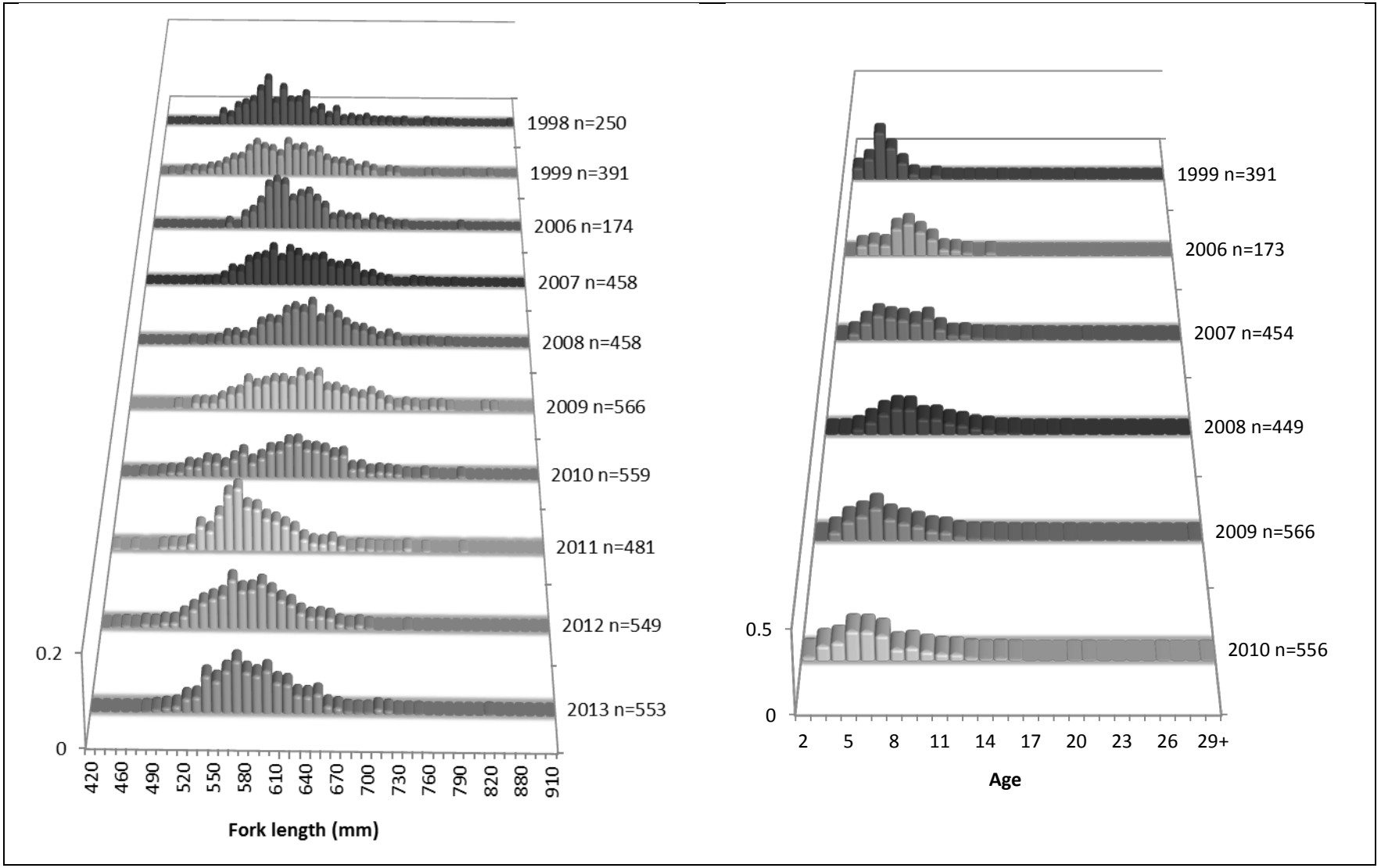

Figure 11.–Sablefish length and age distributions for the commercial SSEI pot fishery from 1998 to 2013. No length data were collected from 2000–2005.

