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Reconstructed Sport Harvests and Releases of Black and Yelloweye Rockfishes in the Gulf of Alaska, 1998–2018

by

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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

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ABSTRACT

Fishery stock assessments require defensible estimates of total extractions (commercial, sport, subsistence, personal use, and bycatch) throughout the history of exploitation and at appropriate spatial scales for management. This study estimated the total sport harvest and releases for black and yelloweye rockfishes in geographic units consistent with commercial fishery management units (CFMUs), such that total fishing mortality could be estimated. Sport harvest and release information is available from Alaska Department of Fish and Game saltwater guide logbooks and the Alaska Sport Fishing Survey (commonly known as the statewide harvest survey or SWHS). Guide logbooks have provided a census of guided sport harvest and release by statistical reporting areas and by pelagic and nonpelagic rockfish assemblages since 1998/1999, and a census of yelloweye rockfish harvest and release since 2006. The SWHS has provided estimates of harvest and catch by guided and unguided anglers, but at a coarser geographic scale, and not by species or assemblages (e.g., pelagic–nonpelagic) of rockfish. In the novel methodology presented here, guided harvest (or release) from logbook data from a given CFMU was expanded to total sport harvest (or release) using SWHS estimates of the guided:unguided harvest (or release) ratio. Species compositions from port sampling data, aggregated by CFMU and guided/unguided status, were then applied to the estimated rockfish sport harvest (or release) to derive species estimates in each CFMU from 1998–2018. Estimated annual sport harvests generally increased for black and yelloweye rockfishes since the late 1990s in most CFMUs, while releases were either stable or declined. Improved data quality in more recent years provided estimates that were typically more precise, particularly for yelloweye rockfish. Sport black and yelloweye rockfishes harvests and releases provided by this methodology are recommended for use in stock assessments of these species statewide, and the methodology could be useful for other marine finfish species where stock assessment models are needed.

Keywords: sport fish, harvest, release, fishing mortality, black rockfish, yelloweye rockfish, Gulf of Alaska, *Sebastes*, *Sebastes melanops*, *Sebastes ruberrimus*, rockfish

INTRODUCTION

The Alaska Department of Fish and Game (ADF&G) recently initiated an interdivisional, inter-regional strategic plan to develop long-term management and stock assessment strategies for black rockfish (*Sebastes melanops*) and yelloweye rockfish (*S. ruberrimus*) across the Gulf of Alaska (GOA) (Howard et al. 2019a). Black rockfish (part of the pelagic assemblage) and yelloweye rockfish (part of the nonpelagic assemblage) are the primary rockfish species harvested in sport and commercial fisheries throughout the GOA. Except for demersal shelf rockfish (DSR) in outside waters of Southeast Alaska (Table 1, Figure 1; Wood et al. 2019), there are currently no formal stock assessments for these rockfish species in the GOA, despite concerns over increasing harvest and sustainability of the resource.

Integral to this statewide strategic plan is the development of assessment models for each stock, which require spatially explicit exploitation histories from all fishery sources. Statewide total fishing mortality of black and yelloweye rockfishes from all fisheries has yet to be reconciled because commercial and sport harvests are measured in different units (pounds vs. numbers of fish) and with different resolution in terms of geographic and taxonomic scale reported.

Sport fishery harvests are measured through a variety of programs, primarily the Alaska Sport Fishing Survey (commonly known as the statewide harvest survey or SWHS), the saltwater guide logbook program, and sampling programs at primary ports. The SWHS was initiated in 1977 as an annual mail-out survey (Romberg et al. 2018). Response to this survey is voluntary and the survey design provides for estimates of statewide harvest and catch (since 1990) in numbers of fish for rockfish (all species combined) and effort in saltwater angler days (for all marine species combined) by unguided and guided anglers (since 2011) and by predefined geographical strata. These SWHS strata are not, however, geographically consistent with either sport rockfish fishery management areas or commercial fisheries management units (CFMUs). Because of these factors, additional data sources are necessary to estimate black and yelloweye rockfish harvests from

consistent, spatially explicit areas. The guided logbook program was established in 1998 to acquire information on guided industry harvests and releases by species and effort (Powers 2015). In addition to other species such as salmon and halibut, this mandatory program provides a census of harvest and release in numbers of pelagic and nonpelagic rockfish species assemblages and, since 2006, yelloweye rockfishes. The logbook program also provides information on the statistical area where fishing occurred. Sport harvest port sampling programs provide information on biological characteristics of the harvest, including species composition (Jaenicke et al. 2019; Failor 2016). Port sampling programs vary regionally in their design, history, and information collected. The estimation of release mortalities in commercial and sport fisheries presents additional challenges for understanding total fishing mortality. The ability to estimate total removals by both sport and commercial fisheries will enable assessment of harvest rates and be useful for future stock assessments.

Although the simplest estimate of total sport harvest would entail using SWHS estimates, which include both guided and unguided harvests, there are problems with this approach:

1. Guided, and sometimes even total, rockfish harvests from SWHS data often are lower than harvest reported for guided-only harvests from the logbook program, and SWHS estimates of rockfish harvest were poorly associated with port sampling estimates of harvest from the same geographic areas (Clark 2009). These discrepancies are hypothesized to result from poor recall in the annual mail-in SWHS for rockfish compared to more highly prized species (e.g., halibut), and from species misidentification (Meyer and Powers 2009; Clark 2009).
2. As discussed above, SWHS harvest reporting is not based on statistical areas, the finest resolution of harvest reporting, and is therefore difficult to align with reported harvests from commercial fisheries, which are based on statistical areas and CFMUs.

Guided logbook data does not suffer from the problems cited above. Rockfish harvests estimated by port sampling and logbook programs tended to agree for comparable geographic areas in the years examined (Meyer and Powers 2009). Guided logbook harvest is recorded by statistical area and therefore is more easily aligned with commercial fishery harvest reporting.

This report outlines a novel methodology for reconstructing sport harvests and releases of black and yelloweye rockfishes in CFMU reporting groups and is intended to capitalize on the far greater precision of information from guide logbook data (a census of harvest and release at the statistical area scale). The method provides spatially explicit estimates of total harvest and release by expanding guided angler harvests and releases using proportions of guided:unguided harvests and releases from SWHS data. This approach is anticipated to provide more accurate rockfish sport harvest and release estimates, explicit characterization of the uncertainty and assumptions inherent in the estimates, and estimates that are on the same spatial scale as those from commercial fisheries. Estimations of total fishing mortality across all fishery types are then available for stock assessment models.

OBJECTIVE

1) Estimate annual sport harvests and releases of black and yelloweye rockfishes in Gulf of Alaska CFMUs from 1998–2018.

STUDY AREA

Reconstructions were developed for CFMUs across the Gulf of Alaska, from Kodiak Island east to Southeast Alaska (Figures 1–4). Small amounts of black and yelloweye rockfishes harvest also occurs in the South Alaska Peninsula, Chignik, and Bering Sea/Aleutian Island areas; however, harvests and releases in these areas are too small to be accurately estimated with current sampling programs, and no port sampling programs exist in these areas to allow for estimates of black and yelloweye rockfish specifically.

METHODS

Rockfish harvest and release information was compiled from guide logbook, SWHS, and port sampling programs (Table 1). Primary programs used for this analysis provided different kinds of information and maintained different histories. Harvest and release reconstructions were developed for the 1998–2018 period, which encompasses the full history of the guided logbook program, most of the years contained in the modern structure of the SWHS (since 1996), most of the port sampling years from Southcentral Region (since ~1993), and all port sampling years from Southeast Region (since 2006). Although attempts were made to designate sport harvest and releases for all CFMUs (Table 2, Figures 1–4), data limitations in CFMUs with particularly low rockfish harvest required some CFMU data to be aggregated for reporting (e.g., Icy Bay Subdistrict [IBS] + East Yakutat Section [EYKT] = East–West Yakutat management area [EWYKT]; Southeast and Southwest Kodiak Districts = Southern Kodiak management Area [SKMA], and Westside and Mainland Kodiak Districts = Western Kodiak management Area [WKMA]). Guide logbook data and port sampling data were assigned to CFMUs using the statistical area identified for the trip where rockfish were harvested and/or released. SWHS data, required for the estimate of the proportion of guided harvest, were assigned to CFMU using location codes identified in the survey.

The following set of equations describes analyses undertaken for each year of the study; consequently, there are no subscripts denoting year.

GUIDED, UNGUIDED, AND TOTAL ROCKFISH HARVEST ESTIMATES BY CFMU

Rockfish harvests were estimated according to whether the year in question was associated with dedicated guided and unguided SWHS estimates (available for 2011–2018 and absent for 1998–2010), and whether there were an adequate number of SWHS responses for guided and unguided anglers (Figure 5).

Total Harvest: 2011–2018

Adequate SWHS Sample Size

For CFMUs with adequate SWHS response levels ($\geq$12 responses for each of guided and unguided anglers), the proportion of total harvest from CFMU i that was taken by guided anglers was estimated as:

$$\hat{p}_{gi} = \frac{\hat{G}_{Si}}{\hat{G}_{Si} + \hat{U}_{Si}}, \quad (1)$$

where $\widehat{G}_{Si}$ was the harvest estimate of rockfish by guided anglers in CFMU *i* reported by the SWHS, and $\widehat{U}_{Si}$ was the harvest estimate of rockfish by unguided anglers in CFMU *i* reported by the SWHS. The variance of $\hat{p}_{gi}$ was approximated using the delta method (Seber 1982).

$$var(\hat{p}_{gi}) \approx \frac{\widehat{G}_{Si}^{2} var(\widehat{U}_{Si}) + \widehat{U}_{Si}^{2} var(\widehat{G}_{Si})}{(\widehat{G}_{Si} + \widehat{U}_{Si})^{4}}, \quad (2)$$

where $var(\widehat{G}_{Si})$ and $var(\widehat{U}_{Si})$ were reported by the SWHS.

Total sport rockfish harvest by all anglers for each CFMU *i* was estimated by expanding the guide logbook harvest by $\hat{p}_{gi}$ (Equation 1):

$$\widehat{H}_i = \frac{G_i}{\hat{p}_{gi}} \quad (3)$$

where G_i was rockfish harvest in CFMU *i* from guide logbook harvest data. $var(\widehat{H}_i)$ was calculated using the delta method (Seber 1982):

$$var(\widehat{H}_i) \approx G_i^{2} \frac{1}{\hat{p}_{gi}^{4}} var(\hat{p}_{gi}) \quad (4)$$

$$var(\widehat{H}_i) \approx G_i^{2} \frac{\widehat{G}_{Si}^{2} var(\widehat{U}_{Si}) + \widehat{U}_{Si}^{2} var(\widehat{G}_{Si})}{\widehat{G}_{Si}^{4}}, \quad (5)$$

Inadequate SWHS Sample Size

One CFMU (SKMA) had SWHS response levels considered inadequate (<12 responses for each of guided and unguided anglers) for accurate harvest estimation. None of the SKMA years from 2011 to 2018 had adequate sample sizes for estimation and the only alternative was to assume similar proportions as a neighboring CFMU considered to have similar fishery characteristics (WKMA). Under this condition, WKMA proportions were used in Equations 1–2 (Figure 5).

Total Harvest: 1998–2010

Adequate SWHS Sample Size

As $\hat{p}_{gi}$ can only be estimated from the SWHS since 2011, we assumed that for prior years for CFMU *i* where SWHS responses were adequate, the proportion of guided harvest was equal to the mean p_{gi} associated with years since 2011:

$$\bar{p}_{gi} = \frac{1}{t_{2011}} \sum_{j=1}^{t_{2011}} \hat{p}_{gij}, \quad (6)$$

where t_{2011} = 8 (the number of years from 2011 to 2018) and *j* indexes sample year; $\bar{p}_{gi}$ was used in place of $\hat{p}_{gi}$ in Equations 3 and 4 (Figure 5).

This assumption was preferable because the suite of information for the measured years (2011 to 2018) could be used to more completely estimate uncertainty associated with the estimate. The

estimated variance of $\bar{p}_{gi}$ included three sources of uncertainty. First was an estimate of the process error: the variation across years in p_{gi} values, reflecting factors that influence the guided angler participation. The second source of uncertainty was the sampling variance, which declines with more data pairs (more years since 2011). These two sources of variability were analogous to the variability in the ε_i and in the $\hat{Y}_i$, respectively, in the usual linear regression setup. The third source of uncertainty in estimating $\bar{p}_{gi}$, the sampling variability within a year in estimation of the p_{gij}, needed to be addressed (the proportion of guided anglers in year *j* was an estimate from the SWHS and subject to sampling variability). The variance of $\bar{p}_{gi}$ was estimated following methods outlined in Appendix A, subsection B, which described a parallel situation for estimation of expansion factors for aerial surveys.

Inadequate SWHS Sample Size

Because SWHS responses were considered inadequate (<12 responses for each of guided and unguided anglers) for accurate harvest estimation for SKMA in all years 2011 to 2018, a neighboring CFMU with similar fishery characteristics (WKMA) was again used as a proxy in Equation 6 for the estimation of total harvest in years 1998 to 2010.

Unguided Harvest

Although guided harvest could be directly estimated from guide logbook data, unguided harvest could not be directly estimated. Therefore, unguided harvest was estimated as the difference between estimated total sport rockfish harvest and known guide logbook harvest:

$$\hat{U}_i=\hat{H}_i-G_i, \tag{7}$$

with variance:

$$var(\hat{U}_i)=var(\hat{H}_i), \tag{8}$$

SPECIES-SPECIFIC HARVEST BY CFMU

Rockfish harvest estimates by CFMU were apportioned to species (black and yelloweye rockfishes). Because guided and unguided anglers often target different species, species-specific estimates were derived separately for guided and unguided harvests. Guided logbook harvest data included assemblage information (pelagic and nonpelagic) prior to 2006 and additional identification of yelloweye rockfish since 2006 (Table 1). Leveraging this information increased the precision of species-specific estimates for guided harvests. Port sampling programs in Southeast and Southcentral Alaska, in which both guided and unguided harvest was sampled, provided additional information on the species composition of harvests (Jaenicke et al. 2015; Failor 2016; Table 1). The harvest and species composition estimates were combined to give species-specific harvest by CFMU (Figure 6).

Port Sample Harvest Proportions

Harvest returning to a port may have been caught in multiple CFMUs, and fish harvested from a given CFMU may be returned to any one of a number of ports. Port sampling programs were designed to characterize harvest returning to a port for guided and unguided anglers. For each

sampled vessel at a port, guided and unguided rockfish harvest by species was recorded, along with the primary statistical area fished. Statistical area data allowed for aggregation of harvest into CFMUs and calculation of species proportions specific to each CFMU. Years with the full suite of ports sampled (since 2006 for Southeast and since 1998 for Southcentral) are considered most consistently representative of the fishery (Table 1).

Harvest from North Gulf District (NG), Prince William Sound Inside District (PWSI), and Prince William Sound Outside District (PWSO) CFMUs were sampled at one or more of the ports of Seward, Whittier, and Valdez. For these CFMUs, species or assemblage proportions were weighted by harvest from the CFMU returning to each contributing port. These ports were likely not sampled proportionally relative to the actual rockfish harvest. Port sample proportions for guided harvest were weighted by known guide logbook harvest by port for these CFMUs. SWHS estimates of unguided harvest were used to weight port sample proportions from unguided harvest.

SWHS harvest estimates were not available for other ports that may receive harvest from the remaining CFMUs (i.e., other than NG, PWSI, and PWSO), negating our ability to weight species proportions as described above. However, in general, evidence for divergence between port sample proportions of pelagic and yelloweye rockfish from guided harvest and known proportions calculated from guide logbook data was most apparent in the PWSI and PWSO CFMUs. For other CFMUs, where harvest was also landed at multiple ports, port sample proportions of pelagic and yelloweye rockfish from guided harvest agreed with logbook harvest proportions to a much higher degree and weighting was not deemed necessary for these CFMUs.

Port samples were not available for Kodiak Area CFMUs: Mainland, Southeast, Southwest, and Westside Districts (Table 2). In these cases, neighboring CFMU port sample data were substituted as described in the sections below.

Black Rockfish Harvest

Guided Harvest

Full Sample

Black rockfish harvest by guided anglers in CFMU *i* was estimated by:

$$\widehat{G}_{Bi}=G_{Pi}\hat{p}_{bgi}, \tag{9}$$

where G_{Pi} was the pelagic rockfish harvest in CFMU *i* censused by the guide logbook program and $\hat{p}_{bgi}$ was the estimated proportion of black rockfish among guided pelagic rockfish harvested from CFMU *i* reported by the port sampling project. Its variance was calculated using:

$$var(\widehat{G}_{Bi})=G_{Pi}^{2}\, var(\hat{p}_{bgi}), \tag{10}$$

where

$$var(\hat{p}_{bgi})=\frac{\hat{p}_{bgi}(1-\hat{p}_{bgi})}{(n_{Pgi}-1)}, \tag{11}$$

where n_{Pgi} was the number of pelagic guided rockfish sampled for CFMU *i*.

Small Sample

When annual port samples existed but sample size was small (<50 samples) for a given CFMU, a mean proportion was taken across available sample years:

$$\bar{p}_{bgi} = \frac{1}{t_g} \sum_{j=1}^{t_g} \hat{p}_{bgij}, \tag{12}$$

where t_g was the number of available sample years having sufficient sample size for species composition of guided harvest from CFMU *i,* and *j* indexes sample year*;* $\bar{p}_{bgi}$ was then substituted in Equation 9 for $\hat{p}_{bgi}$. This assumption was preferable, in part, because it allowed a more complete assessment of uncertainty associated with the estimate. The variance of $\bar{p}_{bgi}$, needed in the Equation 10 substitution, was estimated in a manner similar to that described for $\bar{p}_{gi}$ above, using methods described in Appendix A, subsection B.

