CHAPTER 14: ASSESSMENT OF THE DEMERSAL SHELF ROCKFISH STOCK FOR 2010 IN THE SOUTHEAST OUTSIDE DISTRICT OF THE GULF OF ALASKA

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EXECUTIVE SUMMARY

This report is submitted to the North Pacific Fishery Management Council annually as part of the stock assessment and fishery evaluation review for the federally managed groundfish species of the Gulf of Alaska (GOA). Relative to the December 2009 Stock Assessment and Fishery Evaluation report (SAFE), the following substantive changes have been made:

Changes in the Input Data

New estimates of yelloweye (*Sebastes ruberrimus*) density for the East Yakutat Section (EYKT) from the 2009 survey were used. Yelloweye average weight and standard error data were updated for all areas using incidental catch from the halibut fishery and fish caught in the directed commercial longline fishery for demersal shelf rockfish (DSR) during 2009. New age data has been added for the Central Southeast Outside Section (CSEO) for 2004 and for EYKT for 2005.

Changes in the Assessment Results

The exploitable biomass estimate for yelloweye rockfish in the Southeast Outside (SEO) for 2010 is 14,321 mt, down 18% from the 2009 exploitable biomass estimate of 17,390 mt.

Scientific and Statistical Committee Comments Specific to Demersal Shelf Rockfishes:

"The SSC looks forward to seeing confidence intervals for recreational removals, which the authors expect to provide next year."

> Unfortunately, confidence intervals are not yet available for recreational removals. Variance estimates are available for SWHS harvest estimates, estimates of average weight, and estimates of release proportions. The variances of average weight are likely underestimated, due to the use of random sampling formulae, when in fact the data are actually collected through cluster sampling. A bootstrap routine to estimate these variances is under development. Formulation of the variance for the released fish biomass has not yet been determined. The primary obstacle to describing uncertainty is that the estimates of the proportion of sport harvest in outside waters are assumed values, based on an assumption that cannot yet be tested, and the variance of these assumed values cannot be calculated. Nevertheless, a ballpark estimate of the sampling error CV of the removal estimates is provided.

Total landed catch of DSR (mt, round weight) in all commercial fisheries in SEO, by species and year.

DSR Species	2003	2004	2005	2006	2007	2008	Total
canary rockfish	3.75	3.39	0.43	0.43	0.34	0.67	9.01
China rockfish	0.18	0.12	0.03	0.06	0.04	0.01	0.44
copper rockfish	0.08	0.05	0.00	0.01	0.05	0.01	0.2
quillback rockfish	8.31	7.22	3.82	2.81	2.69	2.88	27.73
rosethorn rockfish	0.09	0.11	0.00	0.07	0.02	0.09	0.38
tiger rockfish	0.95	0.94	0.80	0.37	0.11	0.26	3.43
yelloweye rockfish	262.06	311.77	228.15	199.06	192.38	189.71	1383.13
Total DSR	275.42	323.60	233.24	202.82	195.62	193.63	1424.33
% yelloweye of DSR	95.15	96.34	97.82	98.15	98.34	97.98	97.11

ABC and Overfishing Levels

The acceptable biological catch (ABC) for DSR is set using Tier IV definitions with F=M=0.02 and adjusting 3% for the other species landed in the assemblage. The ABC was set at 295 mt. The overfishing level (472 mt) was set using $F_{35\%}$=0.032 and adjusting 3% for the other species landed.

INTRODUCTION[1]

Rockfishes of the genus *Sebastes* are found in temperate waters of the continental shelf off North America. At least thirty-two species of *Sebastes* occur in the Gulf of Alaska. In 1988, the North Pacific Fisheries Management Council (NPFMC) divided the rockfish complex into three components for management purposes in the Eastern Gulf of Alaska (EGOA): Demersal Shelf Rockfish, Pelagic Shelf Rockfish, and Other Rockfish. These assemblages were based on species distribution and habitat, as well as commercial catch composition data. The species composition within each assemblage has changed over time, as new information becomes available. The DSR assemblage is now comprised of the seven species of nearshore, bottom-dwelling rockfishes listed in Table 1. These fish are located on the continental shelf, reside on or near the bottom, and are generally associated with rugged, rocky habitat. For purposes of this report, emphasis is placed on yelloweye rockfish, as it is the dominant species in the DSR fishery (O'Connell and Brylinsky 2003).

All DSR are considered highly K selective, exhibiting slow growth and extreme longevity (Adams 1980, Gunderson 1980, Archibald et al. 1981). Estimates of natural mortality are very low. These types of fishes are very susceptible to over-exploitation and are slow to recover once driven below the level of sustainable yield (Leaman and Beamish 1984; Francis 1985). An acceptable exploitation rate is assumed to be very low (Dorn 2000).

Rockfishes are considered viviparous although different species have different maternal contribution (Boehlert and Yoklavich 1984, Boehlert et al. 1986, Love et al. 2002). Rockfishes have internal fertilization with several months separating copulation, fertilization, and parturition. Within the DSR species complex parturition occurs from February through September with the majority of species extruding larvae in spring. Yelloweye rockfish extrude larvae over an extended time period, with the peak period of parturition occurring in April and May in Southeast Alaska (O'Connell 1987). Although some species of *Sebastes* have been reported to spawn more than once per year in other areas (Love et al. 1990), no incidence of multiple brooding has been noted in Southeast Alaska (O'Connell 1987).

[1] This section provided by Victoria O'Connell, Coastal Marine Research, Sitka, AK.

Rockfishes have a closed swim bladder that makes them susceptible to embolism mortality when brought to the surface from depth. Therefore all DSR caught, including discarded bycatch in other fisheries, are usually fatally injured and should be counted against the total allowable catch (TAC).

Prior to 1992, DSR was recognized as a Fishery Management Plan (FMP) assemblage only in the waters east of 137° W. longitude. In 1992 DSR was recognized in EYKT, and management of DSR extended westward to 140° W. longitude. This area is referred to as the Southeast Outside (SEO) Subdistrict and is comprised of four management sections: EYKT, Northern Southeast Outside (NSEO), CSEO and Southern Southeast Outside (SSEO). In SEO, the State of Alaska and the National Marine Fisheries Service manage DSR jointly. The two internal state water subdistricts, Northern Southeast Inside (NSEI) and Southern Southeast Inside (SSEI) are managed entirely by ADF&G and are not included in this stock assessment (Figure 1).

FISHERY

Description

The directed fishery for DSR began in 1979 as a small, shore-based, hook and line fishery in Southeast Alaska. This fishery targeted the nearshore, bottom-dwelling component of the rockfish complex, with fishing occurring primarily inside the 110 m contour. The early directed fishery targeted the entire DSR complex. In more recent years the fishery targeted yelloweye rockfish and fished primarily between the 90 m and the 200 m contours. Yelloweye rockfish accounted for an average of 97% (by weight) of the total DSR catch over the past six years. Quillback rockfish accounted for 1.9% of the landed catch in those years. The directed fishery is prosecuted almost exclusively by longline gear. Although snap-on longline gear was originally used in this fishery, most vessels now use conventional (fixed-hook) longline gear. Markets for this product are domestic fresh markets and fish are generally brought in whole, bled, and iced. Processors will not accept fish delivered more than three days after being caught. Price per pound (round) decreased in 2009 with the maximum price paid of $1.65 compared to the maximum of $2.00 in 2008. This is a further decrease from the maximum price of $2.60 in 2003.

The internal waters directed DSR fishery is managed with seasonal allocations: 67 percent of the directed fishery quota is allocated to the time period between January 5 and the day before the start of the individual fishing quota (IFQ) halibut season and 33 percent is allocated between the day following the end of the commercial halibut IFQ season and December 31. In SEO regulations stipulate one season only for directed fishing for DSR opening January 5th and continuing until the allocation is landed or until the day before the start of the IFQ halibut season whichever comes first. The directed DSR fleet requested a winter fishery, as the ex-vessel price is highest at that time. The directed season is closed during the halibut IFQ season to prevent over-harvest of DSR. Directed fishery quotas are set by management area and are based on the remaining ABC after subtracting the estimated DSR incidental catch (landed and at sea discard) in other fisheries. No directed fisheries occurred in 2006 or 2007 in the SEO district as the Department took action in two areas; one was to enact management measures to keep the catch of DSR in the sport fishery to the levels mandated by the Board of Fisheries (BOF), and the other was to further compare the estimations of incidental catch in the halibut fishery to the actual landings from full retention regulations in the commercial fishery in those years to see how closely our predicted bycatch matched the landed catch. Directed fisheries did occur in 2008 and 2009 in two of the outer coast areas, EYKT and SSEO.

Bycatch[2] in the directed DSR fishery

Landed bycatch in the DSR fishery includes lingcod, Pacific cod, skates, and other rockfishes. For example, in the 2009 directed DSR fishery landed round weight included 173,515 pounds of DSR, 37,000 lbs of lingcod, 1,900 lbs of Pacific cod, 4,600 lbs of dusky rockfish, 350 lbs of redbanded rockfish, 1,200 lbs of silvergrey rockfish, 150 lbs of black rockfish, and 3,700 lbs of skates. The magnitude of at-sea discard in the directed DSR fishery is difficult to quantify, as this is an unobserved fleet. However, logbook data for 2009 indicates primary discards were halibut and small numbers of lingcod and skates when fishermen reached their bycatch allowance for those species. More skates were retained in 2009 than in previous years due to favorable market conditions.

Bycatch of DSR in other fisheries

DSR have been taken as bycatch in domestic longline fisheries, particularly the halibut fishery, for over 100 years. Some bycatch was also landed by foreign longline and trawl vessels targeting slope rockfish in the EGOA from the late 1960s through the mid-1970s. DSR mortality during the halibut longline fishery continues to account for a significant portion of the TAC. In 2008, reported DSR bycatch in the halibut fishery accounted for 57% of the total reported DSR landings (total landings include sport, subsistence, and commercial directed and bycatch fisheries) in the SEO subdistrict and 78% of the commercial landings (directed and bycatch) of DSR.

The allowable bycatch limit of DSR during halibut fishing is 10% of the halibut weight.
However on an individual set or trip basis there may be a higher rate of DSR caught. Because these fish suffer embolism mortality all bycatch should be counted against the TAC. In 1998 the NPFMC passed an amendment to require full retention of DSR in federal waters. Seven years later, in mid-season 2005, the final rule was published and fishermen must now retain and report all DSR caught in federal waters; any poundage above the 10% bycatch allowance may be donated or kept for personal use but may not enter commerce. In July of 2000, the State of Alaska enacted a regulation requiring that all DSR landed in state waters of Southeast Alaska be fully retained and reported on fish tickets. Proceeds from the sale of DSR in excess of legal sale limits are forfeited to the State of Alaska fishery fund. Until 2006 the amount of DSR landed had significantly increased with these management actions, but due to decreases in the halibut quota in Southeast Alaska the total pounds of DSR bycatch has gradually declined as well. In state water fisheries in Southeast Alaska in 2006 over 34,000 pounds of DSR were landed above the 10% limit compared to 27,000 pounds in 2008. In 2008, the 4th year of the federal full retention requirement, the amount of DSR overages that were landed in federal fisheries in Southeast decreased to 49,000 compared to over 55,000 lbs landed in 2006. Prior to 2005 approximately 10% of the overages from both state and federal waters were retained by the fisherman as personal use or given as donations. By 2006 87% of overages were taken as personal use or donations and this trend has continued to gradually increase to 91% in 2008.

The International Pacific Halibut Commission (IPHC) has provided us with ratio data in numbers of yelloweye to legal halibut net weight from longline surveys from 1996 to the present. Numbers of yelloweye are then converted to weight using average weight data for that year. In years prior to 2007, bycatch was estimated based on sampling the first 20 hooks of each skate of gear. There are can be problems in estimating total bycatch using this sampling approach since DSR are habitat specific and tend to be contagiously distributed. In the years 2007–2009 the IPHC accounted for all yelloweye rockfish caught on the longline survey and has provided those data to the Department by set.

[2] It is important to note that in all State managed fisheries, and in this chapter, the term "bycatch" is used to describe fish caught incidentally and retained while directed fishing for other species.

Because the mortality anticipated in the halibut fishery needs to be deducted from the commercial portion of the TAC before any directed fishery can occur, the department calculates this estimate preseason. In those stock assessments presented in 2006 and prior the estimated total DSR mortality associated with the halibut fishery was calculated by using the IPHC halibut survey data to estimate the bycatch rate of DSR by ADF&G management area. The bycatch rate (ratio of yelloweye to halibut by weight) was applied to the projected halibut catch by management area by using a combination of the current year's halibut quota and the percent of the previous year's commercial halibut fishery catch taken in each area. Using this approach, the estimated DSR bycatch in SEO associated with the 2006 commercial halibut fishery was 354 mt.

Since 2006 a new method has been used to estimate total DSR mortality associated with the halibut commercial fishery. Depth is an important component of the bycatch rate as DSR rockfish are more limited in their normal depth distribution than are halibut. Halibut are often found in deep water in the early portion of the commercial fishing season and some halibut are landed in deeper water throughout the season when fishermen are targeting sablefish as well as halibut. The IPHC provided depth and area-specific survey and commercial catch information that allow evaluation of distribution of catch and rate of bycatch by depth and area.[3] Because there were very few survey stations in some management area/depth strata combinations, the data were analyzed by depth for the whole of SEO with only one area breakout. The three strata used were: 1) all waters of the EYKT subdistrict that were less than 100 fm except for the Fairweather Grounds, 2) all waters of SEO less than 100 fm and not included in the previous category, and 3) all waters of SEO between 100 and 200 fm. Stratum-specific DSR bycatch mortality was estimated by applying the ratio of yelloweye bycatch (lbs) to legal halibut catch (lbs) estimated from the IPHC survey data to the projected halibut catch from the relevant stratum (Schaeffer et al. 1979). Based on the 2007 halibut landing data, it is estimated that approximately 41% of the 2C (IPHC Regulatory Area) halibut quota and 10% of the 3A halibut quota were taken in SEO. Using this 2007 distribution of commercial halibut harvest, the 2009 halibut quotas, and the ratios of yelloweye to halibut from the 2008 IPHC longline survey, the estimated total yelloweye mortality in SEO associated with the 2009 halibut fishery is anticipated to be 140 mt (season will end November 15) (Table 2). This compares to 129 mt of yelloweye actually landed from the 2009 IFQ season so far (March 21 to October 13, 2009). The estimation method described above was used to anticipate the bycatch of yelloweye in the directed halibut fishery in 2008 also. For that year the predicted bycatch for yelloweye in the directed halibut fishery was 148.5 mt. The reported landed bycatch of yelloweye in the directed halibut fishery in 2008 was 129 mt.

This estimation method seems reliable because it is believed that full retention regulations are being followed by most fishermen and that compliance continues to increase. An additional 10% is added to the estimation preseason for that portion of bycatch which may not be landed or reported on fish tickets (anecdotal information suggests that there is not full compliance with full retention regulations). While confidence in this method of predicting bycatch catch appears to be merited, there is an inherent problem in estimating a rate of bycatch for DSR. DSR are habitat specific, and although their distribution overlaps with halibut, the distributions are not correlated. The IPHC longline survey data indicates that bycatch of DSR is highly variable both inter-annually, annually, and spatially. There is no linear relationship between the catch of halibut and the catch of DSR (Figure 2).