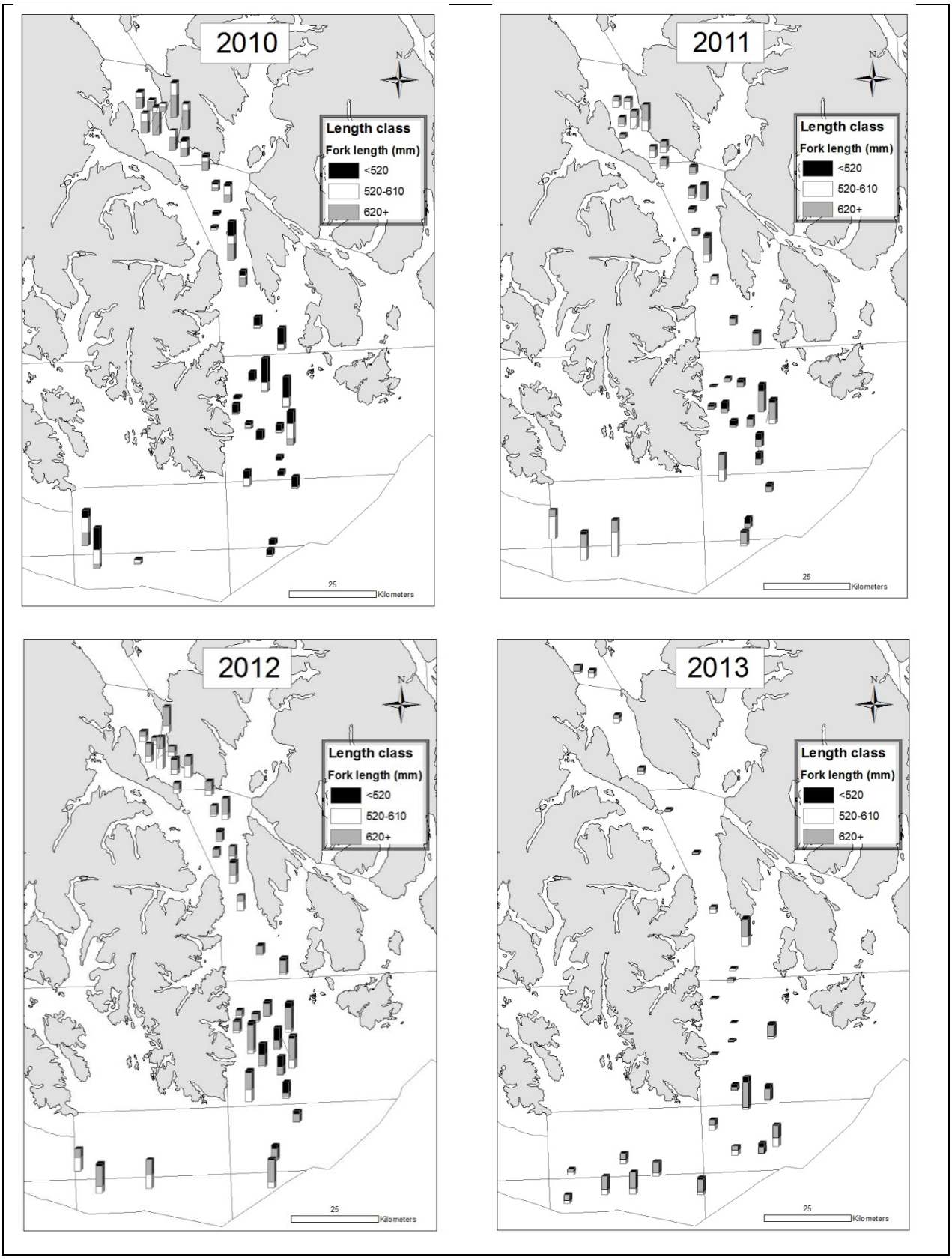

Figure 12.–SSEI longline survey catch by set and length class from 2010 to 2013.