We also considered using $\hat{p}_{bgi'}$, from a neighboring CFMU *i′*, as a surrogate for $\hat{p}_{bgi}$ when sample size was low. For those years where port sampling was more intense, we examined how well these alternative surrogates (long-term mean vs. neighboring CFMU) performed relative to the actual estimated value. We found $\bar{p}_{bgi}$ to be closer to the estimated value for the CFMU compared with a surrogate value from a neighboring CFMU *i′* ($\hat{p}_{bgi'}$) and preferred this assumption when possible.

Absent Sample

For CFMU *i* for which port sample data was entirely absent for all years, we could not calculate a mean over years as described above, and the proportion of black rockfish in guided pelagic rockfish harvests (p_{bgi}) was assumed equal to that for a neighboring CFMU *i′*. The estimated proportion $\hat{p}_{bgi'}$ was substituted in Equation 9 and the $var(\hat{p}_{bgi'})$ (needed in Equation 10 substitution) was calculated from data from CFMU *i′*.

Unguided Harvest

Full Sample

Black rockfish harvest by unguided anglers in CFMU *i* was estimated by:

$$\hat{U}_{Bi} = \hat{U}_i \hat{p}_{Bui}, \tag{13}$$

where $\hat{p}_{Bui}$ was the estimated proportion of black rockfish among all unguided rockfish harvested in CFMU *i* recorded by the port sampling project. The estimated variance of $\hat{U}_{Bi}$ was calculated using Goodman (1960):

$$var(\hat{U}_{Bi}) = \hat{U}_i^2 \, var(\hat{p}_{Bui}) + \hat{p}_{Bui}^2 \, var(\hat{U}_i) - var(\hat{U}_i) \, var(\hat{p}_{Bui}), \tag{14}$$

where

$$var(\hat{p}_{Bui}) = \frac{\hat{p}_{Bui}(1-\hat{p}_{Bui})}{(n_{ui}-1)}, \tag{15}$$

where n_{ui} was the number of unguided rockfish sampled for CFMU *i*.

Small Sample

When annual port samples existed but sample size was small (<50 samples) for a given CFMU, a mean proportion was taken across available sample years:

$$\bar{p}_{Bui} = \frac{1}{t_u} \sum_{j=1}^{t_u} \hat{p}_{Buij}, \tag{16}$$

where t_u was the number of available sample years having sufficient sample size for species composition of unguided harvest from CFMU i, and j indexes sample year. The mean proportion $\bar{p}_{Bui}$ was substituted in Equation 13 for the estimated proportion $\hat{p}_{Bui}$. This assumption was preferable, in part, because it allowed a more complete assessment of uncertainty associated with the estimate. The variance of $\bar{p}_{Bui}$, needed in the Equation 14 substitution, was estimated using methods described in Appendix A, subsection B.

We also considered using $\hat{p}_{Bui'}$, from a neighboring CFMU i', as a surrogate for $\hat{p}_{Bui}$ when sample size was low. For those years when port sampling was more intense, we examined how well these alternative surrogates (long-term mean vs. neighboring CFMU) performed relative to the actual estimated value. We found $\bar{p}_{Bui}$ to be closer to the estimated value for the CFMU compared with a surrogate value from a neighboring CFMU i' ($\hat{p}_{Bui'}$) and preferred this assumption when possible.

Absent Sample

For CFMU i for which port sample data was entirely absent for all years, we could not calculate a mean over years as described above, and the proportion of unguided rockfish harvest that was black rockfish was assumed to be equal to that of a neighboring CFMU i', $\hat{p}_{Bui''}$. The quantity $\hat{p}_{Bui'}$ was substituted in Equation 13 and the $var(\hat{p}_{Bui'})$ (needed in Equation 14 substitution) was calculated from data from CFMU i' following Equation 15.

Yelloweye Rockfish

Guided Harvest

The guided yelloweye rockfish harvest (G_{Yi}) from 2006 to present was obtained directly from logbook data (census, with no associated variance). The following sections describe yelloweye rockfish harvest for years prior to 2006.

Full Sample

Yelloweye rockfish guided harvest prior to 2006 from CFMU i was estimated by:

$$\widehat{G}_{Yi} = G_{Ni} \hat{p}_{ygi}, \tag{17}$$

where G_{Ni} was the known nonpelagic rockfish harvest in CFMU i censused by the guide logbook program and $\hat{p}_{ygi}$ was the estimated proportion of yelloweye rockfish among guided nonpelagic rockfish harvested from CFMU i reported by the port sampling project. Its variance was calculated using:

$$var(\widehat{G}_{Yi}) = G_{Ni}^2 \, var(\hat{p}_{ygi}), \tag{18}$$

where

$$var\left(\hat{p}_{ygi}\right)=\frac{\hat{p}_{ygi}\left(1-\hat{p}_{ygi}\right)}{\left(n_{Ngi}-1\right)}, \tag{19}$$

where n_{Ngi} was the number of nonpelagic guided rockfish sampled for CFMU i.

Small Sample

When annual port samples existed but sample size was small (<50 samples) for a given CFMU, a mean proportion was taken across available sample years:

$$\bar{p}_{ygi}=\frac{1}{t_g}\sum_{j=1}^{t_g}\hat{p}_{ygij}, \tag{20}$$

where t_g was the number of available sample years having sufficient sample size for species composition of guided harvest from CFMU i and j indexes sample year. $\bar{p}_{ygi}$ was substituted in Equation 17 for $\hat{p}_{ygi}$. This assumption was preferable, in part, as it allowed a more complete assessment of uncertainty associated with the estimate. The variance of $\bar{p}_{ygi}$, needed in the Equation 18 substitution, was estimated using methods described in Appendix A, subsection B.

We also considered using $\hat{p}_{ygi'}$, from a neighboring CFMU i' for low sample size situations, and as with black rockfish, the mean proportion surrogate for yelloweye rockfish proportions was observed to be preferable to the neighboring CFMU substitution when possible.

Absent Sample

For CFMU i for which port sample data was entirely absent for all years, the proportion of yelloweye rockfish in the nonpelagic logbook harvest (p_{ygi}) was assumed to be equal to the mean of the known proportions of yelloweye rockfish in the nonpelagic logbook harvest, $\bar{p}_{ygi}$, available since 2006:

$$\bar{p}_{ygi}=\frac{1}{t_{2006}}\sum_{j=1}^{t_{2006}}p_{ygij}, \tag{21}$$

where t_{2006} =13 (the number of years from 2006 to 2018), and j indexes sample year. This assumption was preferable, in part, because it allowed a more complete assessment of uncertainty associated with the estimate. Alternatives, such as substituting a neighboring CFMU's species proportions, were not appropriate because most frequently encountered species are known to vary spatially.

This mean was applied to the nonpelagic logbook harvest from CFMU i to estimate guided yelloweye rockfish harvest:

$$\widehat{G}_{Yij}=G_{Nij}\bar{p}_{ygi}, \tag{22}$$

Its variance was calculated:

$$var\left(\widehat{G}_{Yi}\right)=G_{Ni}^2 var(\bar{p}_{ygi}), \tag{23}$$

where $var(\bar{p}_{ygi})$ was calculated using methods described in Appendix A, subsection A. (Note that in prior citations of Appendix A, subsection B was used; here subsection A is cited as there was no measurement error within a year for p_{ygi}.)

Unguided Harvest

Full Sample

Yelloweye rockfish harvest by unguided anglers in CFMU *i* was estimated by:

$$\hat{U}_{Yi}=\hat{U}_i\hat{p}_{Yui} \tag{24}$$

where $\hat{p}_{Yui}$ was the estimated proportion of yelloweye rockfish among all unguided rockfish harvested from CFMU *i,* reported by the port sampling project.

Its variance was estimated:

$$var(\hat{U}_{Yi})=\hat{U}_i^2\, var(\hat{p}_{Yui})+\hat{p}_{Yui}^2\, var(\hat{U}_i)- var(\hat{U}_i)\, var(\hat{p}_{Yui}), \tag{25}$$

where

$$var(\hat{p}_{Yui})=\frac{\hat{p}_{Yui}(1-\hat{p}_{Yui})}{(n_{ui}-1)}, \tag{26}$$

where n_{ui} was the number of unguided rockfish sampled from CFMU *i*.

Small Sample

When annual port samples existed but sample size was small (<50 samples) for a given CFMU, a mean proportion was taken across available sample years ($\bar{p}_{Yui}$):

$$\bar{p}_{Yui}=\frac{1}{t_u}\sum_{j=1}^{t_u}\hat{p}_{Yuij}, \tag{27}$$

Where t_u was the number of available sample years having sufficient sample size for species composition of unguided harvest from CFMU *i,* and *j* indexes sample year. $\bar{p}_{Yui}$ was substituted in Equation 24 for $\hat{p}_{Yui}$. The variance of $\bar{p}_{Yui}$, needed in the Equation 25 substitution, was estimated using methods described in Appendix A, subsection B.

We also considered using $\hat{p}_{Yui'}$ from a neighboring CFMU *i'* for low sample size situations, and as with black rockfish, the mean proportion surrogate for yelloweye rockfish proportions was observed to be preferable to the neighboring CFMU substitution when possible.

Absent Sample

Unlike for black rockfish where a lack of port sample data can only be informed by using neighboring CFMU data as a proxy, yelloweye rockfish species composition information can be obtained from logbook data from guided harvests. It was deemed that substituting guided yelloweye species composition data from logbooks for unguided species composition, when port sample data were absent, was preferable to assuming the species composition was the same as a neighboring CFMU because there tends to be spatial heterogeneity in rockfish species distribution. For CFMU *i* for which port sample data was absent, the proportion of yelloweye rockfish among unguided rockfish was assumed to equal to that of guided rockfish (for years since 2006):

$$\bar{p}_{Ygi} = \frac{1}{t_{2006}} \sum_{j=1}^{t_{2006}} p_{Ygij}, \quad (28)$$

where p_{Ygij} was the proportion of yelloweye rockfish recorded in the guide logbook program in year j. This mean (Equation 28) was applied to the unguided harvest estimate from CFMU i to estimate unguided yelloweye rockfish harvest:

$$\hat{U}_{Yi} = \hat{U}_i \bar{p}_{Ygi}, \quad (29)$$

Its variance was estimated:

$$var(\hat{U}_{Yi}) = \hat{U}_i^2 \, var(\bar{p}_{Ygi}) + \bar{p}_{Ygi}^2 \, var(\hat{U}_i) - var(\hat{U}_i) \, var(\bar{p}_{Ygi}), \quad (30)$$

The variance of $\bar{p}_{Ygi}$, needed in the Equation 30 substitution, was estimated in a manner similar to that described for $\bar{p}_{gi}$ above, using methods described in Appendix A, subsection A (no measurement error in p_{Ygij} in Equation 28).

Total Rockfish Species Harvest by CFMU

For black and yelloweye rockfishes, unguided and guided harvests (and variances) were summed to derive total harvest for CFMU i, respectively.

$$\hat{H}_{Bi} = \hat{U}_{Bi} + \hat{G}_{Bi}, \quad (31)$$

$$\hat{H}_{Yi} = \hat{U}_{Yi} + \hat{G}_{Yi}, \quad (32)$$

with variances:

$$var(\hat{H}_{Bi}) = var(\hat{U}_{Bi}) + var(\hat{G}_{Bi}), \quad (33)$$

$$var(\hat{H}_{Yi}) = var(\hat{U}_{Yi}) + var(\hat{G}_{Yi}), \quad (34)$$

RELEASE ESTIMATES

Estimates of sport harvest release by CFMU were conducted following Equations 1–34 above. Species compositions of releases were assumed to be the same as for harvests because no data exists for species composition of releases.

SENSITIVITY ANALYSIS

Several assumptions were inherent in this methodology to reconstruct sport harvest and release estimates because no individual data collection project was designed to estimate sport harvest and release of black and yelloweye rockfishes. Sensitivity analyses were conducted to evaluate the performance of this reconstruction methodology for those assumptions that could be tested.

This analysis assumed SWHS location codes were appropriately assigned to CFMUs. Location codes can be spatially vague (e.g., Noyes Island spans two management units and could be

assigned to either). Fishery expertise of local managers was used to assist in uncertain assignments. This assumption was examined by comparing SWHS proportions of guided harvests, releases assigned to CFMUs, or both to those proportions calculated from logbook data for years when both data types were available (2011–2018). Analyses were based on the absolute differences between SWHS and logbook proportions (SWHS proportion minus logbook proportion) within a CFMU by year; zero differences indicated appropriate designation of location codes. CFMU SKMA was deleted from the analysis due to low harvest. The dataset therefore consisted of an 8 (2011–2018) by 14 (number of CFMUs) matrix of differences. Although analysis of variance and nonparametric methods were explored, the differences between SWHS and logbook proportions were mostly quite small. Therefore, analysis presented here is limited to the mean difference of each CFMU for all years and their 95% confidence intervals.

This analysis also assumed species composition measured in the port sampling programs for guided and unguided anglers fishing in a given CFMU was representative of the true species composition of the harvests and releases for guided and unguided anglers, respectively, from the CFMU. This assumption was examined using a suite of tests of the hypothesis that proportions of pelagic and yelloweye rockfish from guided anglers sampled in the port sampling programs were equal to the (known) proportions of pelagic and yelloweye rockfishes in guided logbook data. Analyses were based on the differences between port sample (guided) and logbook proportions of yelloweye (2006–2018) and of pelagic (1998–2018) rockfish within a CFMU and year, a difference of zero indicating representative sampling. CFMUs Afognak and Eastside were deleted from the analysis due to sparse data. The yelloweye rockfish data framework therefore consisted of a 13 (2006–2018) by 13 (number of CFMUs) matrix; some year-by-CFMU combinations were not available. The pelagic rockfish data framework consisted of a 21 (1998–2018) by 13 (number of CFMUs) matrix; like the yelloweye rockfish data, some year-by-CFMU combinations were not available. Analysis for each of the yelloweye and pelagic rockfishes datasets followed that for the SWHS vs. logbook comparison above.

RESULTS

Twenty-one years of sport harvest and 20 years of releases were estimated for 15 CFMU reporting groups across the Gulf of Alaska (Table 2). Results are organized by species and major geographic areas (Southcentral Region: Kodiak Area; Southcentral Region: Cook Inlet and Prince William Sound areas; and Southeast Region) for harvests and releases. Attempts were not made here to construct assumptions of mortality for released fish and estimate total sport fishing mortality; these will be products in stock assessment model analysis, tailored to the history of fishery regulations and fishing behavior on the stocks in question.

HARVEST AND RELEASE PATTERNS AND TRENDS

Rockfish sport harvests have increased across the Gulf of Alaska since 1998. Sport harvest increases of black rockfish have been particularly dramatic over the past 20 years (Tables 3–5, and Figure 7). Black rockfish harvest more than doubled in all CFMUs, with many CFMUs observing 10-fold or larger increases. Harvest of black rockfish appears more concentrated in certain CFMUs, such as Northeast in Kodiak area, NG in Cook Inlet, Prince William Sound areas, and CSEO in Southeast Region (Figure 7). The magnitude of black rockfish harvest in recent years has been similar between Southeast and Southcentral Regions (Figure 7), around 120,000 fish, suggesting a total GOA black rockfish harvest of approximately 250,000 fish.

Black rockfish releases show very different temporal patterns to the harvests (Tables 6–8, and Figure 8). Although black rockfish releases appear to fluctuate without an apparent trend in the Kodiak area, the Cook Inlet, Prince William Sound, and Southeast Region black rockfish releases show a distinct pattern of higher releases prior to 2009 followed by lower and stable releases since that time (Figure 8). There does appear to be an uptick in black rockfish releases in Southeast Region in 2018 to approximately 16,000 fish, but it remains to be seen if this increase in black rockfish releases will persist. Black rockfish release magnitude is small compared to harvests, with recent year estimates of approximately 10,000 fish in each of Southeast and Southcentral Regions, about 8% of the estimated harvest.

Although yelloweye rockfish harvests have also increased over this 20-year period, the scale of harvest is much lower than for black rockfish. Harvests more than doubled for most CFMUs over the past 20 years, but recent harvests of yelloweye rockfish were estimated at about 25,000 fish for each of Southeast and Southcentral Regions (Tables 9–11, and Figure 9). In contrast to black rockfish, CFMUs exhibiting the highest harvests were Prince William Sound Inside District (PWSI) in Southcentral Region and Southern Southeast Inside Subdistrict (SSEI) in Southeast Region (Figure 9), illustrating the spatially-explicit and species-specific challenges for rockfish management and assessment.

As with black rockfish, yelloweye rockfish releases demonstrate very different trends relative to harvests in these CFMUs (Tables 12–14, and Figure 10). Yelloweye rockfish releases appear to fluctuate at low levels without an apparent trend in Kodiak area, while releases appear to have decreased after about 2006 in the other areas (Figure 10). In Southeast Region, releases appear to increase again starting in 2017. Prior to the recent uptick in yelloweye rockfish releases in Southeast Alaska, releases were about 3,000 fish for each of Southcentral and Southeast regions recently; releases increased to almost 8,000 fish in Southeast Region in 2018 (Tables 12–14). The overall magnitude of releases tends to be low, near 12% of the recent harvest levels.

SENSITIVITY TO ASSUMPTIONS

Location Code-Assignment Assumption

None of the CFMU mean differences in harvest was greater than 4%, indicating that the assumption of unbiased location-code assignment is valid. The mean difference for CFMU NG was the largest, with the SWHS proportion being about 3.7% larger than that of the logbook (Figure 11, panel A). Similarly, none of the CFMU mean differences in releases was greater than 7%, indicating this assumption holds up for releases as well. The mean (absolute) difference for Afognak CFMU was the largest for releases, with the SWHS proportion being about 6.1% smaller than that of the logbook (Figure 11, panel B).