Other Sources of Mortality

Although management of this stock has been conservative, the continued decline in the density estimates in the CSEO and the current evidence of decline in EYKT may be indications that localized overfishing is occurring. Harvest limits are set by management area based on density and habitat. Our harvest strategy

[3] Unpublished data IPHC (contact Tom Kong for commercial data, Claude Dykstra for survey data).

suggests we are taking 2% of the exploitable biomass per year and this level is sustainable. Yelloweye tend to be resident and tag return information indicates that adult fish reside in the same area over years (O'Connell 1991). Catch curve analysis of age data from CSEO using age data from 2000-2002 suggests that total mortality (*Z*) is approaching 6% (natural mortality is estimated at 2% annually) (Table 3). Catch curves are problematic for fish with variable recruitment, however, catch curves from the SSEO and EYKT areas suggest harvest rate more in line with the harvest policy with Z estimated at 4% or less (Table 3). It is possible that DSR mortality associated with the halibut fishery has been underestimated in CSEO and EYKT. A review of available sport fishery catch data done in 2005 indicated that this fishery is a source of significant exploitation in CSEO. Sport fish harvest had not previously been accounted for in total catch statistics or TAC setting but has been accounted for in recent years (2006-2009).

Sport Fishery Removals[4]

Prior to 2006, the daily bag limit in the Southeast Alaska sport fishery for non-pelagic (DSR and slope/other) rockfish was 3 to 5 fish, depending upon the area fished, and there were no annual limits on any rockfish species.

Since 2006, the Division of Sport Fish instituted restrictions on the non-pelagic rockfish sport fishery in Southeast Alaska to curtail DSR removals down to the BOF allocation of the annual DSR TAC in the SEO Subdistrict. A daily bag limit of 3 non-pelagic rockfish, of which only one could be a yelloweye rockfish, and a possession limit of six fish of which only two may be a yelloweye rockfish, were established for resident and nonresident anglers in Southeast Alaska beginning in 2006. All non-pelagic rockfish caught are required to be retained until the bag limit is reached. In addition, nonresident anglers had an annual limit of three yelloweye rockfish in 2006, which was further reduced to an annual limit of two yelloweye rockfish during 2007-2009. Finally, charter operators and crewmembers were prohibited from retaining non-pelagic rockfish while clients were on board the vessel.

There are three sources of data available from the sport fish fishery: the Statewide Harvest Survey (SWHS), the charter logbook, and creel surveys at selected ports in Southeast Alaska. The detail of data varies greatly between these three sources.

The SWHS is an annual mail survey of a sample of households containing licensed anglers. This survey provides estimates of harvest and catch (kept+released fish), in numbers of fish, for all rockfish species combined. Estimates are provided for SWHS reporting areas, which closely mirror ADF&G Sport Fish management areas. Logbooks have been mandatory for the charter fishery since 1998. Before 2006, charter logbook data were reported for pelagic and non-pelagic rockfish assemblages. Since 2006 logbooks have required reporting for pelagic rockfish, yelloweye rockfish, and all other non-pelagic species. Charter operators are also required to report the primary ADF&G statistical area for each boat trip. Creel survey sampling is conducted at major ports, but mainly at public access sites. There is some sampling of fish landed at private docks and lodges, although this requires the permission of owners to sample on their private property. Prior to 2006, there were no biological data collected by creel samplers beyond species composition of sport-caught rockfish. Length and weight data were added in 2006 and 2007 to estimate length-weight functions for each species. Species composition and length only were collected in 2008 and 2009. The numbers of rockfish kept and released per boat-trip have been collected by DSR species since 2006. The creel survey interviews include reporting of the primary statistical area fished for each boat trip.

The SWHS estimates of total sport catch and harvest (retained catch) are significantly higher than the logbook estimates because SWHS estimates include the unguided, or private harvest (Figure 3)[4]. Catch

[4] Unpublished data, Mike Jaenicke, Alaska Department of Fish and Game, Sport Fish Division, Douglas, AK.

and harvest have grown substantially since 1990. Standard errors and confidence intervals for SWHS estimates are presented in Table 4.

2008 Sport DSR Removals – Methods

The total biomass removal (in metric tons) by the sport fishery in 2008 was estimated using a combination of SWHS, creel survey, and charter logbook data. The total removals were estimated as the sum of the mass of the harvest (retained catch) and release mortality. The harvest biomass (*HB*) in each area (*a*) (NSEO, CSEO, and SSEO) was estimated as:

$$\widehat{HB_a} = \sum_s \hat{H}_a \hat{p}_{aO} \hat{p}_{as} \hat{\bar{w}}_{as} ,$$

where:

$\hat{H}_a$ = the SWHS estimate of the number of all rockfish species combined harvested in area *a* (closely corresponding with SWHS areas B, D, or G),

$\hat{p}_{aO}$ = the estimated proportion of harvest in the SWHS area that is taken from outside waters of area *a*,

$\hat{p}_{as}$ = the estimated proportion of species *s* in the sport harvest of all rockfish from the outside waters of area *a*,

$\hat{\bar{w}}_{as}$ = the estimated average round weight of species *s* in the sport harvest from outside waters of area *a*.

SWHS Areas B (Prince of Wales), D (Sitka), and G (Glacier Bay) roughly correspond to the SSEO, CSEO, and NSEO groundfish management areas. The 2008 SWHS estimates for each area are listed in Table 4.

The SWHS rockfish harvest estimates for the SWHS areas Prince of Wales Island, Sitka, and Glacier Bay include areas of NSEI and SSEI groundfish areas. Examination of logbook and SWHS data indicated that about 65% of the rockfish harvest for the Prince of Wales Island and Glacier Bay SWHS areas occurs in the corresponding SSEO and NSEO groundfish areas, respectively. For the Sitka SWHS area, about 90% of the rockfish harvest occurs in the CSEO groundfish area. These percentages were applied to the total harvest biomass of DSR in SWHS areas B, D, and G to estimate the DSR harvest biomass in SSEO, CSEO, and NSEO, respectively. Prior to 2006, Sport Fish Division had utilized a value of 75% to estimate the DSR harvest biomass in SWHS areas B, D, and G. Charter and private harvests were assumed to have similar distributions, although this cannot yet be tested. These percentages are very uncertain but have a major influence on the final estimated removal biomass. These estimates will be re-examined in the future to determine if the adjustment needs to be more species specific and estimated each year.

Species composition of the harvest was estimated using creel survey data from Craig (Area B), Sitka (Area D), and Elfin Cove (Area G). The primary purpose of these surveys is to estimate salmon harvest and collect coded-wire-tags from salmon, but rockfish data is also obtained as time permits. Although creel survey information was used to estimate the species composition of DSR released, logbook data were used as a secondary source of information for species composition (yelloweye, other non-pelagics, and pelagics) of harvested and released rockfish and release rates.

There were differences between 2008 logbook data and creel survey data in yelloweye species composition in the SSEO and CSEO areas: 19.3% (logbook value for charter anglers only) versus 13.6% (creel survey data for all anglers) for SSEO, and 23.9% (logbook value) versus 16.5% (creel survey value) for CSEO. In both cases the average of the two values were calculated to estimate the percent

yelloweye for the respective areas. Future analysis will be done with harvest data from the logbook and creel data to determine if a different approach is needed to obtain a more accurate species composition percentage.

The length-weight relationships used to estimate average weight were modeled assuming multiplicative error as *ln(weight) = ln(a) + b ln(length)*, where weight is in kilograms and length is measured in cm. Parameters were estimated using length-weight data from 2006 and 2007.

Summary of length-weight model parameters for six DSR species based on data collected during 2006 and 2007 in Southeast Alaska sport fisheries.

DSR Species	Sample size	Intercept Parameter ln(a)	Intercept SE	Slope Parameter (b)	Slope SE	R^2	Range of fork lengths for model
Canary	120	-8.57525	0.539925	2.33787	0.144025	0.691	29-60
China	165	-8.13254	0.613854	2.23404	0.170490	0.513	22-54
Copper	262	-11.4011	0.314182	3.13037	0.085279	0.834	22-56
Quillback	1,373	-9.93877	0.154202	2.71886	0.041879	0.755	14-73
Tiger	56	-9.50100	0.62838	2.591418	0.167826	0.815	27.5-63
Yelloweye	2,449	-10.2901	0.10479	2.820538	0.025759	0.831	23-94

The parameters of this length-weight model were similar in value to those generated for harvested DSR sampled in Southcentral Alaska during 1991-2007 (personal communication, Scott Meyer, ADF&G, Div. of Sport Fish). The models have not been tested for differences between inside and outside waters, but are assumed to provide reasonable estimates of average weight for this biomass estimation process.

The biomass of DSR release mortality (*RB*) was estimated for each outer coast groundfish area as:

$$\widehat{RB_a} = \sum_s \left(\frac{\widehat{HB_{as}}}{1 - r_{as}} - \widehat{HB_{as}} \right)$$

where:

$\widehat{HB}_{as}$ = the estimated harvest biomass of species *s* in area *a*, and

$\hat{r}_s$ = the estimated proportion of the catch of rockfish species *s* that was released in area *a*.

Release rates for the 2008 and 2009 seasons were estimated from the onsite creel survey data. These release rates were comparable to release rates estimated from logbook data for yelloweye rockfish and all other non-pelagic species. In cases where the release rate for a particular DSR species was 0% for the creel data, the logbook data release rate was applied as a precautionary measure in case releases were under-reported.. The creel survey estimates of the yelloweye rockfish release rates were higher than the logbook estimate for the charter fishery. Similarly, the creel survey estimates of release rates for quillback rockfish were higher than the charter logbook estimates for other non-pelagics. Future analysis of these two databases will be required to resolve these differences and to arrive at the best release rate values to use for SSEO, CSEO, and NSEO groundfish areas.

This estimation approach assumes that released fish have the same average weight as harvested fish. Sport fishery regulations in Southeast Alaska require that all non-pelagic rockfish caught be retained until the bag limit is reached. Compliance with this requirement has not been assessed. Estimates of the release mortality biomass would be biased high if high-grading (in violation of the regulations) was common.

This approach also assumes a mortality rate of 100% for all released DSR. This assumption may be too conservative, but release mortality has not been estimated for any DSR species in a recreational fishery. Hannah et al. (2008) documented successful re-submergence by quillback, copper, and canary rockfish caught at depths of up to 51 m, despite showing signs of barotrauma. Juveniles caught in shallow water and released probably have substantially higher survival. The lack of data on depth of capture and sizes of released fish makes it difficult to select a lower mortality rate.

For 2008, the estimated biomass of DSR sport harvest removals was 61.63 mt, and the release mortality was estimated at 5.92 mt. The total DSR removals from the SEO sport fishery was estimated as the sum, or 67.55 mt (Table 4).

2009 Sport DSR Removal Projection:

The 2009 final SWHS harvest estimates for rockfish in the three outer coast SWHS areas will not be available until August 2010. Utilizing the recent five-year average of the ratio between total rockfish harvested in the three SWHS areas (B, D, and G) and the creel survey rockfish harvest data (raw unexpanded harvest data for B and G, and total estimated harvest for Area D) from creel interviews provides a method to project a preliminary SWHS harvest for these three areas. The 2009 projected biomass removals for the sport fishery are as follows:

Projected 2009 Sport Fishery DSR removals in outside waters of SE Alaska.

Groundfish area	Harvest biomass (mt)	Release biomass (mt)	Total Biomass (mt)
SSEO	21.97	1.76	23.73
CSEO	21.68	1.50	23.17
NSEO	2.81	0.15	2.95
Total	46.46	3.41	49.86

During the 2009 season, there was a noticeable decline in charter fishing effort in Southeast Alaska. Declines of charter fishing effort of up to 30% or more occurred in some coastal communities, based on onsite creel survey data and anecdotal information, presumably in response to recent economic conditions. These declines are supported by preliminary logbook data for 2009 (personal communication, Bob Powers, ADF&G, Sport Fish). The biomass removal amount appears to have declined as well, as evident in the above 2009 preliminary projections.

Uncertainty in Sport Removal Estimates:

The above estimates are based on the best available data at this time, but may be subject to change as new information becomes available and as further examination of the data occurs. Further refinement of the analysis of the rockfish fishery data from the logbook and onsite creel programs should improve the accuracy of the rockfish biomass removal estimates.

Last year the SSC expressed an interest in seeing confidence intervals for the sport removal estimates. Unfortunately, these estimates are not yet available for this analysis. Variance estimates are available for SWHS harvest estimates, estimates of average weight, and estimates of release proportions. The variances of average weight are likely underestimated, due to the use of random sampling formulae, when in fact

the data are actually collected through cluster sampling. A bootstrap routine to estimate these variances is under development. Formulation of the variance for the released fish biomass has not yet been determined.

A primary concern for describing uncertainty, as noted in the harvest biomass section above, is that the estimates of the proportion of harvest in outside waters are very soft. This is due mostly to a lack of data from the unguided sport fishery and reliance on the assumption that guided and unguided harvests have the same spatial distribution. As a result, an approximate value was assumed based on logbook data, the variance of which cannot be calculated.

Nevertheless, an attempt was made to provide a ballpark estimate of the sampling error CV of the removal estimates. This evaluation used creel survey estimates of species composition (rather than a blend of creel survey and logbook data) and the variances of mean weight that are likely underestimated. The CVs of the overall removal estimates were about 15-17% in each area (NSEO, CSEO, and SSEO), and about 11% overall (entire SEO area), assuming the logbook-based estimates of the proportion of harvest in outside waters were accurate and had a CV of 20%. More work is needed to refine these estimates.

Subsistence removals

In July 2009 the Alaska Department of Fish and Game Division of Subsistence published the results of a study done to estimate the subsistence harvest of rockfish near four Alaskan communities, one of which was Sitka (Turek et al 2009). This study provided an updated estimate of the percent DSR in the catch of rockfish in the subsistence fishery. As reported by the Subsistence Division, in an effort to obtain additional information on the species composition of subsistence caught rockfish, a call out survey of "high harvesting households" was conducted. This survey revealed that 50% of the rockfish harvested are DSR species, predominantly quillback. These "high harvesting households" fished predominantly in the Sitka Local Area Management Plan (LAMP) area. Using information about total rockfish harvest by broad location data (northern southeast, southern southeast, and the Sitka LAMP area) and applying the updated estimate of percent DSR (50%) and using the species breakdown from the call out survey will give a more realistic estimate of the subsistence harvest of DSR in the SEO. Because the subsistence harvest is reported in numbers of fish, these data needed to be converted to metric tons. The average weights provided from creel sampled sport harvest were used. With the exception of the fish reported from the Sitka LAMP area, there is no way to determine how many of these fish came from SEO and how many were taken in internal state waters. In 2007 the voluntary mail survey indicated 10,331 rockfish (not defined by species) had been taken in area 2C. The catch came mostly from the southern southeast area (5,108 rockfish) followed by the Sitka LAMP area (3,964 rockfish) and then the northern southeast area (1,259 rockfish). Using these data sources to make a prediction about what might be taken in the subsistence fishery in 2010 the total anticipated harvest is 8 metric tons.