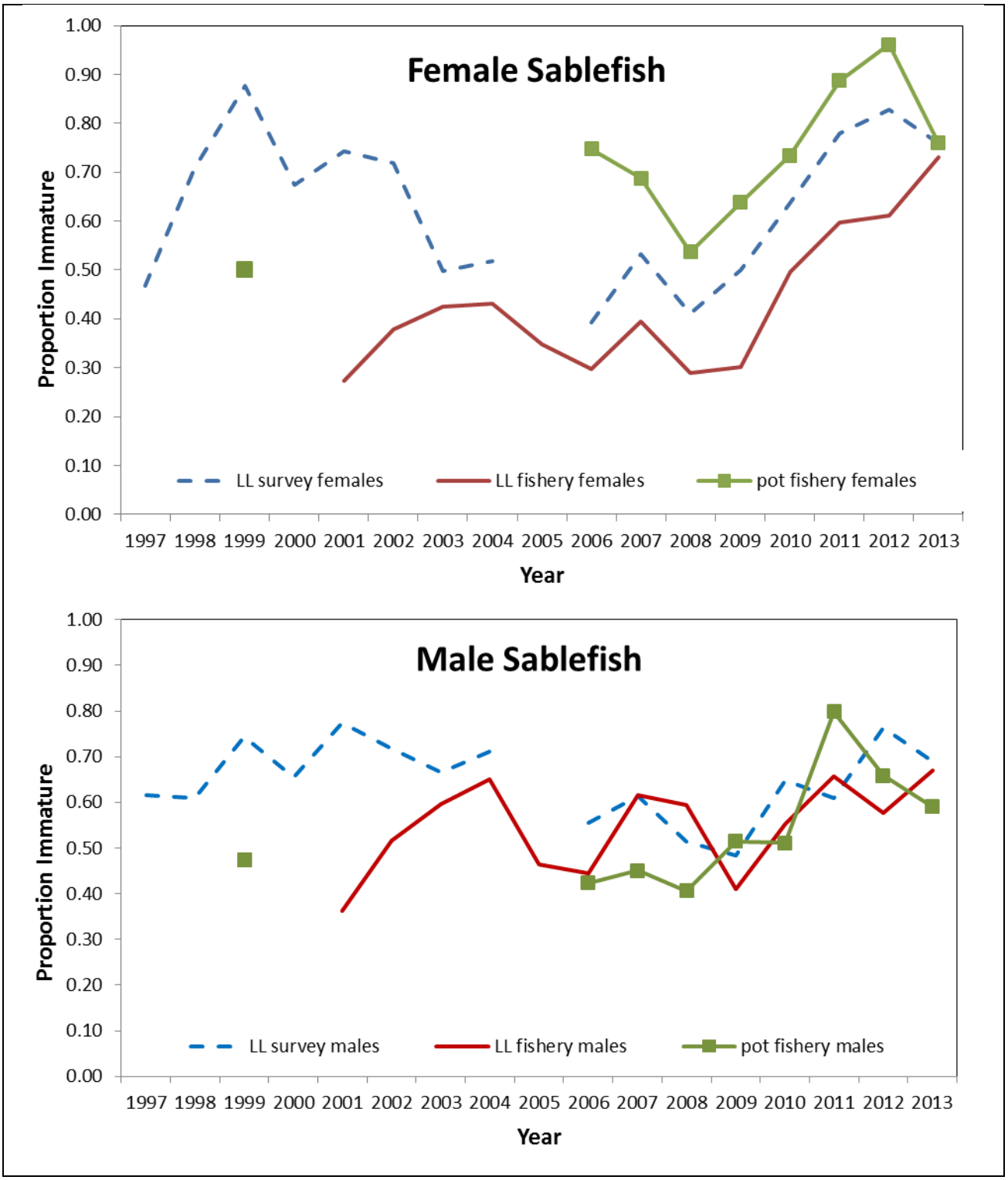

Figure 13.–Proportion of immature female and male sablefish sampled from the SSEI longline survey and the SSEI longline and pot fisheries from 1997 to 2013. Sablefish maturity data for the pot fishery is only available for 1999 and 2006–2013.