Representative Species Apportionment From Port Sampling Assumption

Yelloweye Rockfish Proportion Differences

None of the CFMU mean differences was greater than 5% for yelloweye rockfish, indicating that the assumption of representative sampling is valid. The mean difference for Southern Southeast Outside Section (SSEO) CFMU was the largest, with the port sample proportion of yelloweye rockfish being about 4.8% smaller than that of the logbook (Figure 11, panel C).

Pelagic Rockfish Proportion Differences

None of the CFMU mean differences were greater than 10% for pelagic rockfish, indicating that the assumption of representative sampling is approximately valid. It is noted that these mean differences are greater than those for the yelloweye rockfish comparisons above. The mean difference for CFMU PWSI was the largest, with the port sample proportion being about 9.2% smaller than that of the logbook (Figure 11, panel D).

DISCUSSION

The harvest and release estimates provided in this novel methodology, in many ways, correspond to the generally assumed trends over time. Rockfish managers have noted an apparent increase in rockfish harvest, with more fish being kept for consumption rather than being released. Dynamics of Alaskan sport rockfish fisheries are interwoven with more valuable fisheries, such as Pacific halibut (*Hippoglossus stenolepis*) and Pacific salmon (*Oncorhynchus*). As restrictions in these other species fisheries have reduced their harvest, sport anglers have shifted focus to what are perceived to be more reliable and accessible fishing taxa, including rockfishes (Beaudreau et al. 2018).

It may be possible to use these data to evaluate the effect of management measures. For example, restrictive management measures were implemented in 2017 and 2018 for nonpelagic rockfish species in Southeast Region (Howard et al. 2019b), which may explain the increase in yelloweye rockfish release estimates for this region in these years; however, comparable declines in harvest were not evident. Likewise, outside waters demersal shelf rockfish (DSR), which includes yelloweye rockfish, are federally managed under allowable catch allocations in Southeast Region. This may be why harvest of nonpelagic species in outside waters CFMUs in that region (EWYKT, SSEO, Northern Southeast Outside Section [NSEO], Central Southeast Outside Section [CSEO]) have stabilized or decreased since 2006 relative to other CFMUs (also see Appendices B–C).

Results of this analysis provide an important data input for stock assessments of rockfishes throughout the GOA; however, the magnitude of harvest has differed dramatically in some cases between this new methodology and prior means of deriving estimates. This difference is largely due to differences in estimates of rockfish harvest that are based on SWHS versus guide logbook data. Our methodology assumes guide logbook data provide a more accurate assessment of guided rockfish harvest, whereas prior rockfish harvest estimates relied on SWHS to provide magnitude of harvest for all fishery sectors. As previously mentioned, comparisons of these programs illustrate that harvest from guide logbook data is often substantially higher than that captured in the SWHS data for guided harvests, and sometimes even for total (guided and unguided) harvests (Meyer and Powers 2009; Clark 2009). Guide logbook data are recorded in real time for each angler and accurate accounting of harvest is required in regulation, whereas SWHS data are from a voluntary mail-in survey that asks respondents to recall the total harvest of all fish species by the entire household from the prior year. Guide logbook data are also recorded by fishing guides who likely are better at species identification than the general sport fish license-holding community (the respondent pool for the SWHS). For these reasons, it is believed the guide logbook magnitude of harvest for rockfish species is more accurate than the magnitude of harvest the SWHS estimates are able to provide. The guide logbook data also have the advantage of providing greater taxon and location specificity, which is useful for creating taxon-specific harvest and release estimates aligned spatially with commercial fishery harvest estimates.

This analysis was constrained by the data available for use in reconstructions and makes some key assumptions about data pieces being representative and unbiased. For example, this methodology assumed that magnitude of guided harvest from the logbook program was accurate, and SWHS estimates of the proportion of harvests or releases that was guided for a given management unit was representative of all sport harvests or releases from that management unit. The analysis also assumed spatial accuracy in the guided logbook and port sampling data, even though only one statistical area was provided for a given fishing trip. Because management units are much larger than individual statistical areas, the likelihood that violation of this assumption would result in grossly inaccurate estimates for each CFMU appears low. It also assumed that port sampling programs provided an accurate representation of species harvested across all CFMUs. When data were available and evidence suggested otherwise (NG, PWSI, and PWSO CFMUs), weighting of samples was undertaken to make the sampling more representative of CFMUs. Because there was evidence to the contrary, this analysis did not assume that SWHS magnitude of rockfish harvest was accurate. Sensitivity analysis revealed that SWHS proportional harvest and release by CFMU was very similar to logbook proportions (<4% and <7% differences, respectively); this provides confidence that SWHS location codes were accurately assigned and that the spatial attribution of harvest and releases are reasonably close to the true values. The sensitivity analysis also revealed that port sample (guided) and logbook yelloweye rockfish species proportions were very similar (<5% difference) and that use of port samples for species composition can be considered representative. Although more error was detected in pelagic species proportions, it was an acceptable level (<10% difference), especially given no other more viable methods were apparent.

This analysis implemented proxies where data were unavailable or insufficient. It assumed SWHS estimates of guided:unguided rockfish harvest and release proportions prior to 2011 were similar to those estimated after 2011. Likewise, proxies used to account for paucity of species composition data (e.g., Southeast port sampling data prior to 2006) were assumed to be unbiased. Although the most representative proxies were used, these do present weaknesses in the analyses that cannot be resolved with available data.

Throughout the analysis, particular care was given to appropriately propagate uncertainty in the estimates throughout the procedure. It is important that this uncertainty be considered when evaluating these estimates. For example, information available for yelloweye rockfish in the Kodiak area suggests a paucity of port sampling data in many CFMUs for use in species apportionment and some CFMUs lacking enough responses in the SWHS to estimate guided:unguided proportions. Moreover, saltwater guide logbook data suggest relatively low guided harvest levels. Combined, these characteristics lead to estimates of harvest and releases that have relatively large variances for some CFMUs. This uncertainty should be incorporated when assessing risks and tradeoffs of proposed management actions in these CFMUs, particularly because the “true” harvest level may be encompassed in a wider range of potential values.

CONCLUSIONS

Recreational fisheries are challenging to monitor directly because of the large number of participants and diffuse access points (Arlinghaus et al. 2019). As the Statewide Rockfish Initiative (SRI) moves toward rockfish fisheries management strategies that are coordinated across use types and are responsive to stock status, an understanding of fishery extractions for a given management unit are needed. This analysis was undertaken to provide increased precision and accuracy for sport harvests of rockfishes in the GOA in a spatially explicit manner, so the SRI can be more

successful in its mission to support sustainable rockfish fisheries. It is recommended that these estimates be used in developing stock assessments and exploring the magnitude of total fishery extractions of black and yelloweye rockfishes in the GOA when considering the efficacy of potential management options. As additional data become available, it is recommended that this methodology be reevaluated and improved upon and appraised for its potential use for other groundfish stocks. Additionally, although data limitations prohibit applying this methodology to years before 1998, it is often useful for stock assessment models to capture as much of the fishery history as possible. Supplementary methodologies should be developed and employed for these stock assessment models that acknowledge that some sport fishery extraction occurred prior to this time, even if data are not available to clearly define the magnitude of those fishery extractions. Investigation into Bayesian methods may be fruitful in this regard.

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TABLES AND FIGURES

Table 1.–Available historical information on sport harvest/catch estimation (SWHS and guide logbook) and sport harvest species composition estimation (port sampling) for use in rockfish sport harvest reconstruction.

Program	Data type	Port/area	Years data available
SWHS	rockfish harvest estimate	statewide	1977–2018
	rockfish catch (harvest plus releases) estimate	statewide	1990–2018
	rockfish harvest estimates by guided/unguided anglers[a]	statewide	2011–2018
	rockfish catch estimates by guided/unguided anglers[a]	statewide	2011–2018
Guide Logbook	guided rockfish harvest census by pelagic and nonpelagic assemblage	statewide	1998–2018
	guided rockfish release census by pelagic and nonpelagic assemblage	statewide	1998–2018
	guided rockfish harvest census of yelloweye rockfish	statewide	2006–2018
	guided rockfish release census of yelloweye rockfish	statewide	2006–2018
Southeast Port Sampling	rockfish species composition[b] for guided and unguided anglers	Yakutat	2006–2018
		Elfin Cove	2002–2018
		Gustavus	2002–2018
		Juneau	2005–2018
		Sitka	2000–2018
		Petersburg	2006–2018
		Wrangell	2006–2018
		Ketchikan	2001–2018
		Craig	2000–2018
		Klawock	2000–2018
Southcentral Port Sampling (Central and Westward Commercial Fisheries Regions)	rockfish species composition[b] for guided and unguided anglers	Homer	1991–2018
		Seward	1991–2018
		Valdez	1991–2018
		Kodiak	1992–2018
		Anchor Point	1996–2018
		Deep Creek	1996–2018
		Whittier	1991, 1998–2018

Note: "SWHS" (commonly known as the statewide harvest survey) refers to the Alaska Sport Fishing Survey (http://www.adfg.alaska.gov/sf/sfpublic/sportfishingsurvey/).

[a] A survey supplement that distinguished guided and unguided harvests was provided to 50% of respondents since 1996, but it was only made an integral component of the main survey for all respondents since the 2011 redesign. Because of SWHS estimation techniques, the supplemental data cannot be used, and guided/unguided harvest is only available from 2011.

[b] Early years of port sample data collection are not consistent with modern sample design and may not be representative of the fishery for species composition analysis, particularly as the smaller number of ports sampled in early years of the program may not have provided a spatially comprehensive representation of fishery harvest. Years with the full suite of ports sampled (since 2006 for Southeast and since 1998 for Southcentral) are considered most consistently representative of the fishery.

Table 2.–Commercial fishery management units (CFMU) used for spatial delineation of harvest reconstructions. Report groups refers to those CFMUs where data necessitated two CFMUs be combined.

Commercial fishery region	Commercial fishery subregion	Commercial fishery management unit (CFMU)	Sport estimate report group
Southeast	Southeast Outside waters	Icy Bay Subdistrict (IBS)	EWYKT
		East Yakutat Section (EYKT)	
		Northern Southeast Outside Section (NSEO)	NSEO
		Central Southeast Outside Section (CSEO)	CSEO
		Southern Southeast Outside Section (SSEO)	SSEO
	Southeast Inside waters	Northern Southeast Inside Subdistrict (NSEI)	NSEI
		Southern Southeast Inside Subdistrict (SSEI)	SSEI
Central	Prince William Sound Area	Prince William Sound Inside District (PWSI)	PWSI
		Prince William Sound Outside District (PWSO)	PWSO
	Cook Inlet Area	North Gulf District (NG)	NG
		Cook Inlet District (CI)	CI
Westward	Kodiak Area	Afognak District (Afognak)	Afognak
		Northeast District (Northeast)	Northeast
		Eastside District (Eastside)	Eastside
		Southeast District (Southeast)	SKMA
		Southwest District (Southwest)	
		Westside District (Westside)	WKMA
		Mainland District (Mainland)	

Note: EWYKT = East–West Yakutat management area (IBS + EYKT); SKMA = Southern Kodiak management area (Southeast and Southwest Districts); WKMA = Western Kodiak management area (Mainland and Westside Districts).

Table 3.–Southcentral region, Kodiak area estimated sport harvest of black rockfish (BRF) in each commercial fishery management unit (CFMU) report group by year. SKMA = Southern Kodiak management area (Southeast and Southwest Districts), and WKMA = Western Kodiak management area (Mainland and Westside Districts).

	Afognak		Eastside		Northeast		SKMA		WKMA		Total	
Year	BRF Harvest	CV	BRF Harvest	CV	BRF Harvest	CV	BRF Harvest	CV	BRF Harvest	CV	BRF Harvest	CV
1998	359	15%	89	18%	1,751	18%	28	15%	131	17%	2,358	13%
1999	470	12%	106	11%	2,532	13%	88	14%	247	12%	3,442	10%
2000	1,414	11%	401	11%	2,943	13%	19	45%	371	14%	5,150	8%
2001	573	12%	251	13%	3,092	14%	14	28%	1,395	13%	5,326	9%
2002	313	11%	280	10%	2,872	12%	101	12%	874	12%	4,439	8%
2003	529	12%	1,011	10%	3,692	14%	130	15%	1,068	14%	6,430	8%
2004	362	16%	712	11%	4,378	15%	197	15%	747	16%	6,395	10%
2005	1,410	12%	1,153	12%	7,004	13%	192	22%	1,372	14%	11,132	9%
2006	865	13%	1,445	11%	5,343	14%	253	18%	682	16%	8,588	9%
2007	1,962	18%	3,548	11%	6,423	18%	1,224	16%	1,257	22%	14,414	9%
2008	2,248	13%	2,198	10%	8,311	13%	1,219	12%	1,010	15%	14,986	8%
2009	2,934	12%	2,424	6%	7,252	13%	858	10%	1,430	14%	14,898	7%
2010	1,674	22%	1,831	13%	8,334	19%	523	17%	712	25%	13,073	13%
2011	2,824	12%	1,783	6%	10,011	11%	637	14%	1,194	14%	16,449	7%
2012	2,740	14%	3,231	6%	8,541	13%	976	26%	1,865	26%	17,352	7%
2013	1,581	16%	2,198	11%	10,856	14%	960	11%	1,149	16%	16,744	9%
2014	2,804	15%	3,385	6%	12,651	8%	696	16%	2,059	19%	21,596	6%
2015	3,583	22%	3,172	15%	16,217	15%	724	26%	1,847	33%	25,543	10%
2016	2,858	9%	3,415	8%	18,816	21%	764	16%	1,938	26%	27,790	15%
2017	3,031	8%	4,458	17%	6,753	11%	724	13%	2,158	20%	17,125	7%
2018	3,958	14%	3,707	7%	12,775	15%	646	9%	2,508	15%	23,595	9%

Table 4.–Southcentral region, Cook Inlet, and Prince William Sound areas estimated sport harvest of black rockfish (BRF) in each commercial fishery management unit (CFMU) report group by year. CI = Cook Inlet, NG = North Gulf, PWSI = Prince William Sound Inside, and PWSO = Prince William Sound Outside.

	CI		NG		PWSI		PWSO		Total	
Year	BRF Harvest	CV	BRF Harvest	CV	BRF Harvest	CV	BRF Harvest	CV	BRF Harvest	CV
1998	579	27%	5,467	9%	5,783	38%	6,211	9%	18,039	13%
1999	751	22%	10,243	7%	7,707	21%	3,886	9%	22,587	8%
2000	901	26%	14,224	9%	12,191	25%	8,258	8%	35,575	9%
2001	575	22%	24,400	8%	4,739	10%	8,998	8%	38,713	5%
2002	1,542	26%	19,833	8%	9,001	18%	7,467	9%	37,843	6%
2003	3,814	18%	18,852	9%	25,435	21%	8,752	10%	56,854	10%
2004	3,186	26%	21,306	8%	18,585	20%	10,315	8%	53,392	8%
2005	2,621	20%	24,400	8%	8,129	2%	8,700	10%	43,851	5%
2006	1,626	26%	20,495	7%	13,913	21%	7,294	9%	43,327	8%
2007	1,700	26%	27,235	7%	28,589	21%	9,945	9%	67,470	10%
2008	1,440	26%	28,695	8%	19,587	22%	11,068	9%	60,791	8%
2009	1,410	15%	22,602	8%	12,253	18%	10,352	9%	46,617	6%
2010	1,541	16%	26,879	8%	24,433	22%	9,550	10%	62,404	9%
2011	1,701	15%	30,411	5%	41,154	15%	13,511	7%	86,777	7%
2012	3,469	22%	27,781	4%	17,988	11%	10,965	4%	60,203	4%
2013	3,161	15%	34,083	5%	21,249	10%	14,211	9%	72,705	4%
2014	2,819	12%	41,651	4%	14,155	9%	17,415	9%	76,040	4%
2015	3,780	13%	50,442	4%	17,208	6%	14,751	4%	86,180	3%
2016	5,953	11%	55,044	3%	35,769	13%	20,499	3%	117,266	4%
2017	5,927	9%	36,999	4%	26,515	13%	23,212	7%	92,653	4%
2018	11,591	12%	45,071	3%	15,300	10%	22,025	5%	93,986	3%

Table 5.–Southeast region estimated sport harvest of black rockfish (BRF) in each commercial fishery management unit (CFMU) report group by year. CSEO = Central Southeast Outside, EWYKT = East–West Yakutat (IBS + EYKT), NSEI = Northern Southeast Inside, NSEO = Northern Southeast Outside, SSEI = Southern Southeast Inside, and SSEO = Southern Southeast Outside.