Commercial Catch History

The history of domestic landings of DSR from SEO is shown in Table 5. The directed DSR catch in SEO increased from 106 mt in 1982 to a peak of 726 mt in 1987. Total landings exceeded 900 mt in 1993. Directed commercial fishery landings have often been constrained by other fishery management actions. In 1992 the directed DSR fishery was allotted a separate halibut prohibited species cap (PSC) and is therefore no longer affected when the PSC is met for other longline fisheries in the GOA. In 1993, the fall directed fishery was cancelled due to an unanticipated increase in DSR bycatch during the fall halibut fishery.

The directed commercial DSR fisheries in the CSEO and SSEO management areas were not opened in 2005 because it was estimated that total mortality in the sport fish fishery was significant and combined with the directed commercial fishery would likely result in exceeding the TAC. The directed fishery was

not opened in 2006 or 2007 in SEO because our estimation method for predicting bycatch in the halibut fishery was new and needed to time to be compared to actual bycatch landings. Bycatch landings in 2006 and 2007 totaled 205 mt in each of those two years, 97% of which were landed in the halibut fishery. In 2008 and 2009 it was determined that there was sufficient TAC to accommodate anticipated removals in the halibut fishery and accommodate directed fisheries in EYKT and SSEO in those years. Total landed catch of DSR in 2008 in SEO was 195 mt.

DATA

Fishery Data

In addition to catch data listed in Table 5, catch per unit effort (CPUE) data are collected through a mandatory logbook program and biological information is collected through port sampling of the commercial catch from both the directed fishery and from bycatch from the halibut fishery. Species composition and length, weight, sex, and maturity stage data are recorded and otoliths taken for aging. Yelloweye rockfish is the primary target of the directed fishery and accounted for 97%, by weight, of DSR landed in all commercial fisheries in SEO during the past six years. Biological information detailed below is reported for yelloweye rockfish only.

Commercial fishery CPUE expressed as round pounds of yelloweye rockfish per hook for vessels using conventional gear was fairly stable in CSEO from 1991 through 2004 (the most recent year this area was open) (Figure 4). The CPUE for SSEO in 2008 and 2009 is comparable to the CPUE from 2001 through 2004 (this area was not open in 2005–2007). CPUE has been variable in EYKT which could be due in part to some new entrants to that fishery in 2008. Overall CPUE is generally higher for snap-on gear than for conventional longline gear with very few fishermen using the snap-on gear type.

Mortality Estimates

An estimate of Z=0.0174 (± 0.0053) from a 1984 “lightly-exploited” stock in SSEO is used to estimate M=0.02 (Table 3). There is a distinct decline in the log frequency of fish after age 95. This may be due to increased natural mortality in the older ages, perhaps senescence. The M=0.02 is based on a catch curve analysis of age data grouped into two-year intervals (to avoid zero counts) between the ages of 36 and 96. This number is similar to the estimate of Z from a small sample from CSEO in 1981 and to the 0.0196 estimated for a lightly exploited stock of yelloweye on Bowie Seamount (Lynne Yamanaka, Department of Fisheries and Oceans Canada, Pacific Biological Station, pers. comm.). Hoenig’s geometric mean method ($\ln Z = a + b \ln(t\max)$) for calculating Z yields estimates of 0.033 when using parameters (a=1.46, b=-1.01) derived from fish species and 0.038 when using parameters (a=1.44, b=-0.982) derived from a combination of taxa (mollusks, fish and crustaceans) when a maximum age (tmax) of 121 years for yelloweye rockfish is used (Hoenig 1983). Wallace (2001) set natural mortality equal to 0.04 in his stock assessment of west coast yelloweye. For the northern California and Oregon data the model performed better when M was set constant until 50% maturity then increased linearly until age 70 (Wallace 2001).

The most recent catch curve analysis of available age data was run in 2003 for each management area in SEO. The port sampling data from 2000-2002 were used and a line fit to the data between the majority of the ages (approximately 20-60 years). The estimate of Z is 0.03 for SSEO, 0.04 for EYKT, and 0.056 for CSEO (Table 3). Catch curves are problematic for fish with variable recruitment, however, given a natural mortality estimate of 0.02, the catch curve results indicated that we may have been exceeding our harvest policy of 2 percent in the CSEO area in 2000-2002.

Growth Parameters

Von Bertalanffy growth parameters and length weight parameters for yelloweye are listed in Table 6. These parameters were calculated using 2003 to 2005 port sampling data. Estimated length- and age-at-50% maturity for yelloweye collected in CSEO are 42 cm and 22 years for females and 43 cm and 18 years for males (Table 7). Rosenthal et al. (1982) estimated length-at-50% sexual maturity for yelloweye from this area to be 52 cm for females and 57 cm for males.

Fishery Age Compositions

Length frequency distributions are not particularly useful in identifying individual strong year classes because individual growth levels off at about age 30 (O'Connell and Funk 1987). Sagittal otoliths are collected for aging. The break and burn technique is used for distinguishing annuli (Chilton and Beamish 1983). Radiometric age validation has been conducted for yelloweye rockfish otoliths collected in Southeast Alaska (Andrews et al. 2002). Radiometry of the disequilibrium of ^{210}Pb and ^{226}Ra was used as the validation technique. Although there was some subjectivity in these techniques, generally agreement between growth-zone-derived ages and radiometric ages was good with a low coefficient of variation. In addition, Andrews et al. (2002) conclude strong support for age that exceeds 100 years from their observation that as growth-zone-derived ages approached and exceeded 100 years, the sample ratios of ^{210}Pb and ^{226}Ra approached equilibrium with a ratio equal to 1. Maximum published age for yelloweye is 118 years (O'Connell and Funk 1987), but one specimen from the SSEO 2000 samples was aged at 121 years.

Age frequency data of yelloweye from port samples from the directed commercial fishery are presented in figures 5a-c for years where sample sizes were over n=100. In SSEO commercial port sampling occurred as early as 1984 and in that year the average age of fish was 52. By 1988 the average age had decreased to 40, and in 2004, the most recent year for which age samples are available and processed, the average age had declined to 36 with a strong mode at 22-23 years. There has been a notable decline in the oldest ages in SSEO from those seen in 1984 (Figure 5b). In CSEO, a multi-modal pattern has been present in the age distribution since 1991 and the oldest ages have also declined in frequency over time (Figures 5a). Maximum age for fish sampled from CSEO in 2004 is 104 years and the average age is 32. There is a noticeable mode at 21-22 years and a secondary mode around 34-36 years. The 2005 distribution from EYKT is multi-modal (Figure 5c). The two main modes are at 18 and 34-37. In 2005 the oldest fish sampled from EYKT was 105 and the average age was 37. There appears to be significant recruitment of fish in EYKT.

Also included in this stock assessment are new age data for 2004 for CSEO and 2005 for EYKT. Biological samples, including age structures, were collected from the directed DSR fisheries in 2008 and 2009 as well as from incidental catch in the directed halibut fishery in those years. No biological data was collected from the directed DSR fishery in 2006 or 2007 in SSEO and EYKT and none from CSEO after 2004 because the fishery was closed in those years for those areas. However, otoliths were collected from yelloweye captured as bycatch in the IPHC longline survey during the summer of 2007. Not all of the otoliths collected in 2007–2009 have been aged at present but will be included in the next full stock assessment.

Survey Data

Traditional abundance estimation methods (e.g., area-swept trawl surveys, mark recapture) are not considered useful for rockfishes given their distribution, life history, and physiology. ADF&G uses direct observation to collect density estimates and is continuing research to develop and improve a stock assessment approach for these fishes. As part of that research, a manned submersible, *Delta*, has been used to conduct line transects to estimate rockfish density (Buckland et al. 1993, Burnham et al. 1980). Locations for transects are selected randomly and must fall within the area that is believed to be rocky

habitat. We have surveyed the Fairweather Ground in the EYKT section in 1990, 1994, 1995, 1997, 1999, 2003 and 2009 (Figure 6); the CSEO section during 1990, 1994, 1995, 1997, 2003 and 2007 (Figure 7); the NSEO section in 1994 and 2001; and the SSEO section in 1994, 1999 and 2005 (Figure 8). Since 1989 a total of 624 line transects have been conducted for assessment purposes (Figure 9). Although line transect data are collected for all seven of the DSR species (yelloweye, quillback, tiger, rosethorn, copper, China, and canary rockfishes) and for juvenile as well as adult yelloweye rockfish, included here are density estimates for adult yelloweye rockfish only. Density estimates are limited to adult yelloweye rockfish because it is the principal species targeted and caught in the directed DSR fishery, and our ABC recommendations for the entire assemblage are based on adult yelloweye biomass. Biomass of adult yelloweye rockfish is derived as the product of estimated density, the estimate of rocky habitat within the 200 m contour, and average weight of fish for each management area. Variances are estimated for the density and weight parameters but not for area. This is an *in-situ* method for stock assessment and we have made some changes in techniques each year in an attempt to improve the survey. Estimation of both transect line lengths and total area of rocky habitat are difficult and contribute to the uncertainty in the biomass estimates.

In a typical submersible dive, two transects were completed per dive with each transect lasting 30 minutes. During each transect, the submersible pilot attempted to maintain a constant speed of 0.5 kn and to remain within 1 m of the bottom, terrain permitting. A predetermined compass heading was used to orient each transect line.

The usual procedure for line transect sampling entails counting objects on both sides of a transect line. Due to the configuration of the submersible, with primary view ports and imaging equipment on the starboard side, we only counted fish on the right side of the line. In 2009 horizontal visibility was usually good, 8-25 m. Only one dive was aborted due to very poor visibility (less than 4 feet). All fish observed from the starboard port were individually counted and their perpendicular distance from the transect line recorded (Buckland et al. 1993). An externally mounted video camera was used on the starboard side to record both habitat and audio observations. In 1995, a second video camera was mounted in a forward-facing position. This camera was used to ensure 100% detectability of yelloweye rockfish on the transect line, a critical assumption when using line transect sampling to estimate density. The forward camera also enabled counts of fish that avoided the sub as the sub approached and removals of fish that swam into the transect from the left side because of interaction with the submersible. Yelloweye rockfish have distinct coloration differences between juveniles, subadults, and adults, so these observations were recorded separately.

Hand-held sonar guns were used to calibrate observer estimates of perpendicular distances. It was not practical and can be deleterious to accurate counts and distance estimates to make a sonar gun confirmation for every fish. We therefore calibrated observer distance estimates using the sonar gun at the beginning of each dive prior to running the transect and between transects. In addition, in 2009 we attempted an observer calibration exercise prior to performing line transects. The purpose was to determine the ability of individual observers to accurately estimate both distance to fish and size of fish. Unanticipated logistical problems with this experiment preclude the use of the results for calibrating individual observer's estimations of distance or fish size. We hope to fix the logistical problems and try this exercise again.

Beginning in 1997, we positioned the support ship directly over the submersible at five-minute time intervals and used the corresponding Differential Global Positioning (DGPS) fixes to determine line length. In 2003 the submersible tracking system was equipped with a gyro compass, enabling more accurate tracking of the submersible without positioning the vessel over the submersible. In 2007 and 2009, in addition to collecting the position of the submersible using five minute time intervals, we also collected position data every 2 seconds using the WinFrog tracking software provided by *Delta*. Outliers

were identified in the WinFrog data by calculating the rate of travel between submersible locations. The destination record was removed if the rate of travel was greater than 2 meters per second. In 2007, a 9-point running average was used to smooth the edited WinFrog data and then smoothed data was visually examined in ArcGIS. If any additional irregularities in data were observed, such as loops or back tracks, then these anomalies were removed and the data resmoothed. In 2009, a 9-point running average was initially used to smooth the edited WinFrog data, and then smoothed line length data were visually examined in ArcGIS. Irregular sections of data, such as loops, back tracks, sharp turns, or zig zags were examined more closely by overlaying the time on the mapped transect and then reviewing the submersible video to determine if these irregularities were true movements of the sub. After close examination of the 2009 line transects, we determined that a 27-point smoother would be more appropriate for the majority of the line transects. After a 27-point smoother was applied to the data, these smoothed line transects were examined in ArcGIS. If any irregularities still existed in the line transects that were thought to be misrepresentations of the actual submersible movements, then these anomalies were edited out of the line transect and the line transect data was resmoothed. For future surveys we hope to borrow a Doppler velocity logger (DVL) system and a ring laser gyro to verify the accuracy of the winfrog collected position information.

ANALYTIC APPROACH

For each area yelloweye density was estimated as:

$$\hat{D}_{YE} = \frac{nf(0)}{L},$$

where:

n = total number yelloweye rockfish adults observed,
$f(0)$ = probability density function of distance from a transect line, evaluated at zero distance,
L = total line length in meters.

Yelloweye density was estimated using Version 5.0 Release 2 of the DISTANCE software (Thomas et al. 2006) (Appendices A and B). A principal function of DISTANCE is to estimate *f(0)*. Estimated probability detection functions (pdf) generally exhibited the "shoulder" (i.e., an inflection and asymptote in the pdf for perpendicular distances at and near 0) that Burnham et al. (1980) advocate as a desirable attribute of the pdf for estimation of *f(0)*. Models were explored with a variety of binning intervals and possible truncation of the yelloweye distance observations. Final models for the stock assessment were picked, by area, based on goodness of fit of model to data (judged by visual examination of plot, AIC value, and X^2 goodness of fit test (Appendices A and B)). The sample sizes for the 2009 EYKT survey are 37 transects and 217 yelloweye rockfish observed. Sample size, number of yelloweye observed, meters surveyed, yelloweye per meter and density of adult yelloweye per km^2 are shown by area and year in Table 8.

For the 1993 SAFE (based on 1990 and 1991 data), to estimate the variance in biomass, we assumed a Poisson distribution for the sample size, *n*. The variance of *n* provides one component of the overall variance estimate of density. We used this approach because of the relatively small number of transects conducted in 1990 and 1991. Beginning in 1994, we substantially increased the numbers of transects conducted and now use an empirical estimate of the variance of *n* (see p. 88, Buckland et al. 1993).

Total yelloweye rockfish biomass is estimated for each management subdistrict as the product of density, mean fish weight, and area estimates of DSR habitat (O'Connell and Carlile, 1993). For estimating variability in yelloweye biomass, we used log-based confidence limits because the distribution of density tends to be positively skewed and we assume density is log-normally distributed (Buckland et al. 1993).

Beginning in 1997, biomass was estimated for the EYKT area by separating the Fairweather and non-Fairweather areas of EYKT. Biomass was then calculated for the Fairweather section using the Fairweather density and weight data and added to the non-Fairweather biomass estimate that had been estimated using data from CSEO. This was done because the Fairweather area had exceptionally high density estimates, not typical of surrounding areas. However, beginning in 1999, given the large reduction in estimated area of rock habitat in non-Fairweather portions of EYKT, we used Fairweather data for the entire EYKT area.

2009 Density Estimates

New density surveys were conducted during 2009 in EYKT (Figure 6). Yelloweye rockfish density for this stock assessment is based on the latest best estimate by management area. The CSEO and SSEO areas were last surveyed in 2007 and 2005 respectively, NSEO was surveyed in 2001. Density estimates by area range from 1,068 to 2,196 adult yelloweye per km^2 (Table 9).