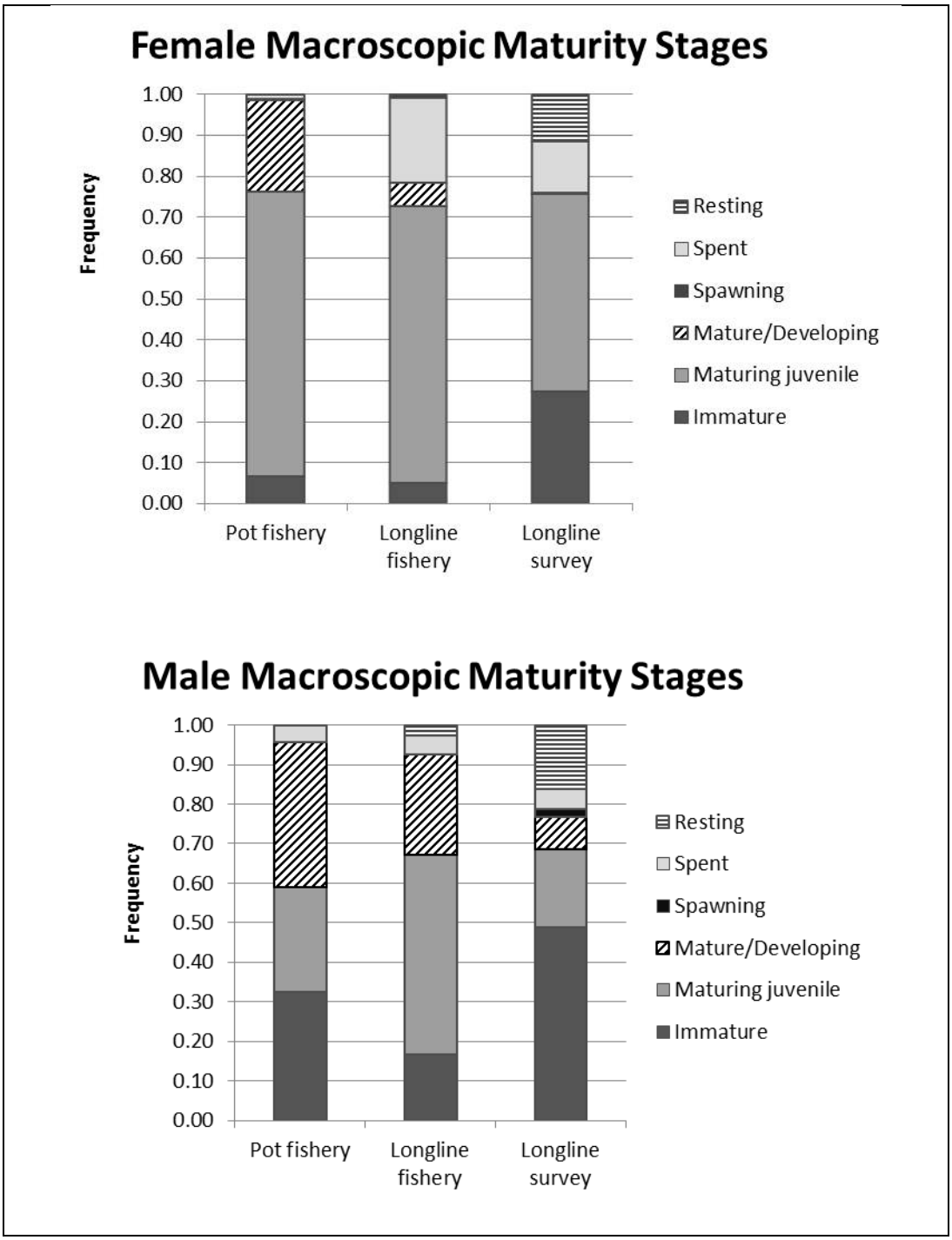

Figure 14.–Macroscopic maturity stages sampled from the SSEI survey and pot and longline fisheries by sex.