	CSEO		EWYKT		NSEI		NSEO		SSEI		SSEO		Total	
Year	BRF Harvest	CV	BRF Harvest	CV	BRF Harvest	CV	BRF Harvest	CV	BRF Harvest	CV	BRF Harvest	CV	BRF Harvest	CV
1998	5,109	6%	986	15%	2,546	28%	928	22%	3,052	13%	2,391	14%	15,012	6%
1999	4,526	6%	690	11%	3,631	29%	801	24%	4,067	12%	2,923	17%	16,638	8%
2000	7,017	7%	1,315	10%	5,329	29%	2,301	22%	5,687	13%	4,182	18%	25,832	8%
2001	5,187	9%	1,116	10%	3,790	29%	2,077	24%	4,872	12%	3,570	17%	20,611	8%
2002	6,222	7%	983	10%	2,911	29%	1,299	28%	4,261	12%	5,713	14%	21,390	7%
2003	7,783	6%	1,538	12%	3,372	29%	2,333	24%	6,043	12%	4,823	15%	25,892	6%
2004	11,312	6%	1,449	12%	3,211	29%	1,881	28%	5,961	13%	7,085	15%	30,898	6%
2005	14,772	6%	1,754	11%	4,246	29%	2,018	25%	6,617	14%	9,123	15%	38,531	6%
2006	22,696	4%	2,689	11%	4,439	8%	1,963	17%	7,642	6%	7,054	12%	46,483	3%
2007	27,069	4%	2,522	11%	4,776	5%	3,196	12%	8,024	6%	9,451	13%	55,038	3%
2008	41,753	4%	3,043	9%	7,354	4%	4,710	18%	10,189	6%	16,216	12%	83,265	3%
2009	24,308	4%	2,800	11%	5,803	5%	2,449	12%	7,133	5%	8,821	12%	51,314	3%
2010	33,554	4%	2,458	11%	7,659	6%	4,214	16%	10,378	5%	10,594	11%	68,858	3%
2011	50,770	3%	3,516	15%	9,377	4%	7,835	6%	10,331	5%	11,432	10%	93,261	2%
2012	45,759	1%	3,087	6%	13,142	9%	8,951	12%	9,133	3%	14,049	9%	94,121	2%
2013	53,329	2%	3,931	7%	10,262	6%	7,334	13%	13,439	6%	15,767	8%	104,062	2%
2014	65,132	3%	4,904	9%	13,292	7%	13,519	18%	11,517	4%	16,445	9%	124,810	3%
2015	66,093	2%	7,054	15%	13,707	4%	9,065	13%	11,916	3%	22,605	14%	130,441	3%
2016	44,433	2%	8,025	8%	10,697	5%	5,047	9%	13,196	4%	19,470	11%	100,868	3%
2017	50,393	4%	6,491	6%	12,258	9%	11,869	14%	15,085	4%	21,142	10%	117,237	3%
2018	45,640	2%	9,021	6%	10,279	6%	14,178	14%	24,352	4%	31,373	8%	134,843	3%

Table 6.–Southcentral region, Kodiak area estimated sport release of black rockfish (BRF) in each commercial fishery management unit (CFMU) report group by year. SKMA = Southern Kodiak management area (Southeast and Southwest Districts), and WKMA = Western Kodiak management area (Mainland and Westside Districts). Note the time series starts in 1999 because release estimates were not available from datasets prior to this time.

	Afognak		Eastside		Northeast		SKMA		WKMA		Total	
Year	BRF Release	CV	BRF Release	CV	BRF Release	CV	BRF Release	CV	BRF Release	CV	BRF Release	CV
1999	974	26%	400	47%	3,661	36%	155	32%	208	59%	5,397	25%
2000	2,591	27%	1,308	42%	4,466	36%	100	41%	375	47%	8,840	21%
2001	1,210	29%	531	52%	4,482	36%	31	61%	390	49%	6,645	26%
2002	841	24%	823	33%	3,652	34%	73	28%	357	38%	5,745	22%
2003	987	28%	1,027	38%	6,701	36%	167	33%	690	37%	9,572	26%
2004	813	34%	528	41%	3,696	39%	31	35%	294	46%	5,362	28%
2005	1,909	29%	886	42%	9,636	37%	136	37%	492	38%	13,060	27%
2006	1,057	30%	995	40%	3,777	37%	97	36%	611	39%	6,537	23%
2007	3,066	39%	3,353	43%	3,740	44%	589	39%	350	55%	11,098	23%
2008	1,772	27%	975	39%	3,167	36%	974	32%	563	38%	7,451	18%
2009	1,587	26%	738	29%	2,261	35%	406	25%	609	35%	5,601	17%
2010	1,219	41%	1,295	43%	1,773	44%	158	49%	388	55%	4,832	23%
2011	3,887	61%	512	18%	2,863	40%	207	22%	277	28%	7,747	34%
2012	1,445	43%	835	109%	3,817	98%	181	36%	732	42%	7,011	56%
2013	1,287	42%	624	29%	1,015	45%	206	26%	593	41%	3,725	21%
2014	3,204	51%	804	8%	1,712	56%	520	93%	2,368	97%	8,609	35%
2015	1,194	46%	752	26%	1,930	71%	31	59%	707	81%	4,615	35%
2016	1,429	81%	1,517	69%	1,670	74%	466	25%	1,135	41%	6,216	33%
2017	846	28%	2,496	222%	725	65%	347	102%	1,612	127%	6,025	99%
2018	916	66%	787	44%	827	54%	178	23%	1,761	29%	4,469	22%

Table 7.–Southcentral region, Cook Inlet, and Prince William Sound areas estimated sport releases of black rockfish (BRF) in each commercial fishery management unit (CFMU) report group by year. CI = Cook Inlet, NG = North Gulf, PWSI = Prince William Sound Inside, and PWSO = Prince William Sound Outside. Note the time series starts in 1999 because release estimates were not available from datasets prior to this time.

	CI		NG		PWSI		PWSO		Total	
Year	BRF Release	CV	BRF Release	CV	BRF Release	CV	BRF Release	CV	BRF Release	CV
1999	1,007	43%	5,023	17%	2,937	34%	958	26%	9,925	14%
2000	876	44%	10,322	21%	3,028	39%	2,291	26%	16,517	16%
2001	1,024	41%	9,075	20%	1,063	15%	2,115	26%	13,276	15%
2002	1,899	43%	6,585	20%	1,967	30%	2,069	28%	12,521	14%
2003	4,283	37%	7,142	22%	6,161	36%	2,041	32%	19,627	16%
2004	4,151	42%	8,264	20%	4,574	35%	2,211	28%	19,200	15%
2005	2,695	40%	7,862	19%	2,079	3%	1,888	31%	14,524	13%
2006	1,754	43%	5,528	18%	2,738	36%	1,576	29%	11,597	14%
2007	1,494	42%	5,265	19%	7,340	37%	1,007	31%	15,106	20%
2008	861	42%	4,472	20%	3,845	37%	1,041	31%	10,220	17%
2009	390	25%	2,470	21%	1,558	32%	1,112	31%	5,529	14%
2010	445	37%	2,475	21%	2,329	37%	741	37%	5,991	18%
2011	1,598	74%	2,094	22%	1,334	62%	973	67%	5,999	28%
2012	333	70%	1,352	23%	1,679	55%	571	29%	3,934	26%
2013	518	48%	3,070	37%	1,145	64%	761	79%	5,494	27%
2014	336	59%	3,117	37%	847	49%	741	63%	5,041	26%
2015	573	55%	2,841	26%	670	35%	527	38%	4,611	19%
2016	353	40%	3,624	24%	1,430	57%	775	22%	6,182	20%
2017	313	46%	1,591	35%	1,952	62%	624	73%	4,480	31%
2018	786	78%	3,187	29%	1,493	84%	655	57%	6,121	28%

Table 8.–Southeast region estimated sport release of black rockfish (BRF) in each commercial fishery management unit (CFMU) report group by year. CSEO = Central Southeast Outside, EWYKT = East–West Yakutat (IBS + EYKT), NSEI = Northern Southeast Inside, NSEO = Northern Southeast Outside, SSEI = Southern Southeast Inside, and SSEO = Southern Southeast Outside. Note the time series starts in 1999 because release estimates were not available from datasets prior to this time.

	CSEO		EWYKT		NSEI		NSEO		SSEI		SSEO		Total	
Year	BRF Release	CV	BRF Release	CV	BRF Release	CV	BRF Release	CV	BRF Release	CV	BRF Release	CV	BRF Release	CV
1999	9,511	16%	300	52%	5,841	31%	1,285	26%	4,827	16%	5,346	33%	27,111	11%
2000	6,601	17%	549	52%	6,388	31%	2,347	26%	6,252	17%	5,433	36%	27,569	12%
2001	6,091	17%	945	53%	4,656	31%	1,861	26%	5,131	18%	3,925	36%	22,609	11%
2002	6,844	17%	1,239	52%	4,476	31%	2,543	25%	5,490	17%	6,737	35%	27,329	12%
2003	8,977	17%	1,112	56%	5,406	31%	2,313	26%	5,290	17%	5,527	36%	28,625	11%
2004	7,834	16%	1,153	53%	4,282	31%	2,729	25%	3,704	18%	6,140	34%	25,842	12%
2005	8,687	17%	1,047	52%	5,417	31%	2,880	25%	5,617	18%	8,861	34%	32,508	12%
2006	5,570	16%	700	54%	5,560	19%	1,733	17%	4,282	13%	2,415	27%	20,261	8%
2007	5,638	17%	460	56%	2,393	12%	1,011	16%	1,981	13%	2,819	38%	14,301	11%
2008	4,694	18%	72	64%	2,455	11%	692	25%	2,328	14%	4,049	38%	14,291	13%
2009	2,155	18%	198	54%	1,557	12%	445	16%	1,014	12%	1,350	42%	6,720	11%
2010	2,252	20%	164	58%	1,363	17%	575	27%	1,586	15%	1,133	42%	7,072	11%
2011	3,142	22%	65	86%	1,302	15%	655	31%	1,007	15%	1,316	60%	7,487	15%
2012	2,794	21%	61	51%	1,392	46%	346	39%	803	9%	923	32%	6,320	15%
2013	2,787	16%	167	304%	1,107	33%	577	58%	1,473	45%	1,740	35%	7,851	16%
2014	3,315	41%	166	81%	1,133	36%	614	88%	1,023	16%	2,082	32%	8,333	20%
2015	2,272	22%	361	99%	1,012	23%	346	72%	1,143	9%	2,604	52%	7,737	20%
2016	3,394	28%	1,265	131%	794	28%	339	72%	1,050	19%	1,348	43%	8,190	25%
2017	3,161	33%	255	73%	1,427	44%	438	90%	1,842	27%	1,420	73%	8,543	20%
2018	3,096	26%	992	53%	1,975	63%	1,982	101%	3,512	22%	4,378	59%	15,935	23%

Table 9.–Southcentral region, Kodiak area estimated sport harvest of yelloweye rockfish (YE) in each commercial fishery management unit (CFMU) report group by year. SKMA = Southern Kodiak management area (Southeast and Southwest Districts), and WKMA = Western Kodiak management area (Mainland and Westside Districts).

	Afognak		Eastside		Northeast		SKMA		WKMA		Total	
Year	YE Harvest	CV	YE Harvest	CV	YE Harvest	CV	YE Harvest	CV	YE Harvest	CV	YE Harvest	CV
1998	78	19%	48	40%	305	31%	4	31%	30	16%	466	21%
1999	81	20%	13	39%	131	28%	14	31%	15	47%	253	16%
2000	186	21%	27	38%	139	33%	44	33%	77	17%	473	13%
2001	61	22%	40	39%	118	35%	14	32%	76	48%	309	19%
2002	51	20%	30	38%	226	27%	11	31%	95	29%	413	17%
2003	80	20%	32	37%	150	33%	33	31%	165	21%	461	14%
2004	111	18%	37	37%	225	31%	36	31%	110	23%	518	15%
2005	198	20%	103	38%	186	33%	122	32%	161	25%	769	13%
2006	164	11%	129	5%	207	30%	79	9%	154	15%	733	9%
2007	301	17%	124	12%	203	23%	196	13%	323	16%	1,146	8%
2008	599	9%	151	6%	333	20%	97	26%	270	14%	1,449	7%
2009	593	13%	41	24%	701	34%	103	18%	340	17%	1,777	14%
2010	450	14%	86	13%	480	36%	102	14%	379	10%	1,497	13%
2011	490	12%	41	4%	394	39%	95	14%	215	17%	1,235	14%
2012	548	13%	85	8%	270	18%	173	25%	517	21%	1,593	9%
2013	472	10%	66	17%	679	22%	136	12%	344	13%	1,697	10%
2014	586	13%	139	5%	821	20%	74	23%	534	16%	2,155	9%
2015	635	21%	180	14%	706	18%	99	29%	434	31%	2,055	11%
2016	602	6%	113	10%	646	18%	104	15%	684	14%	2,149	7%
2017	482	8%	78	48%	244	13%	77	22%	654	15%	1,536	8%
2018	634	14%	112	7%	383	22%	83	10%	651	11%	1,864	8%

Table 10.–Southcentral region, Cook Inlet, and Prince William Sound areas estimated sport harvest of yelloweye rockfish (YE) in each commercial fishery management unit (CFMU) report group by year. CI = Cook Inlet, NG = North Gulf, PWSI = Prince William Sound Inside, and PWSO = Prince William Sound Outside.

	CI		NG		PWSI		PWSO		Total	
Year	YE Harvest	CV	YE Harvest	CV	YE Harvest	CV	YE Harvest	CV	YE Harvest	CV
1998	115	33%	1,011	21%	4,323	43%	1,525	11%	6,974	27%
1999	39	35%	1,973	14%	6,232	25%	1,372	7%	9,617	16%
2000	83	35%	2,252	9%	4,194	24%	2,233	9%	8,761	12%
2001	26	35%	3,631	16%	16,006	28%	3,274	13%	22,937	20%
2002	131	36%	2,278	10%	12,765	27%	2,405	8%	17,578	19%
2003	197	39%	3,742	8%	7,553	23%	2,217	5%	13,709	13%
2004	156	44%	4,547	10%	10,754	26%	2,785	5%	18,243	15%
2005	101	49%	4,443	10%	15,413	27%	1,719	8%	21,676	19%
2006	127	24%	4,727	10%	7,058	23%	2,736	7%	14,647	12%
2007	124	26%	4,496	10%	6,813	23%	3,686	7%	15,118	11%
2008	121	22%	4,994	10%	6,020	24%	3,344	8%	14,480	11%
2009	142	0%	3,701	8%	6,656	25%	3,440	8%	13,940	12%
2010	185	0%	4,968	8%	5,891	22%	3,859	4%	14,903	9%
2011	218	12%	10,669	10%	10,013	17%	3,631	5%	24,531	8%
2012	286	30%	7,207	7%	11,294	16%	3,899	3%	22,685	8%
2013	341	28%	5,204	6%	8,548	15%	3,984	5%	18,076	7%
2014	208	29%	6,052	8%	14,882	17%	4,750	8%	25,892	10%
2015	235	23%	6,604	8%	23,886	15%	4,470	3%	35,195	10%
2016	185	0%	7,593	7%	12,059	21%	6,064	3%	25,901	10%
2017	514	14%	4,800	7%	10,754	19%	6,413	7%	22,480	9%
2018	552	19%	7,840	8%	5,220	18%	4,288	8%	17,900	6%

Table 11.–Southeast region estimated sport harvest of yelloweye rockfish (YE) in each commercial fishery management unit (CFMU) report group by year. CSEO = Central Southeast Outside, EWYKT = East–West Yakutat (IBS + EYKT), NSEI = Northern Southeast Inside, NSEO = Northern Southeast Outside, SSEI = Southern Southeast Inside, and SSEO = Southern Southeast Outside.

	CSEO		EWYKT		NSEI		NSEO		SSEI		SSEO		Total	
Year	YE Harvest	CV	YE Harvest	CV	YE Harvest	CV	YE Harvest	CV	YE Harvest	CV	YE Harvest	CV	YE Harvest	CV
1998	2,516	31%	121	22%	1,224	34%	343	28%	2,561	18%	842	25%	7,607	13%
1999	2,945	31%	25	23%	1,232	34%	366	26%	2,864	19%	1,417	25%	8,850	14%
2000	5,591	31%	32	25%	1,986	34%	918	27%	4,955	18%	2,193	25%	15,675	14%
2001	5,537	31%	33	24%	1,549	34%	992	26%	3,724	19%	1,795	25%	13,630	15%
2002	4,454	31%	23	25%	925	34%	795	24%	3,176	19%	2,015	25%	11,389	14%
2003	4,370	31%	91	23%	1,214	34%	1,041	26%	4,432	19%	1,952	25%	13,100	13%
2004	6,137	31%	78	23%	1,276	34%	1,141	24%	5,548	18%	2,830	25%	17,010	14%
2005	7,394	31%	61	23%	1,544	34%	990	26%	6,544	18%	3,488	25%	20,021	14%
2006	10,678	3%	167	0%	2,007	9%	1,570	22%	9,388	12%	5,455	8%	29,264	5%
2007	11,047	3%	112	3%	2,237	14%	2,016	26%	9,283	13%	4,433	7%	29,127	5%
2008	9,732	3%	194	12%	2,668	16%	1,535	19%	8,134	12%	4,502	9%	26,766	5%
2009	6,904	3%	89	8%	2,160	17%	925	20%	6,569	12%	2,353	9%	18,999	5%
2010	7,815	3%	128	5%	2,524	14%	1,402	25%	9,808	15%	3,507	11%	25,183	6%
2011	5,902	8%	137	11%	2,590	14%	1,279	15%	9,576	14%	2,091	11%	21,576	7%
2012	5,442	3%	159	5%	2,279	12%	1,289	18%	11,233	12%	2,751	10%	23,153	6%
2013	5,171	4%	65	14%	1,816	8%	1,179	17%	9,577	12%	2,867	10%	20,674	6%
2014	5,466	6%	141	11%	2,013	11%	1,508	16%	8,485	9%	2,150	12%	19,763	5%
2015	6,346	4%	215	0%	2,263	7%	1,721	21%	9,919	8%	2,859	17%	23,323	4%
2016	6,477	3%	393	13%	2,551	8%	880	8%	10,566	9%	3,005	20%	23,872	5%
2017	7,900	10%	230	0%	2,552	13%	1,465	16%	11,051	10%	2,686	12%	25,885	6%
2018	5,409	4%	327	7%	2,616	10%	1,657	18%	10,992	9%	3,734	15%	24,734	5%

Table 12.–Southcentral region, Kodiak area estimated sport release of yelloweye rockfish (YE) in each commercial fishery management unit (CFMU) report group by year. SKMA = Southern Kodiak management area (Southeast and Southwest Districts), and WKMA = Western Kodiak management area (Mainland and Westside Districts). Note the time series starts in 1999 because release estimates were not available from datasets prior to this time.