The density estimate for EYKT in 2009 was 1930 adult yelloweye/km^2 (CV=16.6%). This is 46% lower than the previous estimate obtained in 2003 of 3,557 adult yelloweye/km^2 (CV=17.2%) The model from which the 2009 estimate is derived is a half-normal model with 3.5 m bins truncated at 28 ft (Appendices A and B). The survey done in EYKT in 2009 covered a larger geographic area than surveys done in previous years in this management area with transects conducted further to the south and east (Figure 10). Based on information from previous surveys yelloweye per meter on the west bank of the Fairweather Grounds is generally lower than yelloweye per meter on the east bank. Yelloweye per meter was lower in 2009 on both banks than any other survey year. In order to determine to what degree the extended geographic distribution of random line transect locations had on the overall density estimate for EYKT a subset of 2009 transects that closely approximated the area covered in 2003 were modeled in Distance. Using the default values the density for the subset from 2009 was 2,015 adult yelloweye/km^2 compared to 1,930 adult yelloweye/km^2 found when using the entire 2009 data set. Because the resulting density estimates are so close, we conclude that the change in the extents of the area surveyed in 2009 compared to 2003 had little effect on the outcome of the density estimate for 2009.

Habitat

Area estimates of yelloweye habitat are based on the known distribution of rocky habitat inshore of 110 fathoms. Information used to identify these areas includes National Ocean Service (NOS) data, sidescan and multibeam data, direct observation from the submersible, and commercial logbook data from the directed DSR fishery. In 2009 we further revised our 2002 protocol for estimating the area of yelloweye habitat. Beginning in 2009 in areas with multibeam and/or sidescan sonar data, areas of yelloweye habitat are delineated based on defined habitat types within the mapped area. For areas without these data sets, we use the position data from 1993-2006 commercial logbooks. For longline sets with only start positions we create a 0.5 mile buffer around that position; for longline sets with both start and end positions, we buffered the set track to 0.5 km (some data for both start and end positions are available as early as 1996, but both positions were required in logbooks beginning in 2003). The buffering criteria for set tracks were determined based on the minimum range of travel of four yelloweye rockfish tagged with transmitters in Oregon (P. Rankin, Oregon Department of Fish and Wildlife, personal communication). Longline sets must have at least a 0.04 yelloweye/hook catch rate to be included in the data. Logbook sets were merged, and segments were only included in the delinated habitat designation if two submersible transects were able to be performed within a segment without overlapping. The segment needed to be 2300 m but could be straight or “v” shaped. No gaps between habitat areas greater than 0.5 nautical miles were allowed within the segment for it to be considered “continuous”. These new area estimates will only be updated in the stock assessment after the new habitat delineation has been incorporated into the survey design for that area. In the current stock assessment we have updated the area estimate for EYKT using this new protocol. Prior to the 2002 assessment the commercial logbook data were not buffered and our estimate

of yelloweye habitat was based on hand drawn polygons encompassing set start locations as well as NOS habitat data. Because these estimates are based on confidential logbook information, maps are not available. We have contributed habitat data collected from our submersible surveys to the usSEABED database; in the future we would like to investigate the possibility of accessing the usSEABED database to further ground truth our estimation of rocky habitat. This database consolidates all the data collected from NOAA, other government agencies, and non-governmental organizations regarding the condition of the ocean floor in the Gulf of Alaska. A time series of densities by management area of yelloweye per km^2 can be found in table 8.

Sidescan Sonar

In 1996 we conducted a side-scan sonar/bathymetric survey for a 536 km^2 area in the CSEO section. The NOS data from the area covered by the sidescan indicated that 216 km^2 of this area was rocky. Interpretation of the sidescan data, combined with direct observation from the submersible to groundtruth the interpretation, reveals that in fact, approximately 304 km^2 of the seafloor is rocky in this area, a 29% increase over the previous estimate.

Area estimates for the Fairweather portion of the East Yakutat Subdistrict were redefined during the 1997 survey. The support ship transected the bank in several sections using a paper-recording fathometer to determine gross bottom type. The *Delta* submersible was then used to groundtruth habitat characterization in several areas. Based on this survey the estimate of total area of rocky habitat on the Fairweather Ground was reduced from 1132 km^2 to 448 km^2. Because of this great discrepancy, we conducted a sidescan sonar survey on the Fairweather Ground in August of 1998. The area surveyed was 780 km^2 of seafloor, primarily on the western bank of Fairweather, 403 km^2 of the area was determined to be rocky.

Multibeam Sonar

In 2004 we conducted a multibeam survey in a portion of EYKT on the east bank of the Fairweather Grounds adjacent to the area surveyed in 2002. We received the geologic interpretation of this area and have incorporated it into our areas of estimated rocky habitat for EYKT replacing logbook estimates of rocky habitat in that area. The 2004 data set was included with other sonar and logbook data to determine the portion of EYKT to survey in 2009.

In 2005 we conducted a one day multibeam survey for a small portion of the SSEO area off Cape Addington. Additionally in 2008 a multibeam echosounder survey was conducted on Learmonth Bank in the far south of the SSEO area. These data are being interpreted and will be used to determine the full extents of the area in which to perform density estimates in 2010. Details of other multibeam echosounder surveys can be found in past years SAFE reports.

Area Estimates

Total area of yelloweye habitat for the SEO is estimated to be 3,352 km^2 (Table 9). The estimates of yelloweye habitat are highly subjective. Although a defined protocol allows for a standard interpretation of yelloweye habitat, there is no way to estimate variance of these data. For logbook data where only a set start location is available, the buffered set data may not be a good representation of the location of yelloweye habitat, because fishermen often start their sets outside of productive habitat to ensure the majority of hooks land in the preferred habitat. We have improved our area estimates by incorporating both start and end positions when available. However, for this stock assessment we have only included our updated area estimate for EYKT. In future stock assessments, we will incorporate the other updated area estimates after we are able to perform a survey with the new habitat delineation. This new method of habitat delineation only increased the habitat estimation for EYKT by 2 km^2; this is due to the fact that most fishing occurs in the area where we have delineated habitat using remote sensing data (MBES and

sidescan imaging) and logbook data contributes less to our area estimation of habitat in EYKT than in the other management areas in SEO.

Exploitable Biomass Estimates

Estimates of exploitable biomass (adult yelloweye), by year and area are listed in Table 9. New information added this year includes a new density estimate for EYKT and changes to average weight data obtained from the directed DSR fishery and incidental catch of yelloweye in the directed halibut fishery in 2009. Updates were made to the standard error of the average weight data for CSEO, EYKT, NSEO and SSEO (Appendix B1). The total exploitable biomass for 2010 is estimated to be 14,321 mt (based on the sum of the lower 90% confidence limits of biomass estimates from each management area).

PROJECTIONS AND HARVEST ALTERNATIVES

ABC Recommendation

Demersal shelf rockfish are particularly vulnerable to overfishing given their longevity, late maturation, and sedentary and habitat-specific residency. We recommend and use a harvest rate lower than the maximum allowed under Tier 4. By applying F=M=0.02 to this biomass and adjusting for the 3% of other DSR species, the recommended 2010 ABC is 295 mt. This rate is more conservative than would be obtained by using Tier 4 definitions for setting ABC, as $F_{40\%}$=0.026. Continued conservatism in managing this fishery is warranted given the life history of the species and the uncertainty of the biomass estimates.

OVERFISHING DEFINITION

The overfishing level for DSR is 472 mt. This was derived by applying a fishing rate of $F_{35\%}$=0.032 against the biomass estimate for yelloweye rockfish and accounting for 3% for the other species in the assemblage.

HARVEST SCENARIOS TO SATISFY REQUIREMENTS OF NPFMC'S AMENDMENT 56, NEPA, AND MSFCMA

Under tier 4 projections of harvest scenarios for future years is not possible. Yields for 2010 are computed for scenarios 1-5 as follows:

Scenario 1: F equals the maximum permissible F_{ABC} as specified in the ABC/OFL definitions. For tier 4 species, the maximum permissible F_{ABC} is $F_{40\%}$. $F_{40\%}$ equals 0.026, corresponding to a yield of 384 mt (including 3 % for other DSR).

Scenario 2: F equals the stock assessment author's recommended F_{ABC}. In this assessment, the recommended F_{ABC} is F=M=0.02, and the corresponding yield is 295 mt (including 3% for other DSR).

Scenario 3: F equals the 5-year average F from 2005 to 2009. The true past catch is not known for this species assemblage so the 5 year average is estimated at F=0.02 (the proposed F in all 5 years), and the corresponding yield is 295 mt (including the 3% other DSR).

Scenario 4: F equals 50% of the maximum permissible F_{ABC} as specified in the ABC/OFL definitions. 50% of $F_{40\%}$ is 0.013, and the corresponding yield is 192 mt (including 3% other DSR).

Scenario 5: F equals 0. The corresponding yield is 0 mt.

OTHER CONSIDERATIONS

The main factor contributing this year to the reduced biomass is the substantial reduction in the density estimate for EYKT (46%). Only EYKT was surveyed in 2009. CSEO, SSEO, and NSEO were surveyed in 2007, 2003 and 2001, respectively. In 2007 a marked decrease in the estimated density in CSEO was also noted (43%). With substantial declines in two out of the four areas managed there is a strong possibility that the TAC will not support both a directed fishery and incidental catch in the halibut fishery in 2010. The determination about whether or not to allow a directed fishery will be made once the final halibut quotas for 2010 are made public in January. In years when the halibut quotas in 2C and 3A are low there is a higher likelihood of a commercial fishery than in years when the halibut quotas are higher. In 2009 average weights went up in EYKT (from 3.67 to 3.99 kg) and in CSEO (from 3.21 to 3.57 kg) but went down in NSEO (from 4.02 to 3.35 kg) and SSEO (from 3.78 to 3.53 kg).

The IPHC collects incidental catch data for DSR species in the course of their annual stock assessment survey. An analysis of those data from 1998 to the present will be done in 2010 and could add some insight to the trends seen in our density surveys.

In 2001 the Pacific Fishery Management Council recommended a harvest rate policy of $F_{50\%}$ for rockfishes (Ralston et al. 2000). This recommendation is based largely on work presented by Ralston (1998) and Dorn (2000). The $F_{50\%}$ for yelloweye in SEO is F=0.017. This corresponds to an ABC of 251 mt (including 3% for other DSR species) for 2010.

In February 2006, the BOF allocated the SEO DSR Total Allowable Catch (TAC) in the following manner: 84% to the commercial fishery and 16% to the sport fish fishery. In February 2009 the BOF further mandated that the anticipated subsistence catch be deducted from the TAC before it is split between commercial and sport fish fisheries. For a 2010 TAC of 295 mt this equates to a 46 mt TAC for sport fish fisheries and a 241 TAC for commercial fisheries after the deduction of 8 mt for anticipated mortality in subsistence fisheries.

The sport fish catch comes mostly from guided anglers, and this was a growing segment of total removals in Southeast Alaska until the 2006 season when more restrictive regulations were put in place regarding DSR retention. The sport fish surveys were not designed for in-season management and so a preliminary estimate of total mortality is provided at the end of the harvest season and the final calculations of total mortality (based on the Statewide Harvest Survey) are provided the following year. Because of the decision by the BOF at their 2006 meeting, the sport harvest of DSR is being actively managed to stay within the sport allocation. Based on the 2008 and 2009 TAC, the target for sport fish removals of DSR in the SEO was 61 and 58 mt respectively. In 2008 removals totaled 67.55 mt and the preliminary number for removals during the 2009 season is 49.86 mt.

ECOSYSTEM CONSIDERATIONS

The following table consolidates information regarding ecosystem effects on the stock and the stocks effect on the ecosystem. Specific data to evaluate these effects is mostly lacking. Yelloweye rockfish consume rockfishes, herring, sandlance, shrimps, and crabs and seasonally lingcod eggs. Many predators, including other rockfishes consume larval and juvenile yelloweye rockfish. Adult yelloweye rockfish have been found in the stomachs of longline caught lingcod and halibut but this may be opportunistic feeding as the yelloweye rockfish were caught on gear. A yelloweye was also found in the stomach of an orca whale (Love et al. 1990).

Ecosystem effects on Demersal Shelf Rockfish			
Indicator	Observation	Interpretation	Evaluation
Prey availability or abundance trends			
Zooplankton	Stomach contents, ichthyoplankton surveys, changes mean wt-at-age	Stable, data limited	Unknown
Predator population trends			
Marine mammals	Fur seals declining, Steller sea lions increasing slightly	Possibly lower mortality on pollock	No concern
Birds	Stable, so`me increasing some decreasing	Affects young-of-year mortality	Probably no concern
Fish (Pollock, Pacific cod, halibut)	Stable to increasing	Possible increases to mortality	Unknown
Changes in habitat quality			
Temperature regime			
Winter-spring envir. Production	Variable	Variable recruitment	Possible concern
Fishery contribution to bycatch			
Prohibited species	Halibut are taken as bycatch but released	Minor contribution to mortality, soak times are short for DSR gear, separate PSC cap for DSR	Little concern
Forage (including herring, Atka mackerel, cod, and pollock)	A small amount of cod bycatch is taken in this fishery	Bycatch levels small relative to forage biomass	No concern
HAPC biota	Low bycatch levels of Primnoa coral, hard coral, and sponges.	Longline gear has some bycatch but levels small relative to HAPC biota	Little concern
Marine mammals and birds	Very minor direct-take	Safe	No concern
Sensitive non-target species	Likely minor impact	Data limited, likely to be safe	No concern
Fishery concentration in space and time	Half the catch is taken through the IFQ season, the directed fishery is concentrated during the winter	Fishery does not hinder reproduction	Little concern
Fishery effects on amount of large size target fish	Fishery is catching primarily adults but difficult to target largest individuals over others	Large and small fish both occur in population	Little concern
Fishery contribution to discards and offal production	Discard rates low for DSR fishery but can include dogfish and skates	Data limited	Possible concern
Fishery effects on age-at-maturity and fecundity	Fishery is catching some immature fish but small proportion of total catch	If increased could reduce spawning potential and yield	Possible concern

DATA GAPS AND RESEARCH PRIORITIES

- Better estimation of sport fish guided and unguided catches including spatial and temporal data.
- Better estimation of rockfish habitat through more complete geophysical surveys (SSEO area in particular) and field evaluation using logbook data as a proxy in areas without geophysical surveys, as well as other sources of habitat information (usSEABED).
- Continued biological sampling of yelloweye captured as bycatch in the halibut fishery to update average weight and age data.
- Fecundity study specific to southeast Alaska yelloweye rockfish.

- Better estimation of survival after capture and release.

SUMMARY

M	0.020
2010 Biomass Estimate	14,321
F_{ofl} ($F_{35\%}$)	0.032
Max F ($F_{40\%}$)	0.026
F_{abc}	0.020
F ($_{avg\ 03\text{-}07}$)	0.020
F ($_{50\%\ F\ max}$)	0.013
Overfishing Level Includes 3% for other DSR	472 mt
Maximum Allowable ABC	384 mt
Recommended ABC Includes 3% for other DSR	295 mt

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Table 1. Species included in the Demersal Shelf Rockfish assemblage.

Common name	Scientific Name
canary rockfish	*S. pinniger*
China rockfish	*S. nebulosus*
copper rockfish	*S. caurinus*
quillback rockfish	*S. maliger*
rosethorn rockfish	*S. helvomaculatus*
tiger rockfish	*S. nigrocinctus*
yelloweye rockfish	*S. ruberrimus*

Table 2. Estimated yelloweye mortality (mt) associated with the 2009 SEO commercial halibut fishery by depth, using the 2008 IPHC survey data and the 2007 halibut landed catch by depth and area distribution percentages.