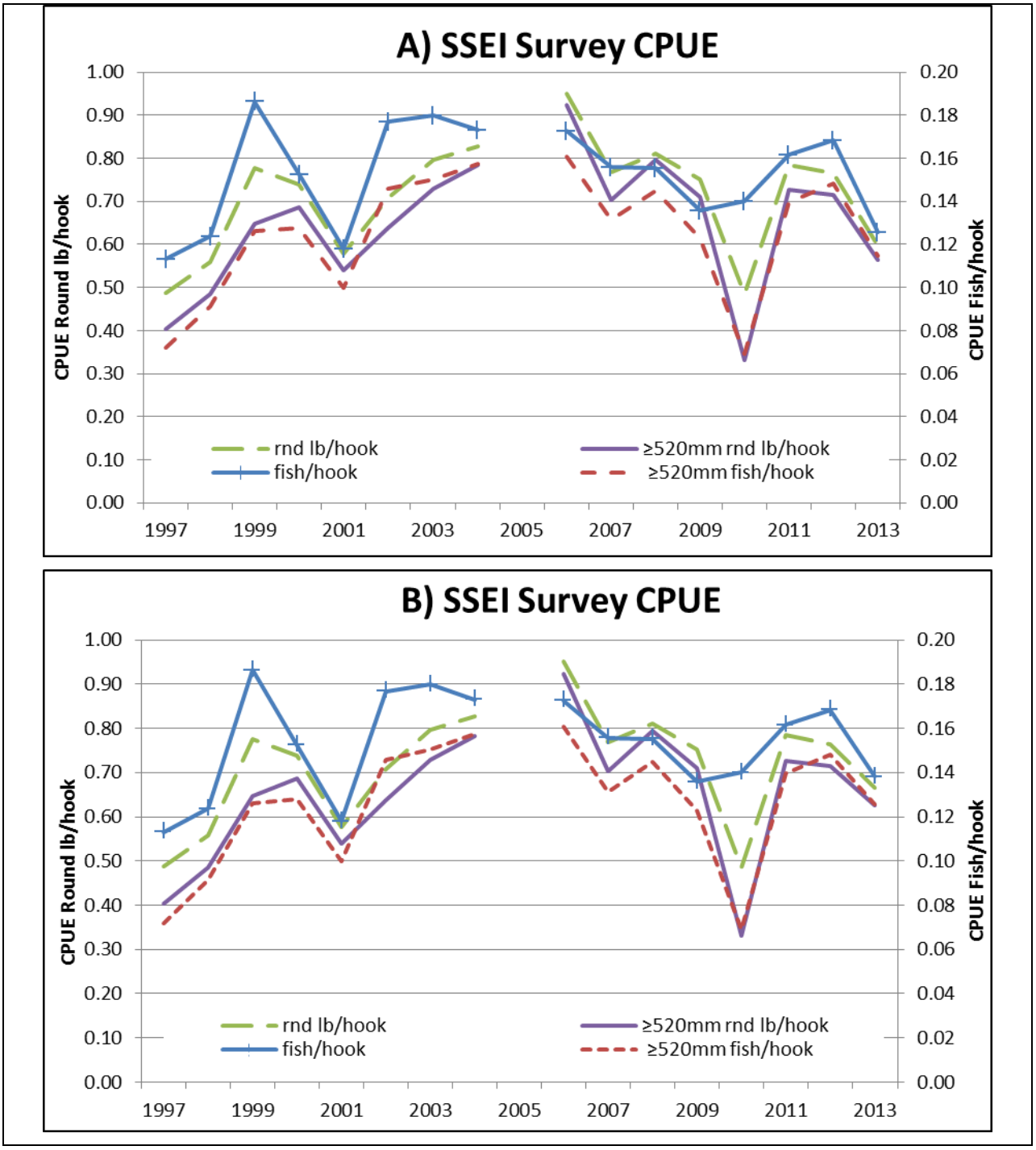

Figure 15.–SSEI Survey CPUE (round lb per hook and fish per hook) weighted by the area of sablefish habitat in each strata for all fish and fish ≥ 520 mm from 1997–2013. The 2013 CPUE estimates in A) include all stations sampled in 2013 and in B) exclude the five stations that will be replaced in the 2014 survey.