	Afognak		Eastside		Northeast		SKMA		WKMA		Total	
Year	YE Release	CV	YE Release	CV	YE Release	CV	YE Release	CV	YE Release	CV	YE Release	CV
1999	10	92%	22	183%	112	61%	1	108%	53	39%	198	42%
2000	39	66%	27	178%	63	103%	13	82%	85	38%	227	40%
2001	28	57%	27	183%	27	140%	12	84%	90	38%	183	40%
2002	12	72%	8	164%	261	58%	0	108%	64	39%	345	45%
2003	22	58%	8	162%	54	84%	1	108%	41	53%	127	42%
2004	43	58%	6	170%	174	62%	1	70%	37	41%	261	43%
2005	32	61%	9	167%	93	89%	3	69%	26	54%	163	54%
2006	24	41%	5	16%	115	71%	2	37%	31	52%	177	47%
2007	42	79%	3	76%	61	60%	5	66%	32	37%	143	36%
2008	29	61%	6	14%	45	82%	5	108%	19	90%	105	43%
2009	38	49%	8	8%	244	65%	5	46%	36	58%	331	49%
2010	22	76%	4	33%	58	85%	1	108%	40	39%	125	44%
2011	76	86%	0	92%	114	74%	2	22%	28	19%	220	48%
2012	54	31%	2	220%	59	104%	6	29%	100	25%	221	31%
2013	79	20%	0	524%	46	59%	8	11%	67	29%	201	18%
2014	132	36%	4	2%	101	96%	20	42%	258	63%	514	38%
2015	91	12%	11	8%	53	101%	1	18%	65	60%	221	30%
2016	104	23%	4	64%	29	79%	12	11%	195	15%	344	13%
2017	29	15%	9	266%	19	61%	6	85%	126	119%	189	81%
2018	20	70%	2	63%	33	37%	3	27%	116	32%	174	24%

Table 13.–Southcentral region, Cook Inlet and Prince William Sound areas estimated sport release of yelloweye rockfish (YE) in each commercial fishery management unit (CFMU) report group by year. CI = Cook Inlet, NG = North Gulf, PWSI = Prince William Sound Inside, and PWSO = Prince William Sound Outside. Note the time series starts in 1999 because release estimates were not available from datasets prior to this time.

	CI		NG		PWSI		PWSO		Total	
Year	YE Release	CV	YE Release	CV	YE Release	CV	YE Release	CV	YE Release	CV
1999	24	86%	907	37%	2,023	45%	116	50%	3,070	32%
2000	54	68%	1,346	20%	798	45%	221	61%	2,419	20%
2001	26	86%	1,371	36%	3,963	46%	398	73%	5,759	33%
2002	86	73%	524	27%	2,784	46%	298	44%	3,692	35%
2003	189	71%	1,045	22%	1,655	42%	207	26%	3,096	24%
2004	149	84%	1,295	30%	2,595	45%	220	31%	4,258	29%
2005	97	82%	1,122	28%	5,142	45%	132	41%	6,493	36%
2006	59	88%	945	34%	1,192	44%	277	37%	2,473	25%
2007	44	99%	566	35%	1,459	46%	294	24%	2,363	30%
2008	36	71%	573	30%	1,045	45%	271	27%	1,924	27%
2009	1	0%	295	28%	833	45%	314	33%	1,442	27%
2010	18	0%	295	30%	489	41%	308	15%	1,109	20%
2011	121	59%	848	37%	286	72%	202	47%	1,457	27%
2012	42	21%	403	35%	1,086	80%	118	40%	1,648	54%
2013	94	37%	475	32%	463	89%	154	54%	1,186	38%
2014	28	79%	595	42%	1,047	92%	309	35%	1,979	51%
2015	44	59%	433	33%	1,340	83%	156	26%	1,973	57%
2016	25	0%	817	29%	509	71%	247	29%	1,598	27%
2017	24	56%	284	27%	810	73%	243	43%	1,361	44%
2018	34	55%	937	33%	686	97%	414	29%	2,070	36%

Table 14.–Southeast region estimated sport release of yelloweye rockfish (YE) in each commercial fishery management unit (CFMU) report group by year. CSEO = Central Southeast Outside, EWYKT = East–West Yakutat (IBS + EYKT), NSEI = Northern Southeast Inside, NSEO = Northern Southeast Outside, SSEI = Southern Southeast Inside, and SSEO = Southern Southeast Outside. Note the time series starts in 1999 because release estimates were not available from datasets prior to this time.

	CSEO		EWYKT		NSEI		NSEO		SSEI		SSEO		Total	
Year	YE Release	CV	YE Release	CV	YE Release	CV	YE Release	CV	YE Release	CV	YE Release	CV	YE Release	CV
1999	1,323	36%	4	58%	1,698	48%	241	49%	3,329	38%	983	46%	7,578	22%
2000	1,018	34%	8	49%	2,013	47%	458	48%	4,998	37%	1,213	41%	9,707	22%
2001	957	34%	17	42%	1,360	48%	364	48%	4,183	37%	910	41%	7,792	22%
2002	1,124	33%	16	53%	1,245	49%	432	52%	4,187	37%	1,393	43%	8,398	22%
2003	1,380	34%	34	30%	1,529	49%	422	50%	4,069	37%	1,256	41%	8,692	21%
2004	1,127	35%	20	42%	1,210	49%	474	52%	3,096	36%	1,254	43%	7,181	20%
2005	1,461	33%	14	51%	1,481	50%	512	51%	4,908	36%	1,701	45%	10,077	21%
2006	1,185	25%	9	0%	1,171	44%	526	57%	3,244	41%	674	49%	6,809	22%
2007	1,213	26%	8	15%	890	43%	356	59%	1,913	38%	551	47%	4,930	19%
2008	830	19%	14	17%	942	43%	138	40%	1,394	37%	694	43%	4,012	19%
2009	479	14%	2	71%	636	42%	85	53%	754	36%	241	44%	2,197	18%
2010	792	10%	11	13%	495	36%	219	35%	1,709	40%	336	48%	3,563	21%
2011	934	25%	16	7%	370	47%	141	55%	965	45%	271	58%	2,697	20%
2012	1,395	10%	10	8%	322	39%	205	13%	1,070	47%	156	39%	3,157	17%
2013	1,164	7%	15	11%	234	34%	239	27%	1,642	60%	359	38%	3,653	27%
2014	1,045	21%	32	5%	164	54%	140	35%	975	37%	206	56%	2,562	18%
2015	1,054	10%	65	0%	167	40%	139	52%	940	29%	263	74%	2,629	14%
2016	1,368	17%	131	49%	195	48%	176	22%	1,168	39%	199	78%	3,236	17%
2017	2,156	20%	90	0%	358	49%	244	22%	2,793	37%	289	55%	5,930	19%
2018	1,840	13%	257	5%	930	59%	702	39%	3,232	31%	878	63%	7,840	17%

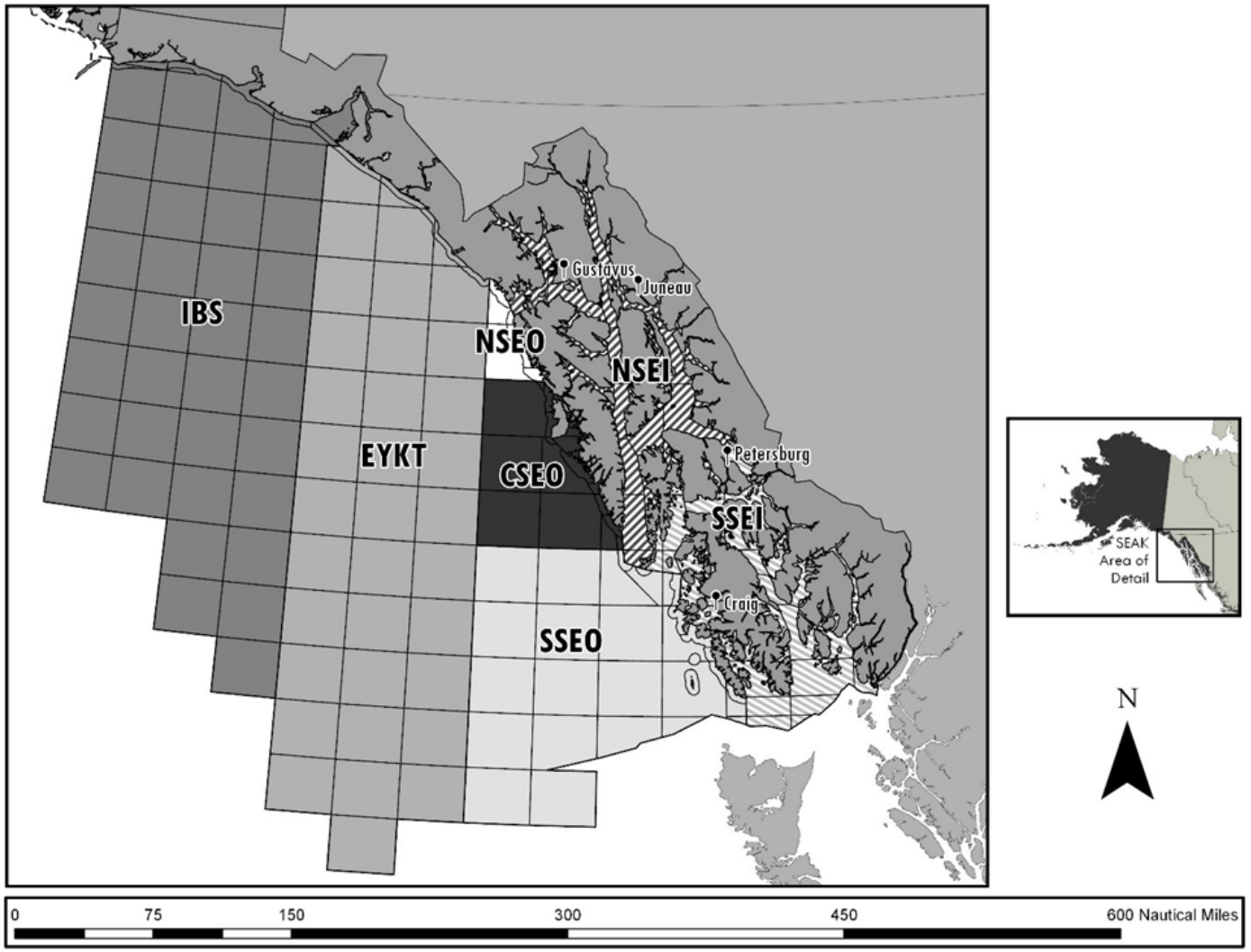

Figure 1.–Southeast Alaska rockfish commercial fishery management units: Icy Bay Subdistrict (IBS), East Yakutat Section (EYKT), Northern Southeast Outside Section (NSEO), Central Southeast Outside Section (CSEO), Southern Southeast Outside Section (SSEO), Northern Southeast Inside Subdistrict (NSEI), and Southern Southeast Inside Subdistrict (SSEI).

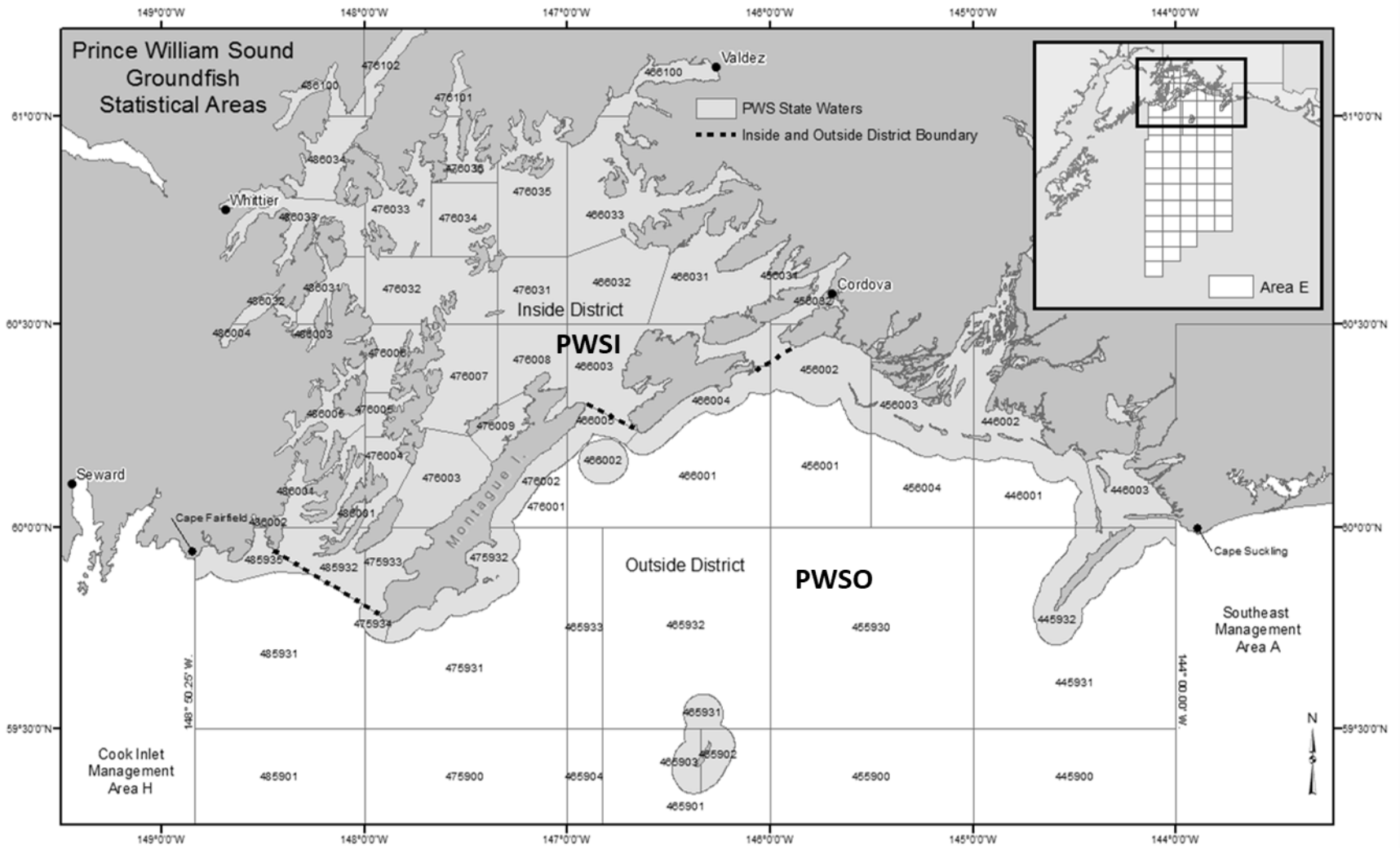

Figure 2.–Prince William Sound rockfish commercial fishery management units: Prince William Sound Inside District (PWSI) and Prince William Sound Outside District (PWSO).

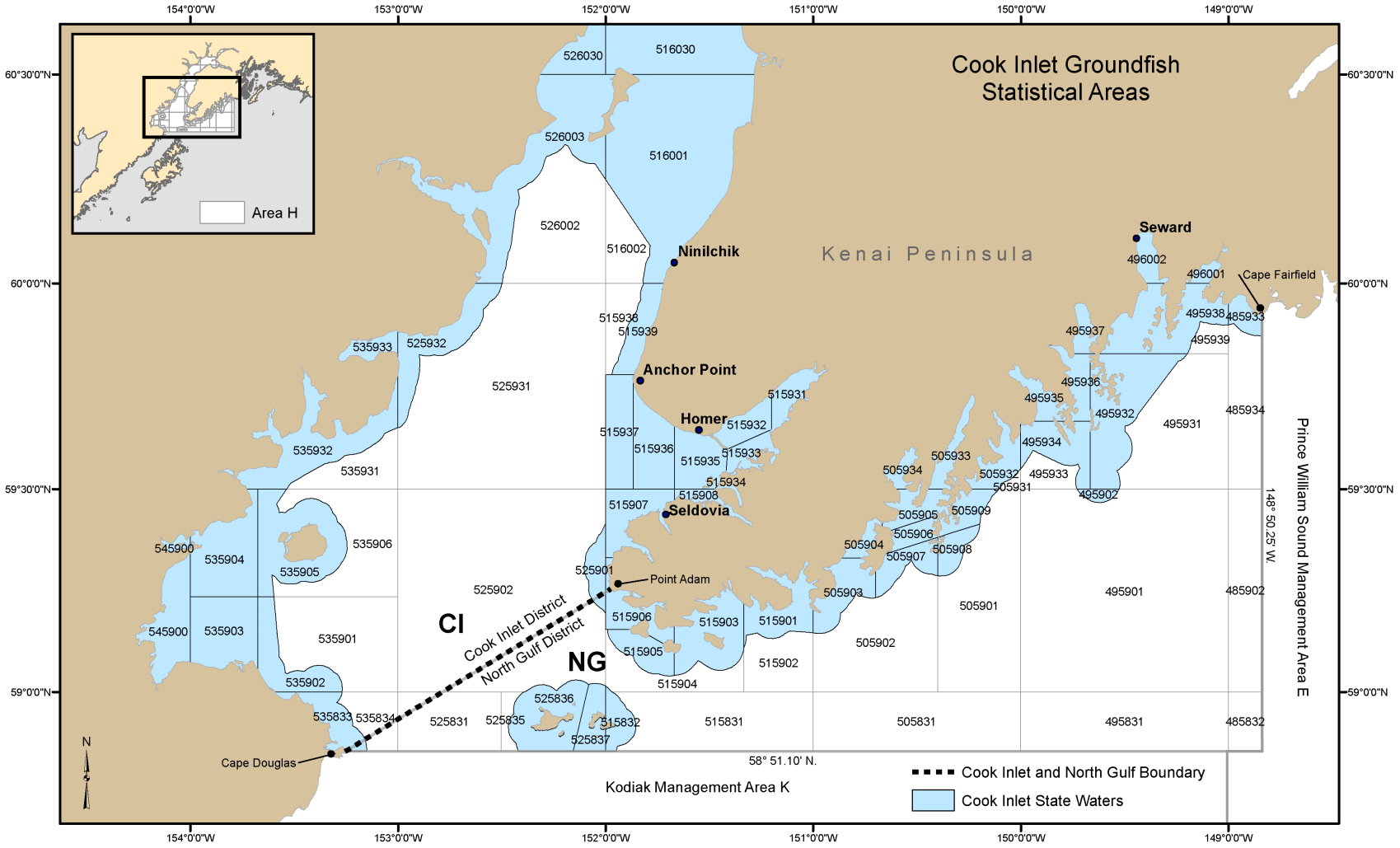

Figure 3.–Cook Inlet rockfish commercial fishery management units: North Gulf District (NG) and Cook Inlet District (CI).