Depth strata	Yelloweye bycatch rate	# survey stations	% halibut catch from stratum	Est. yelloweye mortality point (mt)	Lower 95% CI	Upper 95% CI
<100 fm EYKT w/o Fairweather	0.047	31	5.6% 3A	25.77	9.94	41.6
<100 fm remaining area of SEO	0.235	34	15.5% 2C + 0.05% 3A	95.64	60.55	130.73
100-200 fm SEO	0.019	38	25.9% 2C + 4.0% 3A	19.12	1.62	36.62
Totals				**140.53**	**72.11**	**208.96**

Table 3. Estimates of instantaneous mortality (Z) of yelloweye rockfish in Southeast Alaska (SE).

AREA	YEAR	SOURCE	Z	N
SSEO	1984	Commercial Longline	0.017*	1049
CSEO	1981	Research Jig	0.020*	196
CSEO	1988	Research Longline	0.042	600
EYKT	2000-2002	Commercial Longline ages 24-62	0.040	295
CSEO	2000-2002	Commercial Longline Ages 20-60	0.056	514
SSEO	2000-2002	Commercial Longline (ages 24-67)	0.030	602
SE		Hoenigs equation max age 121 (parameters from combined taxa)	0.038	
SE		Hoenig's equation max age 121 (fish parameters)	0.033	

*Z approximately equal to instantaneous rate of natural mortality (M) as there was very little directed fishing pressure in these areas at that time (1981 for CSEO, 1984 for SSEO).

Table 4. Estimates of DSR species removal (release and harvest) in the Southeast sport fisheries (charter and private combined) in 2008 using statewide harvest survey, charter logbook, and creel data: Numbers in round pounds. Table provided by ADF&G Division of Sport Fish, Region 1, Douglas, AK.

Final 2008 SWHS rockfish harvest estimate (all species):

Estimate	POW Island	Sitka	Glacier Bay	Total
Number of fish	30,843	53,321	5,583	89,747
SE	2,468	2,949	809	
Lower 95% CI	26,209	47,954	4,028	
Upper 95% CI	35,633	59,459	7,239	
Percent of harvest in SEO	65%	90%	65%	
Estimated SEO rockfish harvest:	20,048	47,989	3,629	71,666

Species Composition:

Species	SSEO	CSEO	NSEO
Yelloweye	16.76%	20.17%	18.90%
Quillback	13.91%	5.22%	10.09%
Copper	2.62%	1.34%	3.00%
Canary	1.34%	1.91%	0.29%
Tiger	0.45%	0.46%	1.44%
China	1.58%	1.01%	3.46%
Rosethorn	0.31%	0.11%	0.0%

Average weights (lb) of sport harvested DSR:

Species	SSEO	CSEO	NSEO
Yelloweye	9.03	7.85	7.83
Quillback	2.60	2.30	2.76
Copper	2.71	2.17	3.64
Canary	2.37	3.18	2.55
Tiger	3.78	2.49	2.86
China	2.18	2.20	1.72
Rosethorn	2.50[a]	2.50[a]	2.50[a]

2008 Harvest Biomass (lb) by Species (harvest × species comp.× avg. weight)

Species	SSEO	CSEO	NSEO	Total
Yelloweye	30,324	76,030	5,375	111,729
Quillback	7,262	5,768	1,011	14,041
Copper	1,421	1,402	396	3,220
Canary	639	2,921	27	3,586
Tiger	344	545	149	1,038
China	687	1,067	216	1,970
Rosethorn	154	131	0	286
Total	40,832	87,864	7,174	135,870
Total Harvest (mt)	18.52	39.85	3.25	61.63

[a] – average weight from commercial landings (no sport fishery estimate available).

(continued)

Table 4-(continued) page 2 of 2

Release rates (from onsite creel survey or logbook data)

Species	SSEO	CSEO	NSEO
Yelloweye	7.66%	7.15%	4.93%
Quillback	24.85%	5.67%	4.37%
Copper	24.85%	12.77%	6.57%
Canary	24.85%	4.75%	6.57%
Tiger	24.85%	2.72%	6.57%
China	24.85%	8.12%	1.64%
Rosethorn	24.85%	21.08%	6.57%

Release biomass(lb)

Species	SSEO	CSEO	NSEO	Total
Yelloweye	2,517	5,856	279	16,774
Quillback	2,402	347	46	2,790
Copper	470	205	28	402
Canary	211	146	2	707
Tiger	114	15	11	145
China	227	94	4	723
Rosethorn	51	35	0	0
Total (lb)	5,982	6,696	369	13,046
Total Release (mt)	2.71	3.04	0.17	5.92

2008 TOTAL SPORT REMOVALS = HARVEST+RELEASE

	SSEO	CSEO	NSEO	Total
Total Removals (mt)	21.23	42.89	3.42	67.55

Table 5. Reported landings of demersal shelf rockfish (mt round weight) from domestic fisheries in the Southeast Outside Subdistrict (SEO), 1982-2009[a].

YEAR	Research Catch	Directed Landings AREA 65	Directed Landings AREA 68	Bycatch Landings AREA 65	Bycatch Landings AREA 68	Total SEO[b]	ABC[c]
1982		106		14		120	
1983		161		15		176	
1984		543		20		563	
1985		388	7	100	4	499	
1986		449	2	41	2	494	
1987		726	77	47	5	855	
1988		471	44	29	8	552	660
1989		312	44	101	18	475	420
1990		190	17	100	36	379	470
1991		199	187	83	36	889	425
1992		307	57	145	44	503	550
1993	13	246	99	254	18	901	800
1994	4	174	109	128	26	441	960
1995	13	110	67	90	22	282	580
1996	6	248	97	62	23	436	945
1997	13	202	65	62	25	381	945
1998		176	65	83	34	363	560
1999		169	66	74	38	348	560
2000	5	126	57	70	24	282	340
2001	6	122	50	110	37	326	330
2002	2	136	0	115	38	292	350
2003	7	102	0	123	51	276	390
2004	2	85	83	106	49	325	450
2005	4	0	41	137	55	237	410
2006	2	0	0	161	42	205	410
2007	9	0	0	140	56	205	410
2008	2	20	22	103	48	195	382
2009	4	31	45	78	51	209	362

[a] Landings from ADF&G Southeast Region fish ticket database and NMFS weekly catch reports through October 13, 2009.

[b] Sport and subsistence fisheries and estimated unreported DSR mortality associated with halibut fishery not reflected in totals.

[c] No ABC prior to 1988, 1988-1993 ABC for FMP area 65 only.

Table 6. Growth parameters (cm and kg) for yelloweye rockfish in Southeast Alaska from 2003-2004 port samples, by sex for EYKT, CSEO, and SSEO.

Parameter	Female	Male
Weight vs Length	n=892	n=622
a	0.00004209	0.00001897
b	3.128	3.003
von Bertalanffy	n=919	n=646
L_{inf}	65.07	65.33
K	0.0401	0.0516
t_0	-10.72	-05.49

Table 7. Length and age at 50% sexual maturity for yelloweye rockfish, Southeast Alaska.

	m_∞	κ	γ	50%
Female length	0.98142	1.0813	41.79	41.8
Female age	0.97801	0.283363	21.814	22.0
Male length	1.004079	0.55547	43.128	43.1
Male age	0.9942	0.3645	18.23	18.3

Table 8. Sample size (transects), number of yelloweye observed, meters surveyed, and yelloweye/line length for line transect surveys in EYKT, CSEO, SSEO, NSEO.

Area	Year	# transects (k)	# yelloweye (YE)	Meters surveyed (m)	YE/m	Density (Adults/km^2)
EYKT	1997	18	256	17238	0.01485	4176
	1999	20	206	25646	0.00803	2323
	2003	20	323	18503	0.017456	3557
	2009	37	217	29,892	0.00726	1930
CSEO	1995	24	235	39368	0.00597	2929
	1997	32	166	29176	0.0057	2534
	2003	102	706	90275	0.00782	1865
	2007	60	301	55640	0.00541	1068
SSEO	1994	13	99	18991	0.005213	1173
	1999	45	288	49663	0.00579	1879
	2005	33	283	29907	0.009492	2196
NSEO	1994	9	39	9535	0.00409	839
	2001	9	30	4474	0.006	1420

Table 9. Adult yelloweye rockfish density, weight, habitat, and associated biomass estimates by year and management area.

Fishery Year	Mgt Area	Survey Year	Density (adults/km^2)	CV(D)	avg wt (kg.)	Area of Habitat (km^2)	Biomass Point Est (mt)	Biomass L 90% CL (mt)
2010	EYKT	2009	1930	0.166	3.99	744	5724	4358
	CSEO	2007	1068	0.1271	3.57	1404	5351	4339
	NSEO	2001	1420	0.3144	3.35	472	2245	1352
	SSEO	2005	2196	0.1716	3.53	732	5675	4272
	Total SEO					3352	18995	**14321**
2009	EYKT	2003	3557	0.1720	3.67	742	9686	7300
	CSEO	2007	1068	0.1271	3.21	1404	4813	3895
	NSEO	2001	1420	0.3144	4.02	472	2694	1623
	SSEO	2005	2196	0.1716	3.78	732	6076	4572
	Total SEO					3350	23269	**17,390**
2008	EYKT	2003	3557	0.1720	4.36	742	11508	8622
	CSEO	2007	1068	0.1271	3.23	1404	4841	3919
	NSEO	2001	1420	0.3144	3.04	472	2038	1213
	SSEO	2005	2196	0.1716	3.77	732	6061	4575
	Total SEO					3350	24448	**18329**
2007	EYKT	2003	3557	0.1720	4.05	742	10679	8055
	CSEO	2003	1865	0.1122	2.96	1414	7802	6472
	NSEO	2001	1420	0.3144	2.98	472	1997	1202
	SSEO	2005	2196	0.1716	3.16	732	5080	3829
	Total SEO					3360	25558	**19558**
2006	EYKT	2003	3557	0.1720	4.05	742	10679	8055
	CSEO	2003	1865	0.1122	2.96	1414	7802	6472
	NSEO	2001	1420	0.3144	2.98	472	1997	1202
	SSEO	2005	2196	0.1716	3.16	732	5080	3829
	Total SEO					3360	25558	**19558**
2005	EYKT	2003	3557	0.1720	3.75	742	9895	7454
	CSEO	2003	1865	0.1122	2.96	1414	7802	6472
	NSEO	2001	1420	0.3144	2.98	472	1997	1202
	SSEO	1999	1879	0.1711	3.25	732	4470	3375
	Total SEO					3360	24164	**18508**
2004	EYKT	2003	3557	0.1720	4.30	742	11350	8558
	CSEO	2003	1865	0.1122	3.12	1414	8226	6834
	NSEO	2001	1420	0.3144	2.98	472	1997	1202
	SSEO	1999	1879	0.1711	3.47	732	4772	3574
	Total SEO					3360	26345	**20168**
2003	EYKT	1999	2323	0.3084	4.30	757	7560	4601
	CSEO	1997	2534	0.2009	3.14	1414	11250	8093
	NSEO	2001	1420	0.3144	2.98	472	1997	1205
	SSEO	1999	1879	0.1711	3.47	732	4772	3609
	Total SEO					3375	25579	**17509**
2002	EYKT	1999	2323	0.3084	4.04	703	6596	4208
	CSEO	1997	2534	0.2009	3.3	1184	9690	6981
	NSEO	2001	1420	0.3144	3.76	357	1511	411
	SSEO	1999	1879	0.1711	3.48	851	5564	4015
	Total SEO					3095	23361	**15616**
2001	EYKT	1999	2323	0.3084	3.76	703	6645	3737
	CSEO	1997	2534	0.2009	3.05	1184	9432	6592
	NSEO	Revised 1994	834	0.2778	3.76	357	892	892
	SSEO	1999	1879	0.1711	2.98	851	4858	3797
	TOTAL SEO					3095	21827	**14693**
2000	EYKT	1999	2323	0.3084	4.07	703	6645	4045
	CSEO	1997	2534	0.2009	3.14	1184	9432	6701
	NSEO	Revised 1994	834	0.2778	2.98	357	892	568
	SSEO	1999	1879	0.1711	3.04	851	4858	3673
	TOTAL SEO					3095	21827	**15067**

–continued–

Table 9. (Continued) page 2 of 2

Fishery Year	Mgt Area	Survey Year	Density (adults/km^2)	CV(D)	avg wt (kg.)	Area of Habitat (km^2)	Biomass Point Est (mt)	Biomass L 90% CL (mt)
1998/ 1999	Fairweather	1997	4176	0.18	3.87	448	7369	5443
	Other EYKT	CSEO '97	2534	0.20	3.87	268	2669	1921
	Total EYKT	1997			3.87	716	10039	7899
	CSEO	1997	2534	0.20	2.87	1997	14520	10453
	NSEO	Revised '94	834	0.28	2.98	896	2239	1428
	SSEO	Rev'94,'96 avg wt	1173	0.28	3.27	2149	8243	5253
	TOTAL SEO					5757	35041	**25031**
1996/ 1997	Fairweather	95 with 97 habitat	4805	0.16	3.74	448	8046	5759
	Other EYKT	CSEO 95	2929	0.19	3.74	268	2689	2158
	EYKT total	1995				716	11014	8492
	CSEO	1995	2929	0.19	3.10	1997	18117	13168
	NSEO	Revised 1994	834	0.28	2.98	896	2239	1426
	SSEO	Revised 1994	1173	0.28	3.88	2149	9781	6222
	TOTAL SEO					5757	41151	**29285**
1995	Fairweather	90 D, 97 habitat	2283	0.10	4.05	448	4143	2947
	Other EYKT	CSEO revised 1994	1683	0.10	4.05	268	1686	1414
	EYKT total				4.05	716	5829	4957
	CSEO	Revised 1994	1683	0.10	2.70	1997	9076	7583
	NSEO	Revised 1994	834	0.28	2.98	896	2239	1426
	SSEO	Revised 1994	1173	0.29	3.88	2149	9781	6222
	TOTAL SEO					5757	26925	**20188**
1994	Fairweather	90 D, 97 habitat	2283	0.10	4.05	448	4143	2947
	Other EYKT	1991 CSEO	2030	0.09	4.05	268	2199	1564
	EYKT total					716	6342	4924
	CSEO	1991	2030	0.09	2.93	1997	11892	15608
	NSEO	1991 CSEO	2030		3.73	896	6779	5124
	SSEO	1991 CSEO	2030		3.43	2149	14964	11344
	TOTAL SEO					5757	39977	**30453**