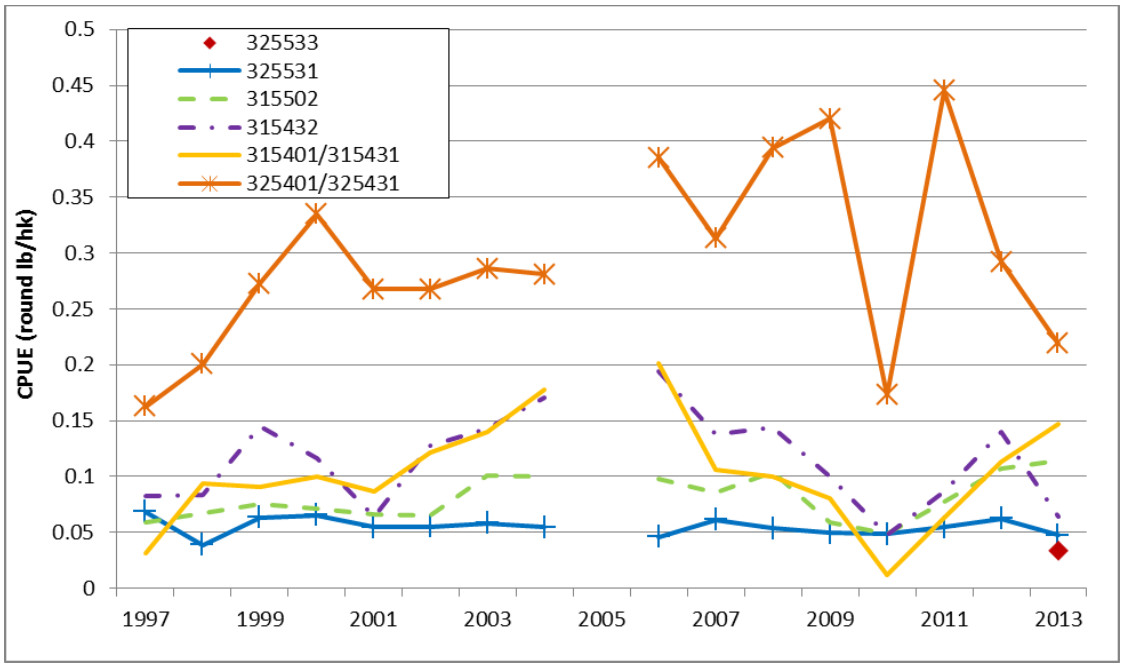

Figure 16.–SSEI survey CPUE (round lb/hook) for fish ≥ 520 mm from 1997–2013. Survey CPUEs are estimated by stratum: northern 1 (325533), northern 2 (325531), middle (315502), and southern Clarence Strait (315432); and eastern (315401 and 315431) and western Dixon Entrance (325401 and 325431). In 2013 statistical area 325533 was added as a stratum, and statistical area 315401 was removed from the eastern Dixon Entrance stratum. CPUE have been weighted by the area of sablefish habitat in each strata. The 2013 CPUE data by strata does not include the five stations that will be replaced in the 2014 survey.

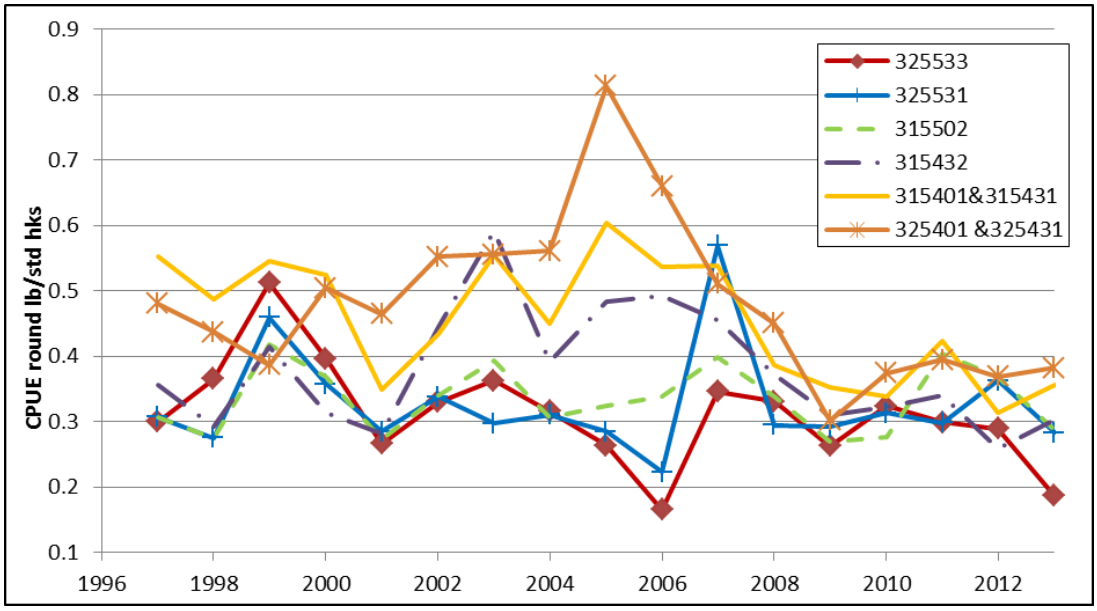

Figure 17.–SSEI longline fishery CPUE (round lb/hook) from 1997–2013. Fishery CPUEs are shown by area within SSEI management area: northern (325533 and 325531), middle (315502), and southern (315432) Clarence Strait; eastern Dixon Entrance (315401 and 315431); and western Dixon Entrance (325401 and 325431). Fishery CPUE data are not weighted by area.