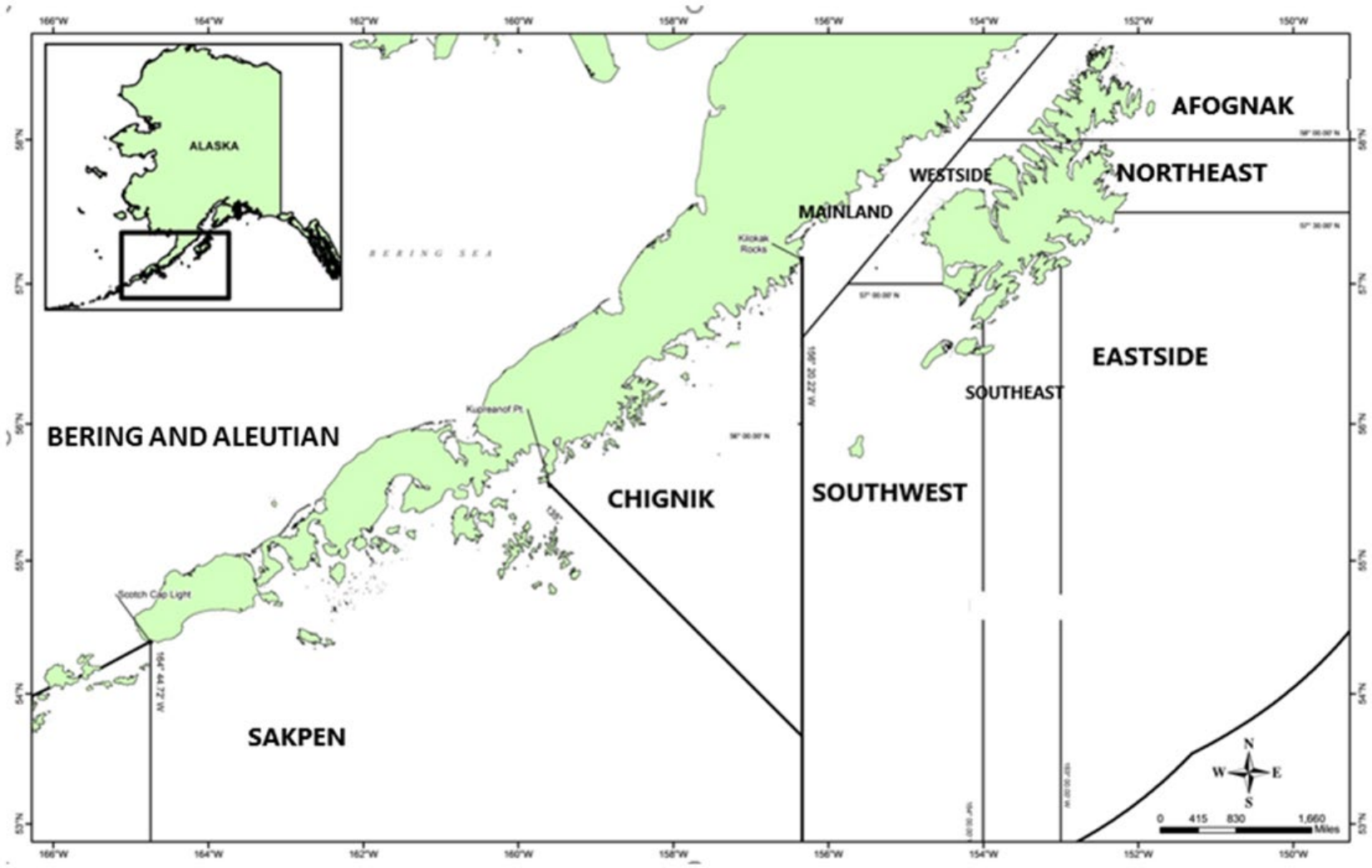

Figure 4.–Kodiak, Chignik, and the South Alaska Peninsula (SAKPEN) rockfish commercial fishery management units. The Bering Sea–Aleutian Islands Area includes all waters west of the South Alaska Peninsula Area border at Scotch Cap Light, and north into the Bering Sea. Kodiak management units include Afognak, Northeast, Eastside, Southeast, Southwest, Westside, and Mainland Districts.

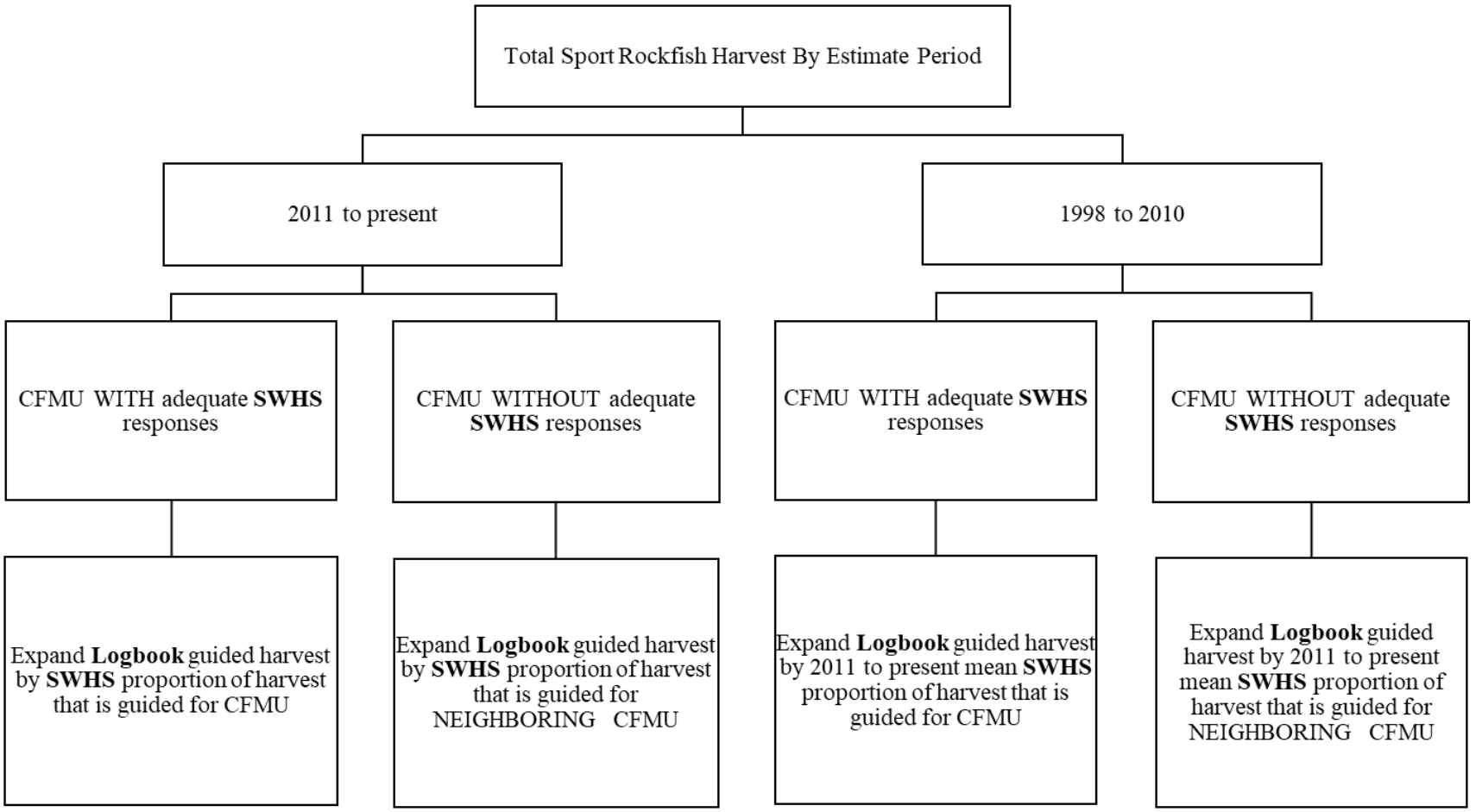

Figure 5.–Procedures for estimating total sport rockfish harvests by commercial fishery management units (CFMUs). Data sources indicated in bold.

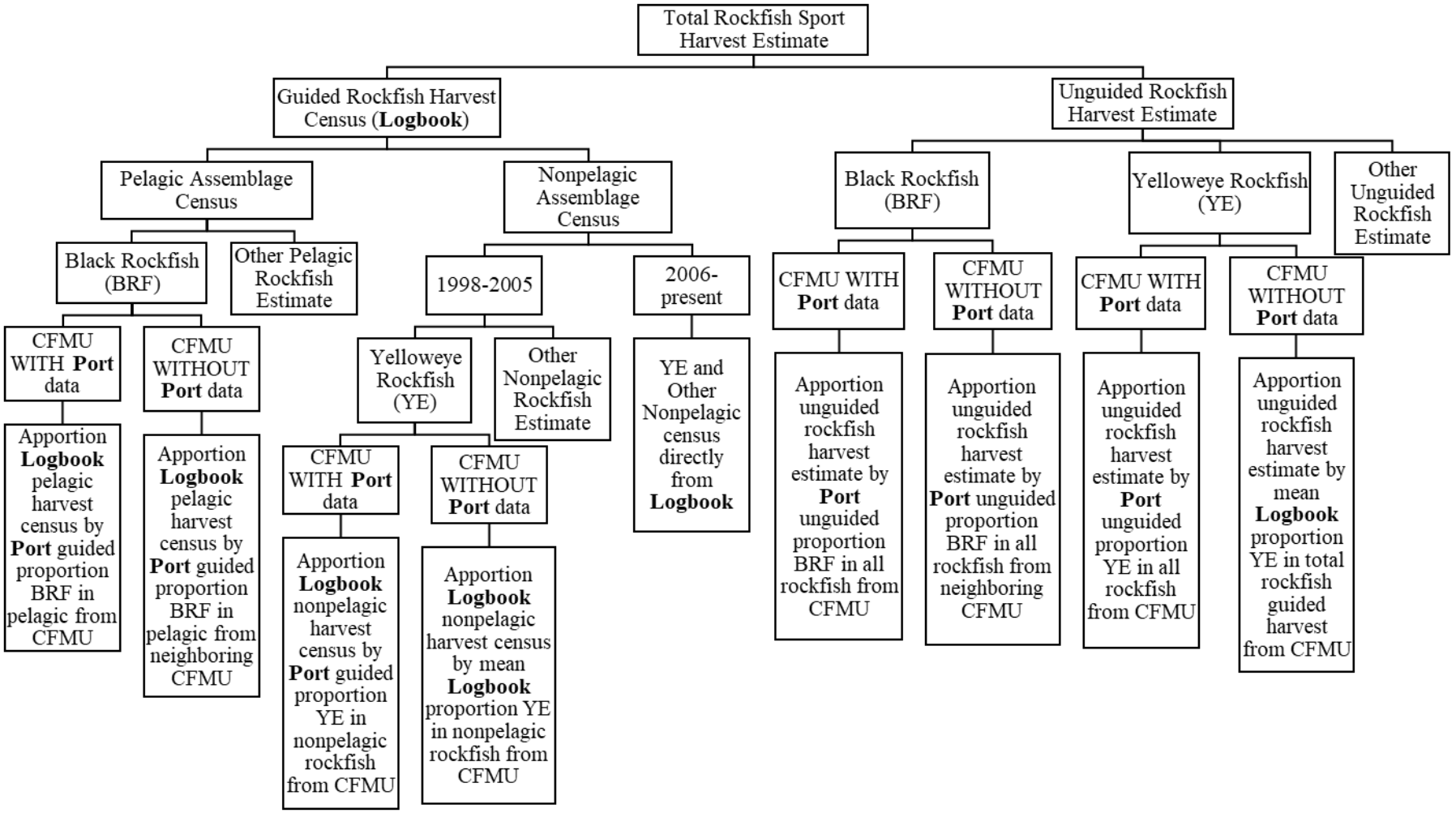

Figure 6.–Procedures for estimating species-specific black rockfish (BRF) and yelloweye rockfish (YE) sport harvests by commercial fishery management units (CFMUs). Data sources indicated in bold.

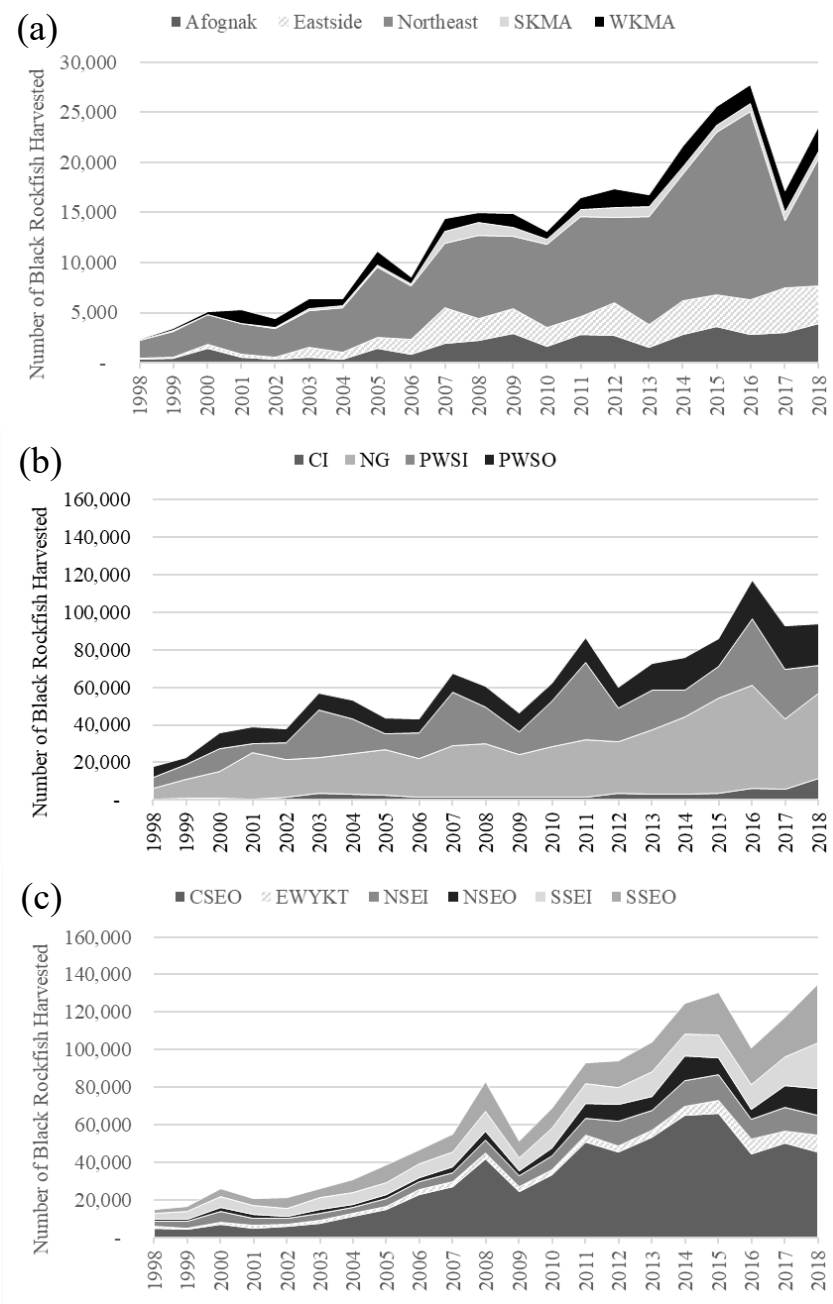

Figure 7.–Estimated sport harvest of black rockfish (BRF) in each commercial fishery management unit (CFMU) report group by year in (a) Kodiak area: SKMA = Southern Kodiak management area (Southeast and Southwest Districts), WKMA = Western Kodiak management area (Mainland and Westside Districts); (b) Cook Inlet and Prince William Sound areas: CI = Cook Inlet, NG = North Gulf, PWSI = Prince William Sound Inside, PWSO = Prince William Sound Outside; and (c) Southeast Alaska: CSEO = Central Southeast Outside, EWYKT = East–West Yakutat (IBS + EYKT), NSEI = Northern Southeast Inside, NSEO = Northern Southeast Outside, SSEI = Southern Southeast Inside, SSEO = Southern Southeast Outside.