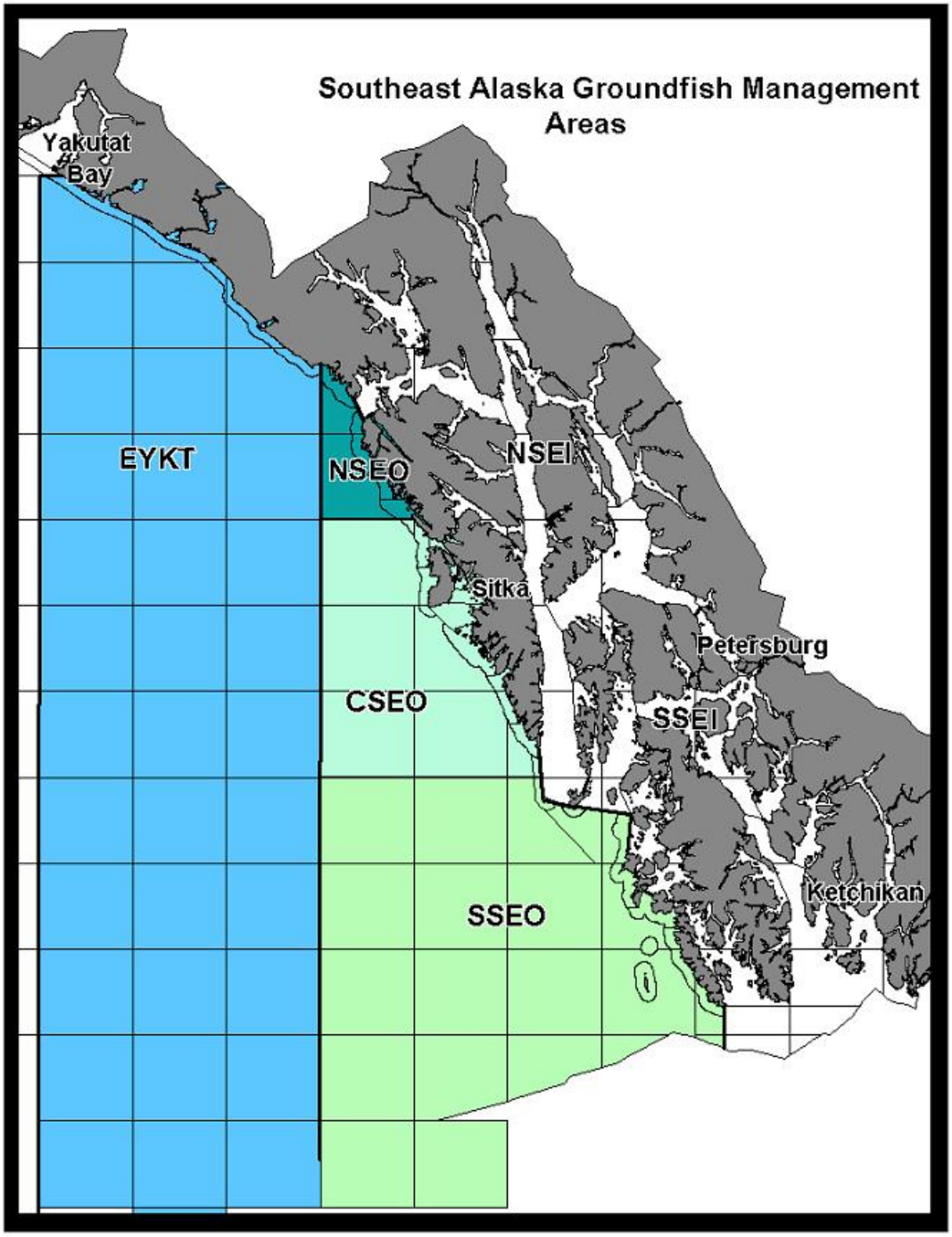


Figure 1. The Eastern Gulf of Alaska with Alaska Department of Fish and Game groundfish management areas: the EYKT, NSEO, CSEO, and SSEO sections comprise the Southeast Outside (SEO) Subdistrict.

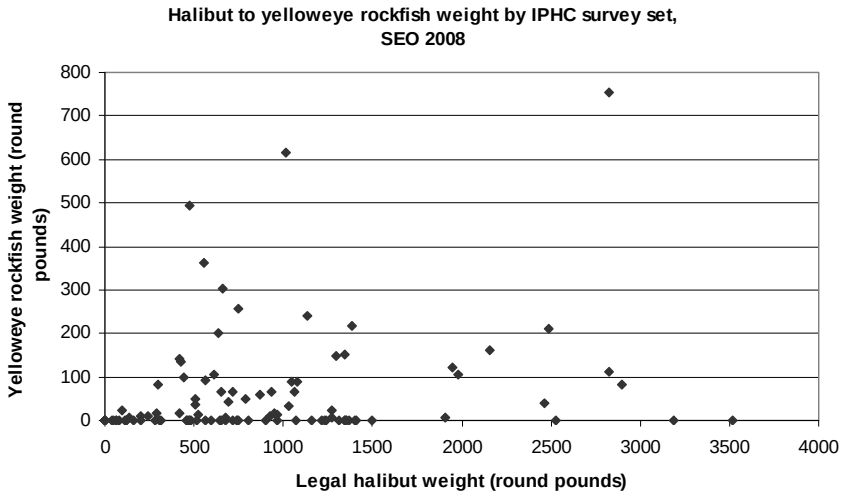


Figure 2. Catch by weight of yelloweye rockfish versus halibut (for legal halibut, ≥82 cm) in the 2008 IPHC longline survey for SEO survey stations.

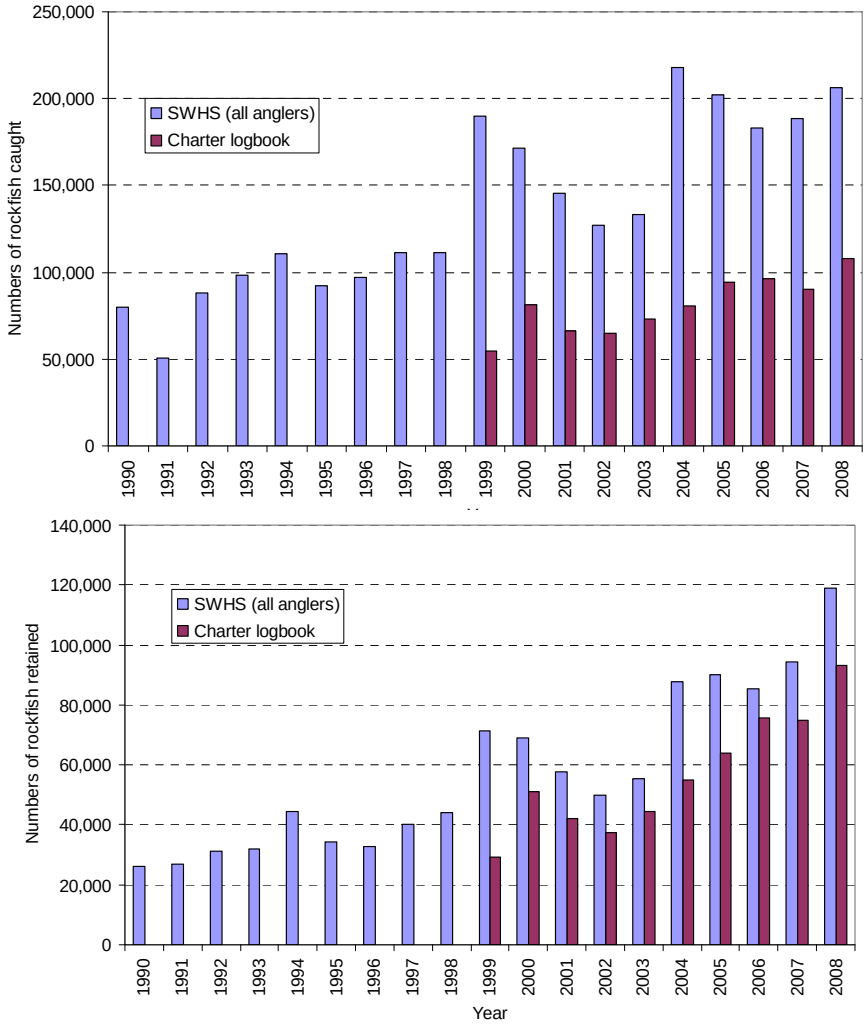


Figure 3. Numbers of rockfish caught and retained in the Southeast Alaska sport fish fishery by year using statewide harvest survey estimates compared with charter logbook data.

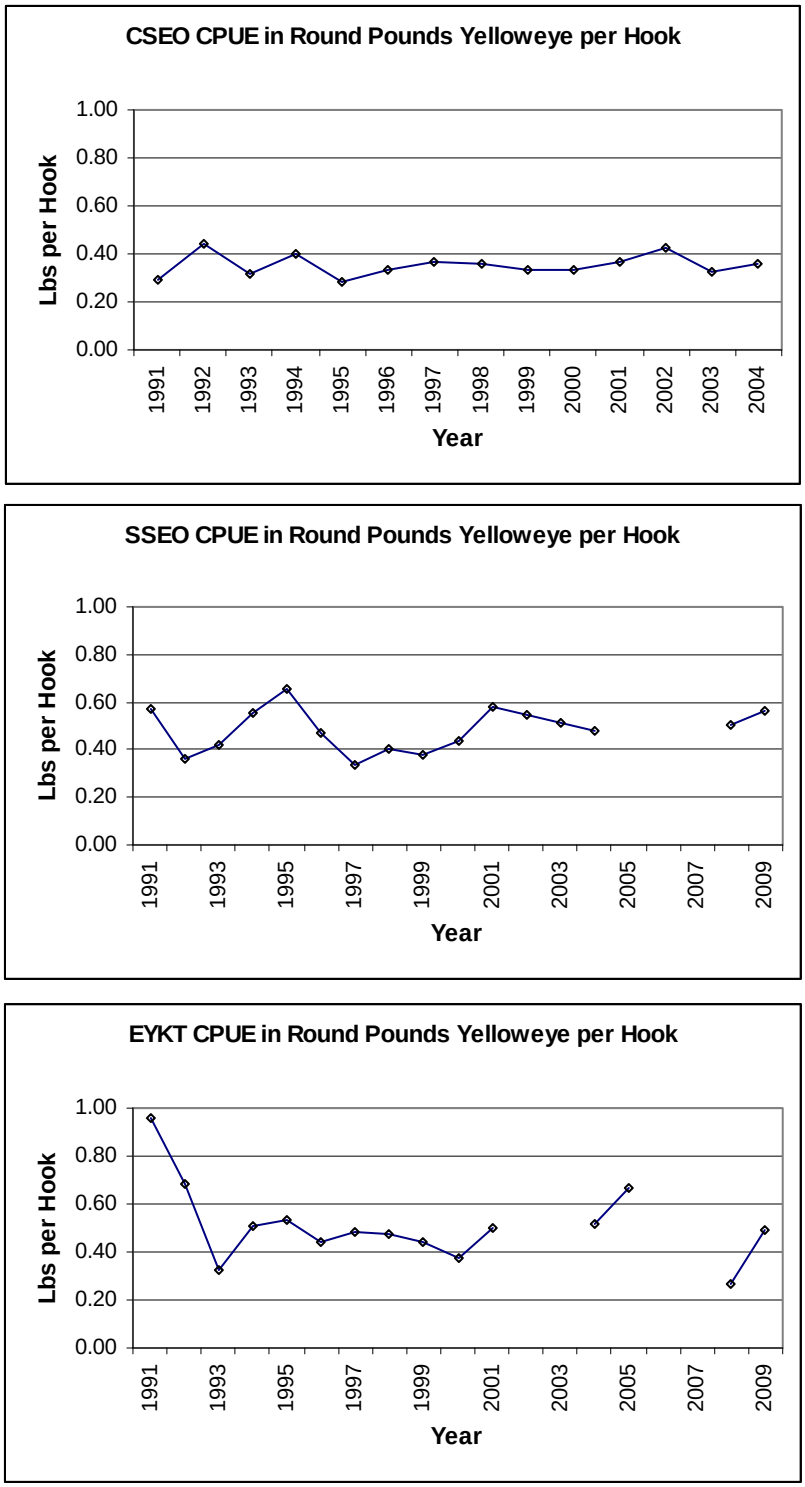


Figure 4. Commercial directed DSR fishery catch per unit effort data for conventional longline gear, by area and year using logbook effort and fish ticket pounds.

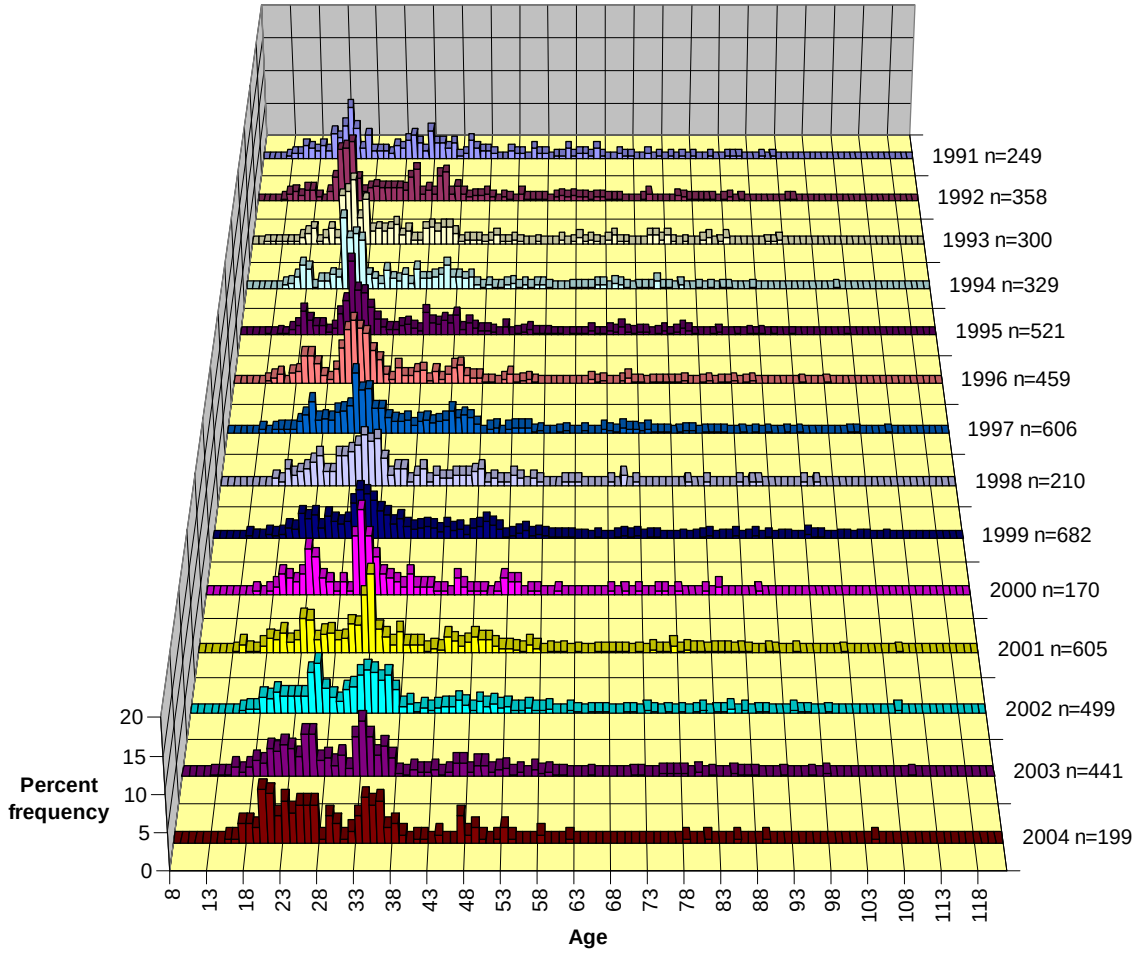


Figure 5a.Yelloweye rockfish age frequency distributions from CSEO port samples, 1991–2004.