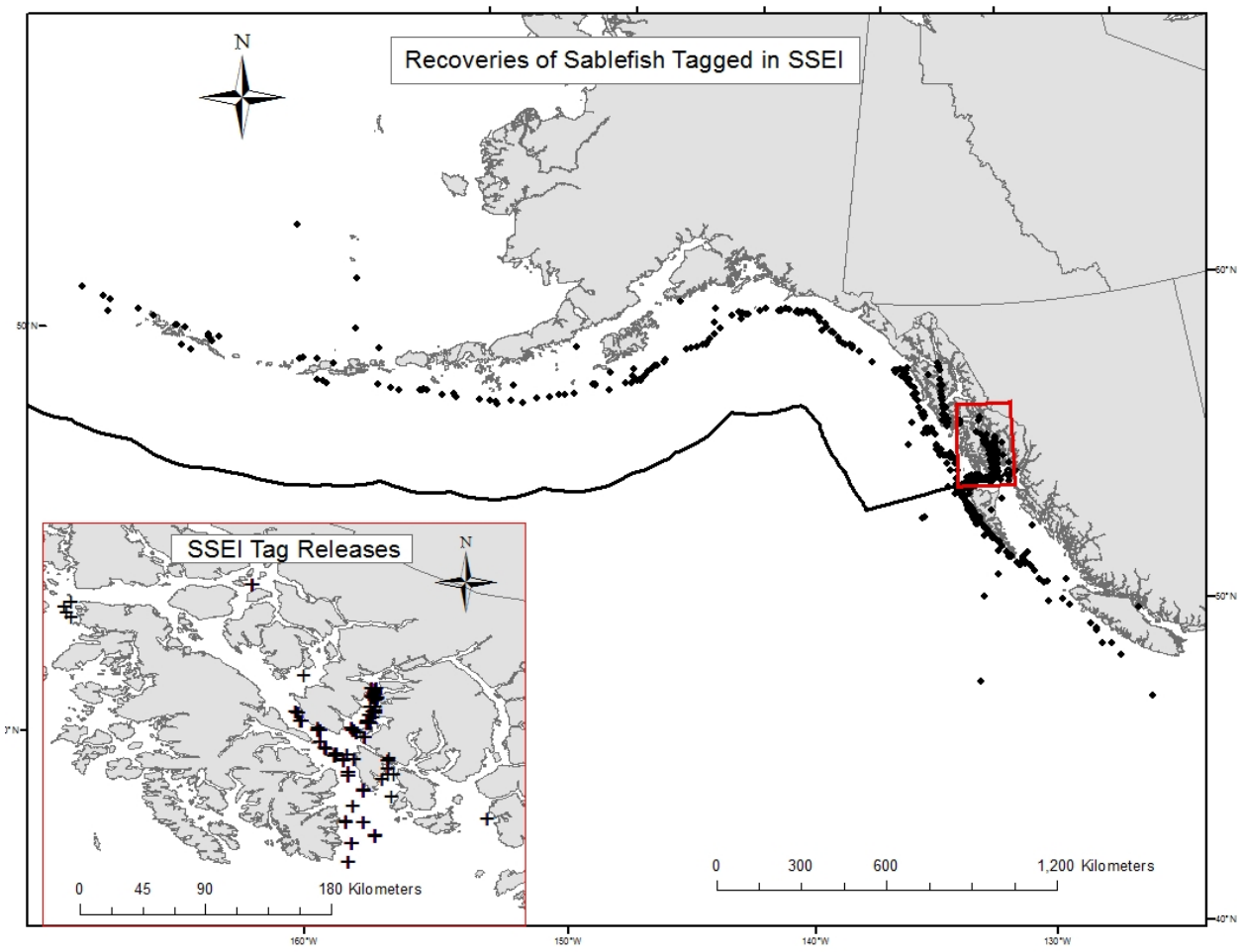

Figure 18.–Tagging (plus symbols) and recovery locations (black diamonds) for sablefish released in SSEI management area. Tag releases occurred from 1979–1981, 1983, 1985–1986, and 1988–1989.

APPENDICES

Appendix A.–Set location information for the 2013 SSEI Subdistrict sablefish longline survey; locations are presented in degrees and decimal minutes.