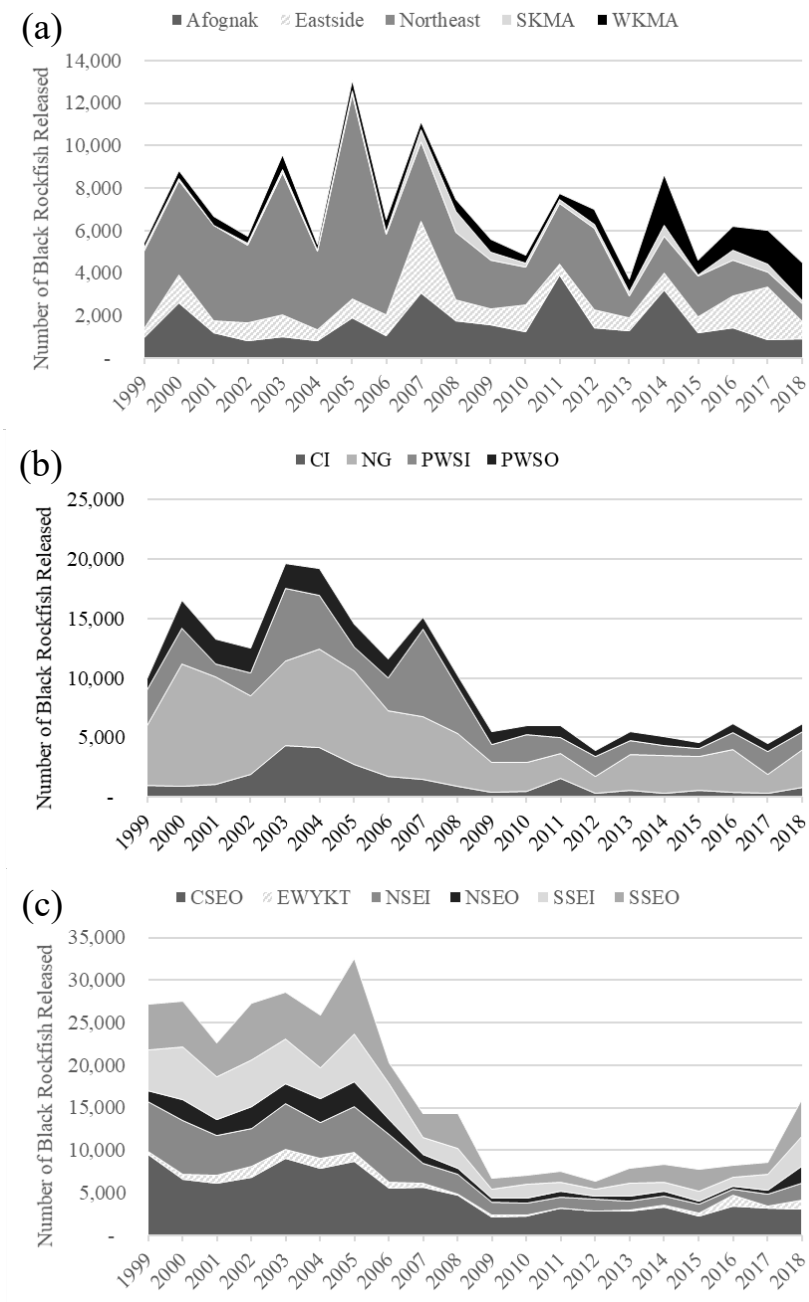

Figure 8.–Estimated sport release of black rockfish (BRF) in each commercial fishery management unit (CFMU) report group by year in (a) Kodiak area: SKMA = Southern Kodiak management area (Southeast and Southwest Districts), WKMA = Western Kodiak management area (Mainland and Westside Districts); (b) Cook Inlet and Prince William Sound areas: CI = Cook Inlet, NG = North Gulf, PWSI = Prince William Sound Inside, PWSO = Prince William Sound Outside; and (c) Southeast Alaska: CSEO = Central Southeast Outside, EWYKT = East–West Yakutat (IBS + EYKT), NSEI = Northern Southeast Inside, NSEO = Northern Southeast Outside, SSEI = Southern Southeast Inside, SSEO = Southern Southeast Outside.

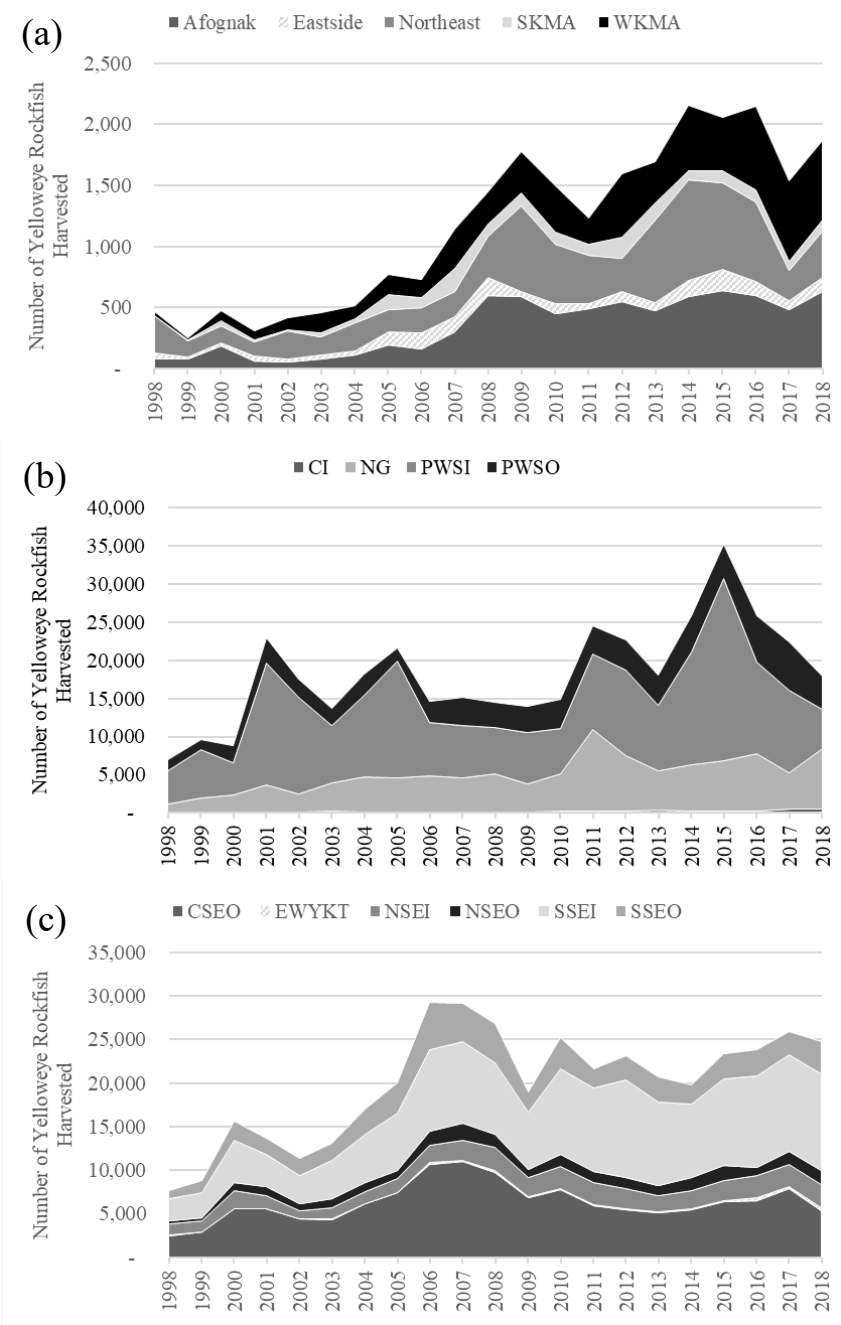

Figure 9.–Estimated sport harvest of yelloweye rockfish (YE) in each commercial fishery management unit (CFMU) report group by year in (a) Kodiak area: SKMA = Southern Kodiak management area (Southeast and Southwest Districts), WKMA = Western Kodiak management area (Mainland and Westside Districts); (b) Cook Inlet and Prince William Sound areas: CI = Cook Inlet, NG = North Gulf, PWSI = Prince William Sound Inside, PWSO = Prince William Sound Outside; and (c) Southeast Alaska: CSEO = Central Southeast Outside, EWYKT = East–West Yakutat (IBS + EYKT), NSEI = Northern Southeast Inside, NSEO = Northern Southeast Outside, SSEI = Southern Southeast Inside, SSEO = Southern Southeast Outside.

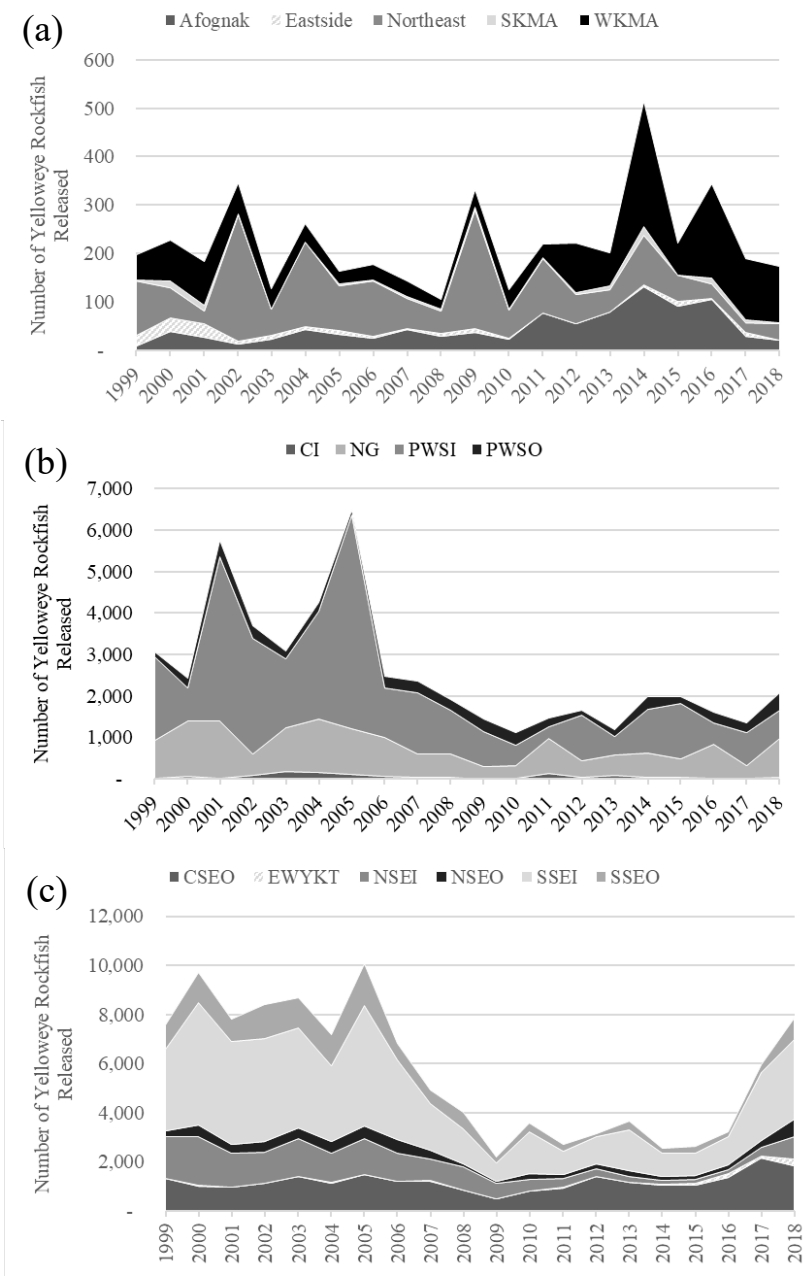

Figure 10.–Estimated sport release of yelloweye rockfish (YE) in each commercial fishery management unit (CFMU) report group by year in (a) Kodiak area: SKMA = Southern Kodiak management area (Southeast and Southwest Districts), WKMA = Western Kodiak management area (Mainland and Westside Districts); (b) Cook Inlet and Prince William Sound areas: CI = Cook Inlet, NG = North Gulf, PWSI = Prince William Sound Inside, PWSO = Prince William Sound Outside; and (c) Southeast Alaska: CSEO = Central Southeast Outside, EWYKT = East–West Yakutat (IBS + EYKT), NSEI = Northern Southeast Inside, NSEO = Northern Southeast Outside, SSEI = Southern Southeast Inside, SSEO = Southern Southeast Outside.

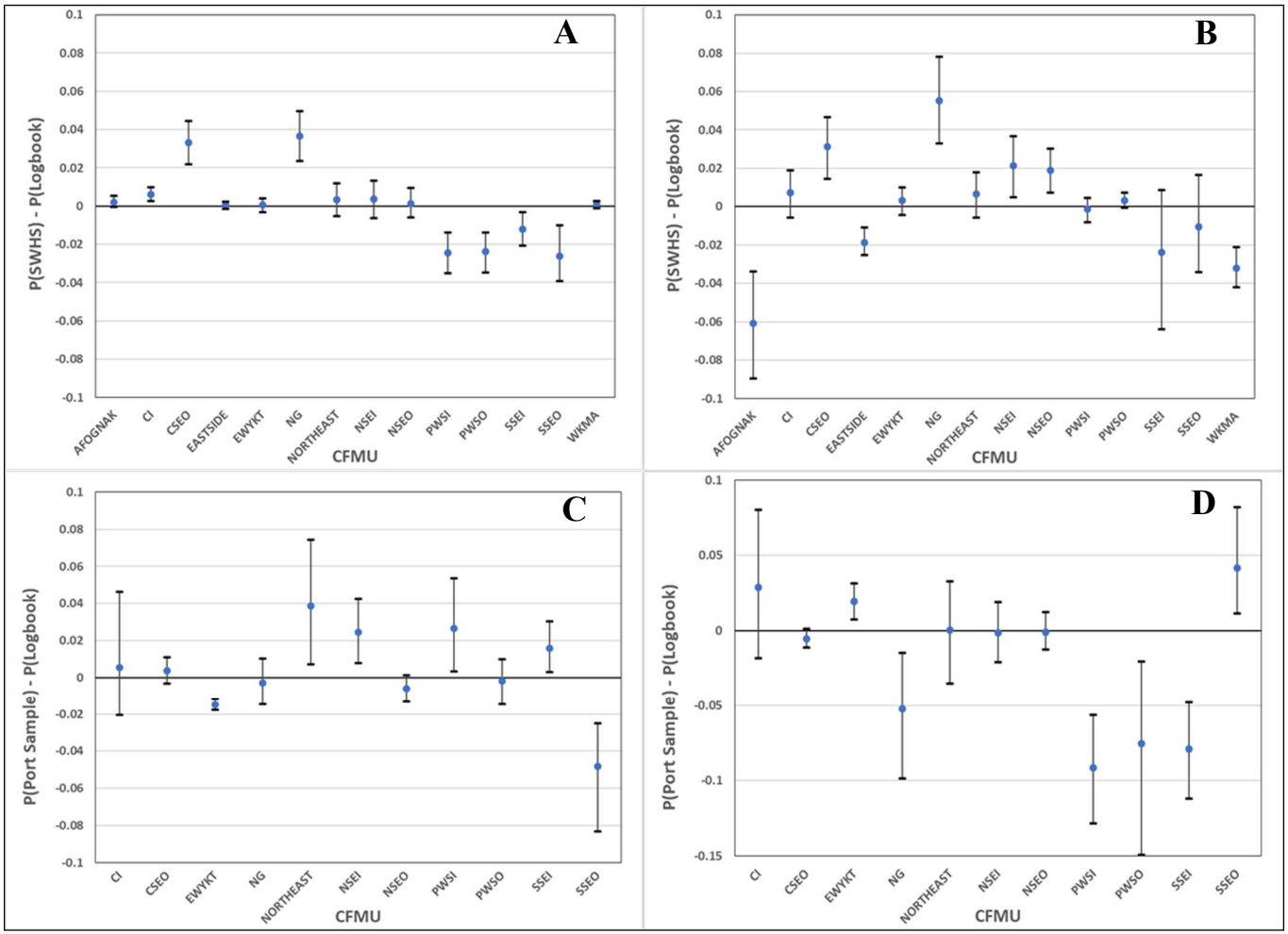

Figure 11.–Mean differences in rockfish proportions by commercial fishery management unit (CFMU) with 95% bootstrapped confidence intervals. (A) SWHS minus logbook for sport guided harvests: 2011–2018; (B) SWHS minus logbook for sport guided releases: 2011–2018; (C) Port sample minus logbook for sport guided yelloweye rockfish harvest: 2006–2018; (D) Port sample minus logbook for sport guided pelagic rockfish harvest: 1998–2018.

Note: CI = Cook Inlet, CSEO = Central Southeast Outside, EWYKT = East–West Yakutat, NG = North Gulf, NSEI = Northern Southeast Inside, NSEO = Northern Southeast Outside, PWSI = Prince William Sound Inside, PWSO = Prince William Sound Outside, SSEI = Southern Southeast Inside, SSEO = Southern Southeast Outside, WKMA = Westside Kodiak.

APPENDIX A:
PREDICTING ESCAPEMENT FROM INDEX COUNTS USING AN EXPANSION FACTOR

The expansion factor provides a means of predicting escapement in years where only an index count of the escapement is available, i.e., no weir counts or mark–recapture experiments were conducted. The expansion factor (π) is the mean over several years of the ratio of the escapement estimate (or weir count) to the index count.