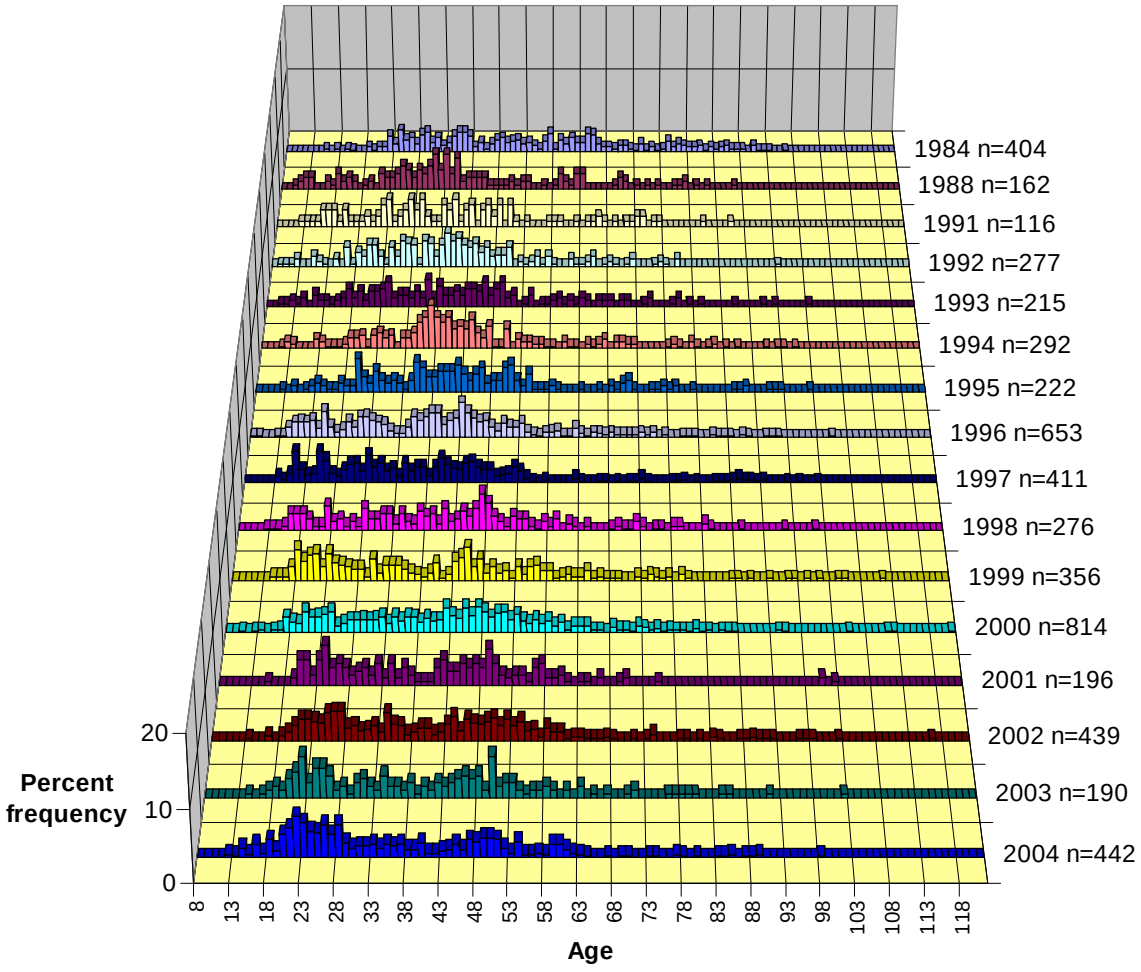


Figure 5b. Yelloweye age frequency distributions from SSEO port samples, 1984, 1988, 1991–2004.

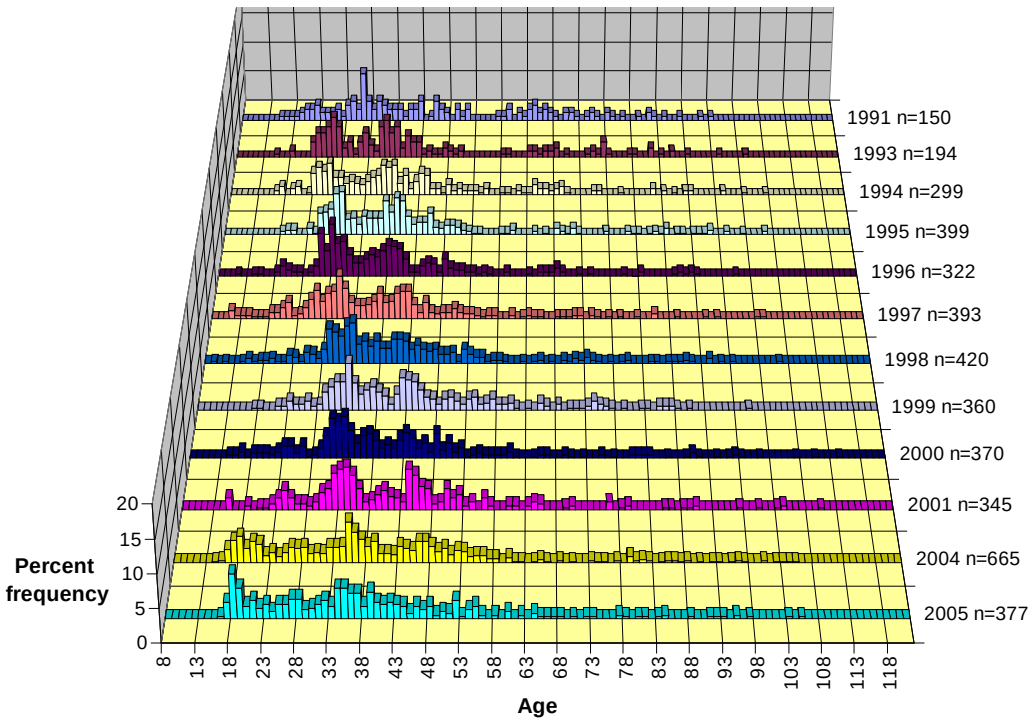


Figure 5c. Yelloweye rockfish age frequency distributions from EYKT commercial port samples, 1991 and 1993–2005.

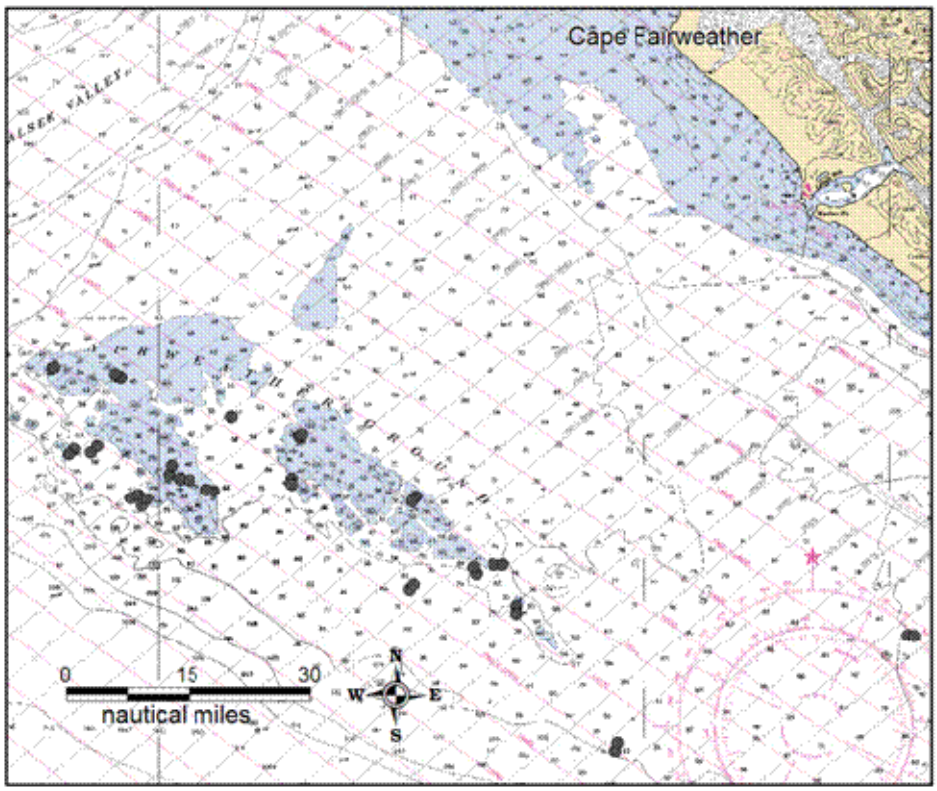


Figure 6. Start locations for line transect submersible dives in EYKT done during the 2009 stock assessment survey.

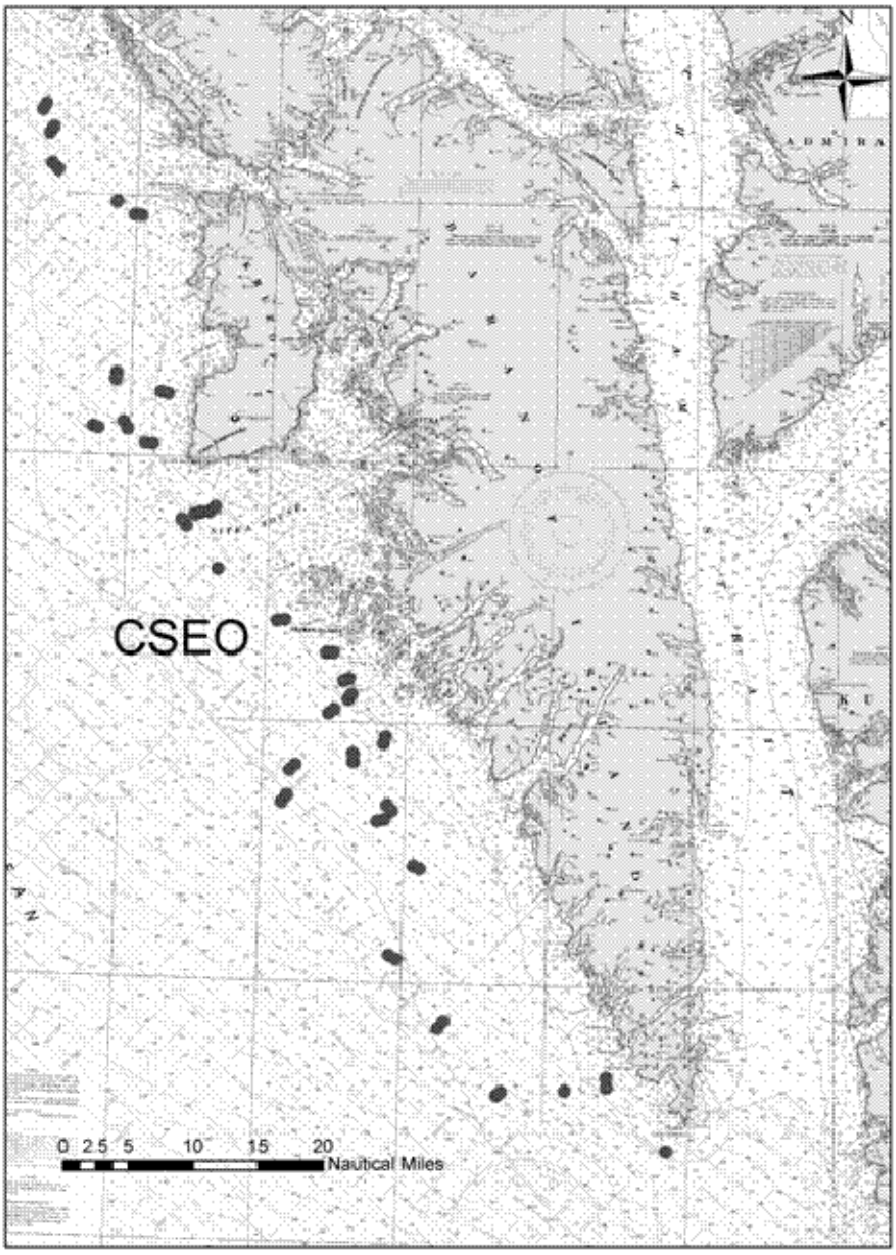


Figure 7. Start location for line transect submersible dives in CSEO during 2007.

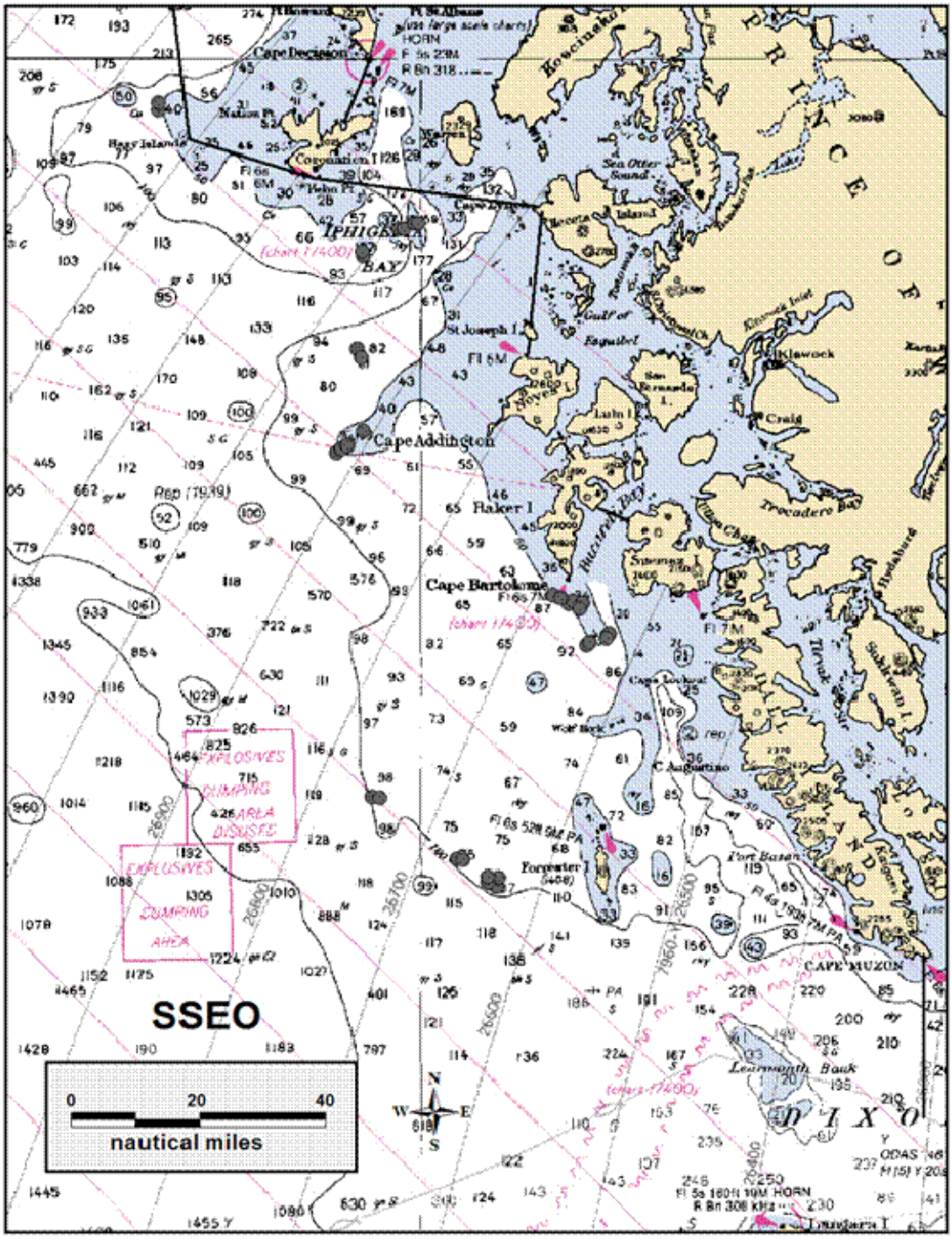


Figure 8. Start location for line transect submersible dives in SSEO during 2005.