Station	Statistical area	General location	Area description	Start latitude	Start longitude	End latitude	End longitude
101	325533	Upper Clarence Strait	Little Ratz Harbor	55 48.71	132 28.76	55 50.11	132 29.83
102	325533	Upper Clarence Strait	Narrow Point	55 48.06	132 24.93	55 46.95	132 23.96
103	325531	Upper Clarence Strait	Tolstoi Point	55 40.87	132 18.48	55 42.30	132 19.65
104	325531	Upper Clarence Strait	Lyman Point	55 32.69	132 12.32	55 33.86	132 14.28
105	315502	Middle Clarence Strait	Grindall Island	55 26.70	132 5.29	55 28.20	132 6.68
106	315502	Middle Clarence Strait	Chasina Point	55 19.85	131 58.24	55 18.49	131 57.20
107	315502	Middle Clarence Strait	Wedge Island	55 10.53	131 54.26	55 12.13	131 54.48
108	315502	Middle Clarence Strait	Dall Head	55 01.51	131 49.51	55 03.09	131 49.46
109	315502	Middle Clarence Strait	Canoe Cove	55 05.22	131 45.91	55 06.42	131 47.66
110	315432	Lower Clarence Strait	Percy Island	54 59.73	131 50.31	54 58.19	131 50.36
111	315432	Lower Clarence Strait	Ingraham Bay	54 57.15	131 55.09	54 58.64	131 55.00
112	315432	Lower Clarence Strait	Kendrick Islands	54 53.38	131 50.04	54 54.94	131 49.95
113	315432	Lower Clarence Strait	West Rock	54 50.62	131 40.06	54 49.15	131 41.14
114	315432	Lower Clarence Strait	Island Point	54 50.40	131 50.81	54 48.88	131 50.91
115	315432	Lower Clarence Strait	McLean Arm	54 48.52	131 55.76	54 46.91	131 55.75
116	315432	Lower Clarence Strait	Cape Chacon	54 42.83	131 50.46	54 44.29	131 50.43
117	315432	Lower Clarence Strait	West Devil Rock	54 41.04	131 41.73	54 42.55	131 41.64
118	315431	Dixon Entrance	West Devil Rock	54 39.76	131 47.72	54 38.31	131 47.78
119	315431	Dixon Entrance	Cape Chacon	54 36.82	131 57.01	54 35.23	131 57.03
120	315431	Dixon Entrance	Celestial Reef	54 32.73	131 51.19	54 34.39	131 51.83
121	315431	Dixon Entrance	Celestial Reef	54 32.85	131 44.06	54 31.47	131 44.07
122	315431	Dixon Entrance	West Devil Rock	54 33.78	131 40.11	54 35.42	131 40.01
123	325401	Dixon Entrance	Celestial Reef	54 26.81	132 0.86	54 26.83	132 3.57
124	325431	Dixon Entrance	Point Nunez	54 30.01	132 12.53	54 30.03	132 15.39
125	325431	Dixon Entrance	Point Marsh	54 32.13	132 21.20	54 32.14	132 18.83
126	325401	Dixon Entrance	Surf Point	54 27.32	132 18.97	54 27.29	132 16.30
127	325401	Dixon Entrance	Point Marsh	54 27.42	132 26.45	54 27.40	132 23.73
128	325431	Dixon Entrance	Cape Muzon	54 30.66	132 35.40	54 30.69	132 38.19
129	325401	Dixon Entrance	Cape Muzon	54 26.28	132 36.65	54 26.30	132 39.09

Appendix B.–Set and haul information for the 2013 SSEI Subdistrict sablefish longline survey.

							Depth (fathoms)		
Trip	Station	Date set	Time set	Soak time (h)	Haul time (h)	Haul direction	Start	End	Avg.
1	101	14-May	6:35	3.7	1.9	Opposite	292	278	287
1	103	14-May	8:50	5.8	1.6	Same	324	315	316
1	102	14-May	12:53	4.4	1.9	Same	333	325	331
1	118	15-May	7:23	3.2	1.6	Opposite	195	190	192
1	121	15-May	8:48	6.0	1.8	Same	12	190	191
1	122	15-May	14:02	3.6	1.7	Opposite	181	209	189
1	119	16-May	4:58	3.5	1.9	Same	195	195	195
1	123	16-May	6:23	6.8	1.6	Same	164	185	174
1	120	16-May	11:36	4.8	1.5	Same	184	184	184
1	105	18-May	4:54	6.7	1.4	Same	236	248	243
1	104	18-May	5:51	3.2	1.5	Opposite	233	269	252
1	106	18-May	14:25	3.2	1.3	Opposite	223	228	229
1	107	19-May	5:01	3.7	1.5	Opposite	228	233	232
1	108	19-May	7:17	5.1	1.3	Opposite	225	226	224
1	109	19-May	11:27	3.2	1.5	Same	278	276	278
2	113	15-May	6:53	3.4	1.3	Same	223	227	225
2	117	15-May	8:49	5.7	1.2	Opposite	228	238	233
2	116	15-May	13:30	3.6	1.1	Opposite	203	208	205
2	129	16-May	5:27	3.2	1.3	Same	188	195	191
2	128	16-May	7:32	3.9	1.2	Same	206	204	205
2	115	16-May	17:26	3.1	1.0	Same	240	241	242
2	114	16-May	19:16	3.3	1.3	Same	223	221	222
2	112	17-May	4:45	3.3	1.1	Opposite	223	225	224
2	111	17-May	6:28	4.7	1.1	Opposite	242	241	242
2	110	17-May	10:35	3.2	1.2	Opposite	222	234	229
2	127	19-May	4:24	4.1	1.3	Opposite	197	196	196
2	126	19-May	5:16	6.7	1.4	Opposite	195	198	196
2	124	19-May	11:15	4.1	1.4	Opposite	191	196	192
2	125	19-May	14:37	3.4	1.3	Same	195	186	191