A: Systems where escapement is known

On systems where escapement can be completely enumerated with weirs or other complete counting methods, the expansion factor is an estimate of the expected value of the "population" of annual expansion factors (π values) for that system:

$$\overline{\pi} = \frac{\sum_{y=1}^{k} \pi_y}{k} \tag{1}$$

where $\pi_y = N_y / C_y$ is the observed expansion factor in year *y*, N_y is the known escapement in year *y*, C_y is the index count in year *y*, and *k* is the number of years for which these data are available to calculate an annual expansion factor.

The estimated variance for expansion of index counts needs to reflect two sources of uncertainty for any predicted value of π , (π_p). First is an estimate of the process error (*var*(π): the variation across years in the π s, reflecting, for example, weather or observer-induced effects on how many fish are counted in a survey for a given escapement), and second is the sampling variance of $\overline{\pi}$ (*var*($\overline{\pi}$)), which will decline as we collect more data pairs. (These two sources of variability are analogous to the variability in the ε_i and in the $\hat{Y}_i$, respectively, in the usual linear regression setup).

The variance for prediction will be estimated (Neter and Wasserman 1990):

$$var(\pi_p) = var(\pi) + var(\overline{\pi}) \tag{2}$$

where

$$var(\pi) = \frac{\sum_{y=1}^{k} (\pi_y - \overline{\pi})^2}{k-1} \tag{3}$$

and

$$var(\overline{\pi}) = \frac{\sum_{y=1}^{k} (\pi_y - \overline{\pi})^2}{k(k-1)} \tag{4}$$

-continued-

[1] *Var* is used to denote population variance; *var* is used to denote estimated variance.

such that

$$var(\pi_p) = \frac{\sum_{y=1}^{k}(\pi_y - \overline{\pi})^2}{k-1} + \frac{\sum_{y=1}^{k}(\pi_y - \overline{\pi})^2}{k(k-1)} \quad (5)$$

B: Systems where escapement is estimated

On systems where escapement is estimated, the expansion factor is an estimate of the expected value of the "population" of annual expansion factors (π) for that system:

$$\overline{\pi} = \frac{\sum_{y=1}^{k}\hat{\pi}_y}{k} \quad (6)$$

where $\hat{\pi}_y = \hat{N}_y / C_y$ is the estimate of the expansion factor in year *y*, $\hat{N}_y$ is the estimated escapement in year *y*, and other terms are as described above.

The variance for prediction will again be estimated:

$$var(\pi_p) = var(\pi) + var(\overline{\pi}) \quad (7)$$

Component: $var(\pi)$

var (π) should again reflect only process error. Variation in $\hat{\pi}$ across years, however, represents process error **plus** measurement error within years (e.g., the mark–recapture induced error in escapement estimation) and is described by the relationship (Cochran 1977; Equation 10.2):

$$Var(\hat{\pi}) = Var[E(\hat{\pi})] + E[Var(\hat{\pi})] \quad (8)$$

This relationship can be rearranged to isolate process error ($Var[E(\hat{\pi})]$), that is:

$$Var[E(\hat{\pi})] = Var[\hat{\pi}] - E[Var(\hat{\pi})] \quad (9)$$

var (π) representing an estimate of only process error therefore is:

$$var(\pi) = var(\hat{\pi}) - \frac{\sum_{y=1}^{k} var(\hat{\pi}_y)}{k} \quad (10)$$

where

$$var(\hat{\pi}) = \frac{\sum_{y=1}^{k}(\hat{\pi}_y - \overline{\pi})^2}{k-1} \quad (11)$$

-continued-

and

$var(\hat{\pi}_y) = var(\hat{N}_y)/C_y^2$, with $var(\hat{N}_y)$ = obtained during the experiment when N_y is estimated.

Component: $var(\overline{\pi})$

As we did above:

$$var(\overline{\pi}) = \frac{\sum_{y=1}^{k}(\hat{\pi}_y - \overline{\pi})^2}{k(k-1)} \tag{12}$$

For large k ($k > 30$), Equations 11 and 12 provide reasonable parameter estimates, however, for small k the estimates are imprecise and may result in negative estimates of variance when the results are applied as in equation 7.

Because k is typically <10, we will obtain $var(\hat{\pi})$ and $var(\overline{\pi})$ using parametric bootstrap techniques (Efron and Tibshirani 1993). The sampling distributions for each of the $\hat{\pi}_y$ are modeled using normal distributions with means $\hat{\pi}_y$ and variances $\hat{var}(\hat{\pi}_y)$. At each bootstrap iteration, a bootstrap value $\hat{\pi}_{y(b)}$ is drawn from each of these normal distributions and the bootstrap value $\hat{\pi}_{(b)}$ is randomly chosen from the k values of $\hat{\pi}_{y(b)}$. Then, a bootstrap sample of size k is drawn from the k values of $\hat{\pi}_{y(b)}$ by sampling with replacement, and the mean of this bootstrap is the bootstrap value $\overline{\pi}_{(b)}$. This procedure is repeated B = 1,000,000 times. We can then estimate $var(\hat{\pi})$ using:

$$var_B(\hat{\pi}) = \frac{\sum_{b=1}^{B}(\hat{\pi}_{(b)} - \overline{\hat{\pi}_{(b)}})^2}{B-1} \tag{13}$$

where

$$\overline{\hat{\pi}_{(b)}} = \frac{\sum_{b=1}^{B}\hat{\pi}_{(b)}}{B} \tag{14}$$

and we can calculate $var_B(\overline{\pi})$ using Equations 13 and 14 with appropriate substitutions.

The variance for prediction is then estimated:

$$var(\pi_p) = var_B(\hat{\pi}) - \frac{\sum_{y=1}^{k}\text{var}(\hat{\pi}_y)}{k} + var_B(\overline{\pi}) \tag{15}$$

As the true sampling distributions for the $\hat{\pi}_y$ are typically skewed right, using a normal distribution to approximate these distributions in the bootstrap process will result in estimates of $var(\hat{\pi})$ and $var(\overline{\pi})$ that are biased slightly high, but simulation studies using values similar to those realized for this applications indicated that the bias in Equation 15 is <1%.

APPENDIX B:
SOUTHEAST REGION DEMERSAL SHELF ROCKFISH

Appendix B1.–Southeast region estimated sport harvest of demersal shelf rockfish (DSR) in each commercial fishery management unit (CFMU) report group by year. CSEO = Central Southeast Outside, EWYKT = East–West Yakutat (IBS + EYKT), NSEI = Northern Southeast Inside, NSEO = Northern Southeast Outside, SSEI = Southern Southeast Inside, and SSEO = Southern Southeast Outside.

	CSEO		EWYKT		NSEI		NSEO		SSEI		SSEO	
Year	DSR Harvest	Variance	DSR Harvest	Variance	DSR Harvest	Variance	DSR Harvest	Variance	DSR Harvest	Variance	DSR Harvest	Variance
1998	4,816	132,604	710	5,065	3,453	313,184	673	16,681	8,157	1,386,077	2,147	43,558
1999	5,620	175,310	171	1,265	3,500	400,428	724	15,472	9,128	1,915,896	3,632	94,288
2000	10,651	620,709	243	4,126	5,630	969,673	1,807	110,677	15,777	5,085,135	5,623	212,975
2001	10,527	598,180	239	3,126	4,381	553,242	1,963	109,185	11,865	3,085,759	4,601	147,147
2002	8,492	397,338	177	2,288	2,633	238,068	1,582	57,276	10,121	2,277,870	5,139	249,159
2003	8,352	392,612	577	7,680	3,444	371,565	2,056	127,887	14,122	4,476,966	4,988	206,768
2004	11,734	777,909	502	6,524	3,611	382,440	2,270	118,758	17,662	6,165,627	7,231	439,586
2005	14,151	1,142,542	424	8,084	4,380	596,736	1,959	106,182	20,827	8,328,714	8,908	693,903
2006	15,207	492,266	809	33,237	4,060	153,452	2,541	224,990	24,976	11,536,690	9,955	1,107,157
2007	15,846	504,796	715	35,148	5,145	314,432	3,172	565,262	27,939	15,748,133	7,952	505,491
2008	16,971	986,620	607	10,830	7,620	1,163,367	2,594	153,479	25,256	11,830,532	9,329	889,349
2009	10,890	395,822	593	20,962	6,029	801,907	1,510	123,718	20,030	7,416,914	5,018	259,912
2010	14,007	518,300	773	17,580	7,916	1,197,683	2,597	292,739	27,485	15,567,107	7,324	715,339
2011	14,469	1,073,739	1,014	59,536	7,635	574,130	2,746	109,815	25,526	11,873,727	5,502	449,523
2012	15,023	144,460	630	4,258	10,510	1,425,774	3,090	212,871	31,882	11,997,871	6,538	315,179
2013	13,505	409,395	616	6,887	5,811	230,563	2,444	160,563	35,125	18,456,697	6,279	311,111
2014	14,401	930,986	846	6,830	9,072	1,159,209	3,606	300,270	33,928	8,932,011	6,894	633,313
2015	17,399	401,233	1,857	141,106	10,101	452,704	3,922	470,950	38,374	10,687,378	9,635	2,406,620
2016	14,149	371,380	1,808	36,497	10,575	715,891	1,818	28,261	38,839	11,670,365	7,354	1,579,367
2017	14,853	2,198,684	1,001	5,911	7,717	890,501	2,740	146,157	33,180	9,676,811	5,916	717,975
2018	10,073	157,345	1,300	19,235	10,320	922,977	3,099	283,237	36,181	7,647,641	7,027	791,729

Appendix B2.–Southeast region estimated sport release of demersal shelf rockfish (DSR) in each commercial fishery management unit (CFMU) report group by year. CSEO = Central Southeast Outside, EWYKT = East–West Yakutat (IBS + EYKT), NSEI = Northern Southeast Inside, NSEO = Northern Southeast Outside, SSEI = Southern Southeast Inside, and SSEO = Southern Southeast Outside. Note the time series starts in 1999 because release estimates were not available from datasets prior to this time.

	CSEO		EWYKT		NSEI		NSEO		SSEI		SSEO	
Year	DSR Release	Variance	DSR Release	Variance	DSR Release	Variance	DSR Release	Variance	DSR Release	Variance	DSR Release	Variance
1999	2,875	948,257	24	430	4,993	3,892,121	453	36,237	10,645	15,318,864	2,402	959,564
2000	2,189	480,641	52	1,473	5,896	4,989,546	863	123,638	15,965	31,597,595	2,992	1,139,484
2001	2,054	413,226	105	4,500	3,998	2,483,178	687	77,890	13,361	21,890,722	2,249	612,723
2002	2,402	533,982	109	7,414	3,669	2,203,571	804	133,971	13,378	22,787,341	3,426	1,655,167
2003	2,969	887,472	201	7,043	4,500	3,257,586	792	115,501	13,003	21,419,470	3,102	1,195,880
2004	2,440	653,739	127	6,684	3,562	2,042,298	885	156,236	9,887	11,826,363	3,081	1,362,038
2005	3,115	871,560	94	5,318	4,366	3,181,412	958	176,256	15,672	29,016,173	4,166	2,714,765
2006	2,317	462,344	53	1,257	3,410	1,280,908	749	178,813	11,298	15,956,492	1,841	677,325
2007	2,038	346,688	33	178	1,888	482,108	585	92,046	6,795	5,705,581	1,889	362,563
2008	1,935	276,227	35	147	2,990	1,196,552	209	5,798	5,134	3,250,929	2,412	563,917
2009	883	62,494	10	41	1,671	446,486	161	7,484	2,700	868,431	1,017	75,850
2010	1,236	61,101	29	121	1,736	352,262	359	14,204	5,663	3,522,445	1,238	127,286
2011	1,551	249,073	27	136	1,108	159,701	298	19,205	2,645	1,291,175	807	213,514
2012	2,342	119,425	21	44	1,305	405,387	323	3,302	3,406	1,812,673	376	16,524
2013	1,616	57,633	40	3,899	637	69,106	338	18,690	6,711	13,364,928	740	70,646
2014	1,839	490,217	62	310	796	219,238	240	13,520	4,345	2,024,888	834	132,211
2015	1,758	92,776	78	20	754	79,002	263	19,949	4,104	1,322,843	1,131	432,259
2016	3,033	506,610	318	81,608	959	203,186	363	8,738	4,663	3,184,415	848	110,525
2017	3,667	702,889	160	352	1,376	295,496	484	8,108	10,401	9,169,034	1,192	173,349
2018	3,413	190,896	690	16,488	4,436	4,761,289	1,700	262,456	16,400	9,257,305	2,386	776,815

APPENDIX C:
SOUTHEAST REGION SLOPE ROCKFISH

Appendix C1.–Southeast region estimated sport harvest of slope rockfish in each commercial fishery management unit (CFMU) report group by year. CSEO = Central Southeast Outside, EWYKT = East–West Yakutat (IBS + EYKT), NSEI = Northern Southeast Inside, NSEO = Northern Southeast Outside, SSEI = Southern Southeast Inside, and SSEO = Southern Southeast Outside.

	CSEO		EWYKT		NSEI		NSEO		SSEI		SSEO	
Year	Slope Harvest	Variance	Slope Harvest	Variance	Slope Harvest	Variance	Slope Harvest	Variance	Slope Harvest	Variance	Slope Harvest	Variance
1998	647	103,771	16	256	1,016	224,068	60	1,051	1,433	100,344	136	3,303
1999	757	144,858	6	24	1,059	211,041	64	1,256	1,588	134,336	227	9,740
2000	1,436	527,702	10	67	1,690	559,399	161	7,663	2,777	370,705	351	23,513
2001	1,422	523,897	9	55	1,305	346,752	175	9,293	2,074	219,588	287	15,682
2002	1,145	333,073	7	37	802	117,408	142	6,256	1,767	161,359	324	18,923
2003	1,124	316,028	16	205	1,037	207,465	183	10,086	2,463	316,200	313	18,062
2004	1,579	621,874	15	162	1,078	233,823	203	12,872	3,118	455,033	455	37,910
2005	1,902	897,530	15	152	1,317	336,383	175	9,293	3,687	621,641	561	57,288
2006	643	7,475	40	665	594	19,685	118	4,317	4,489	305,959	401	13,217
2007	702	6,419	10	96	1,029	82,016	60	1,440	5,476	460,437	230	2,614
2008	1,354	11,496	59	1,124	858	54,516	316	15,698	3,315	242,971	454	5,550
2009	435	3,719	33	465	1,168	64,046	102	2,648	2,296	113,529	225	2,142
2010	1,315	10,211	0	0	1,174	63,616	87	255	3,243	129,001	297	5,335
2011	2,014	31,735	63	914	2,105	134,130	241	2,231	4,303	360,910	401	6,199
2012	1,663	12,418	46	89	2,713	248,970	274	1,963	6,099	601,186	479	7,965
2013	2,429	21,249	8	26	2,652	74,681	268	1,225	6,782	754,643	353	3,630
2014	4,000	89,769	14	74	3,451	286,869	420	5,417	8,748	629,810	380	6,615
2015	2,661	20,800	31	369	2,924	191,608	307	1,876	7,261	308,782	681	35,550
2016	2,295	25,244	21	129	7,102	492,760	120	279	8,902	635,247	323	4,740
2017	3,276	86,019	21	72	2,728	114,377	208	1,615	6,947	505,445	880	39,278
2018	2,722	13,460	83	442	3,881	129,590	350	4,677	5,681	291,027	942	17,299

Appendix C2.–Southeast region estimated sport release of slope rockfish in each commercial fishery management unit (CFMU) report group by year. CSEO = Central Southeast Outside, EWYKT = East–West Yakutat (IBS + EYKT), NSEI = Northern Southeast Inside, NSEO = Northern Southeast Outside, SSEI = Southern Southeast Inside, and SSEO = Southern Southeast Outside. Note the time series starts in 1999 because release estimates were not available from datasets prior to this time.

	CSEO		EWYKT		NSEI		NSEO		SSEI		SSEO	
Year	Slope Release	Variance	Slope Release	Variance	Slope Release	Variance	Slope Release	Variance	Slope Release	Variance	Slope Release	Variance
1999	356	27,052	0	0	1,716	670,305	39	498	1,785	505,617	165	8,038
2000	273	15,170	0	0	2,003	887,051	74	1,776	2,704	1,049,724	202	10,586
2001	256	13,297	1	2	1,373	428,444	59	1,123	2,266	727,922	151	5,824
2002	300	18,005	1	1	1,269	373,618	69	1,651	2,259	755,390	233	14,723
2003	370	27,921	2	10	1,553	555,475	68	1,538	2,197	710,327	209	11,231
2004	302	19,248	1	2	1,229	348,148	76	1,971	1,679	393,728	210	12,032
2005	390	30,154	1	1	1,515	536,275	82	2,279	2,669	968,142	285	23,222
2006	136	3,377	0	0	768	123,390	64	2,478	1,872	345,587	76	1,670
2007	86	767	0	0	709	114,621	13	110	1,246	146,659	52	305
2008	128	638	0	0	433	41,239	35	509	666	54,505	114	1,206
2009	31	73	0	0	378	28,438	15	116	302	10,408	47	263
2010	112	440	0	0	301	15,553	11	4	618	19,858	53	645
2011	213	4,247	1	0	376	30,571	27	177	438	33,301	62	1,480
2012	263	2,022	1	0	379	58,538	33	20	653	75,205	29	216
2013	291	1,427	0	0	303	17,173	41	48	1,276	466,648	40	230
2014	504	35,242	0	0	319	49,042	30	92	1,109	123,015	52	927
2015	264	1,570	0	0	302	30,807	22	26	779	30,583	90	4,622
2016	519	19,574	0	0	689	133,382	24	20	1,054	149,322	41	114
2017	846	20,581	2	1	476	28,871	41	51	2,177	397,383	167	7,606
2018	917	4,187	31	69	1,619	519,325	210	2,422	2,618	234,511	316	9,035