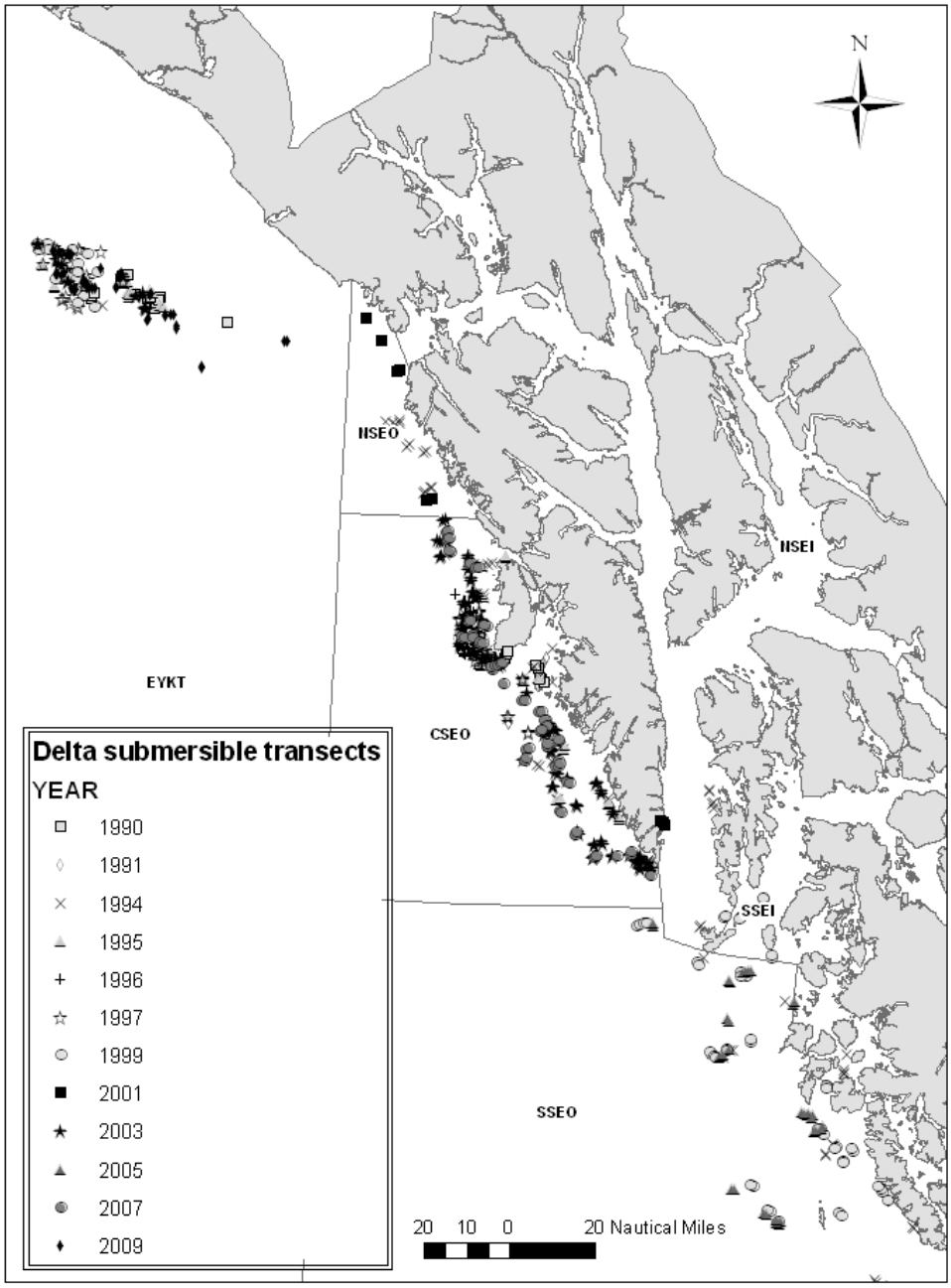


Figure 9. Start locations for submersible research dives in SEO, all years.

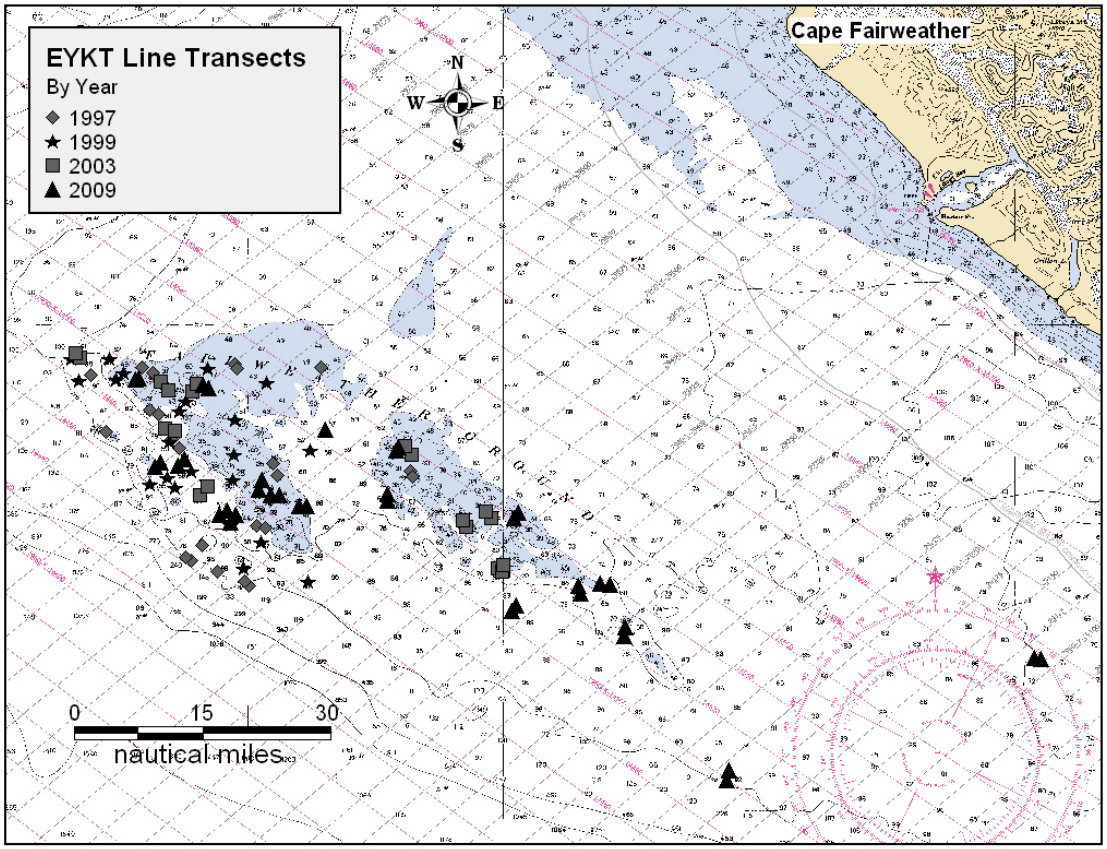
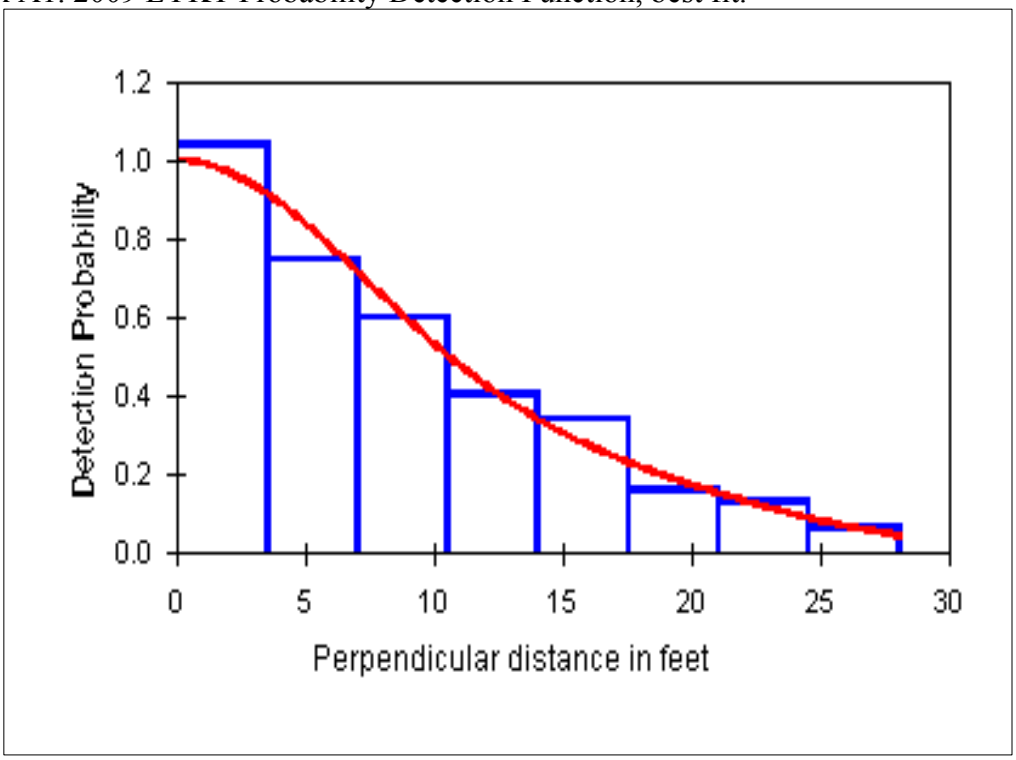


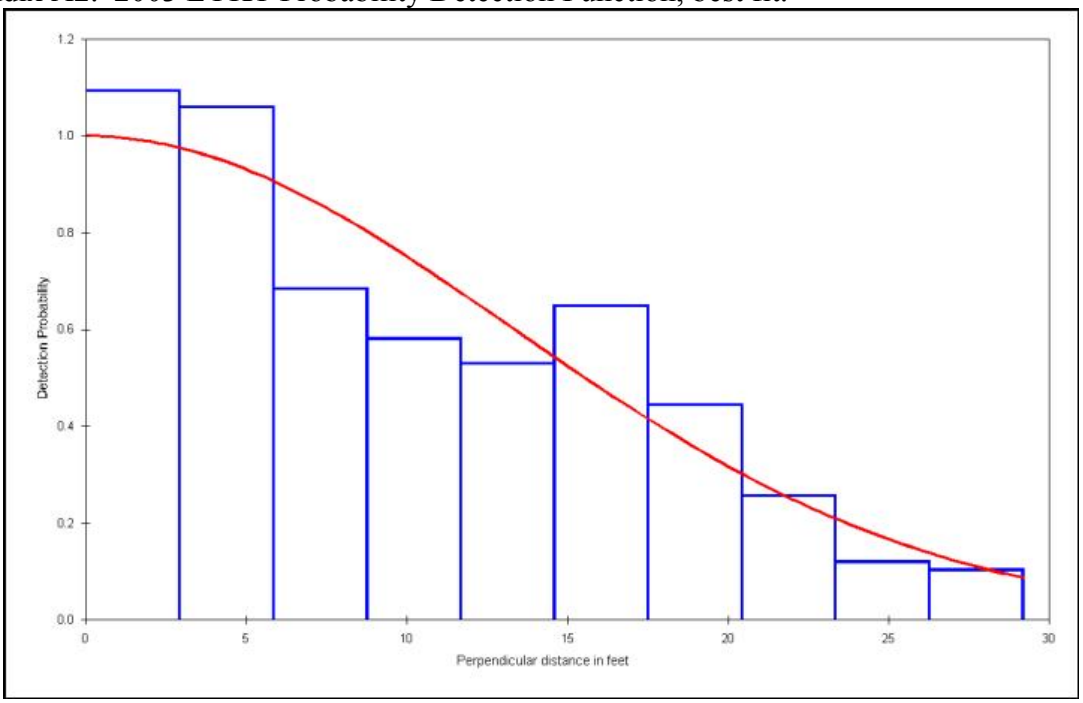
Figure 10. Start locations for line transect submersible dives in EYKT for 1997, 1999, 2003 and 2009.

APPENDIX A. DISTANCE OUTPUT FOR STOCK ASSESSMENTS 1999-2009

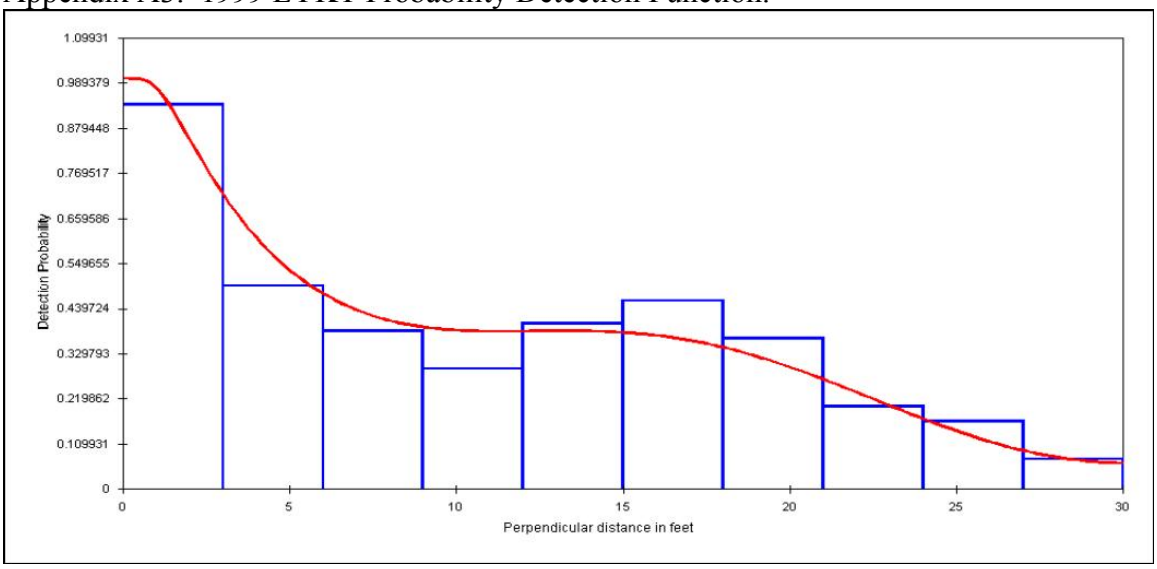
Appendix A1. 2009 EYKT Probability Detection Function, best fit.



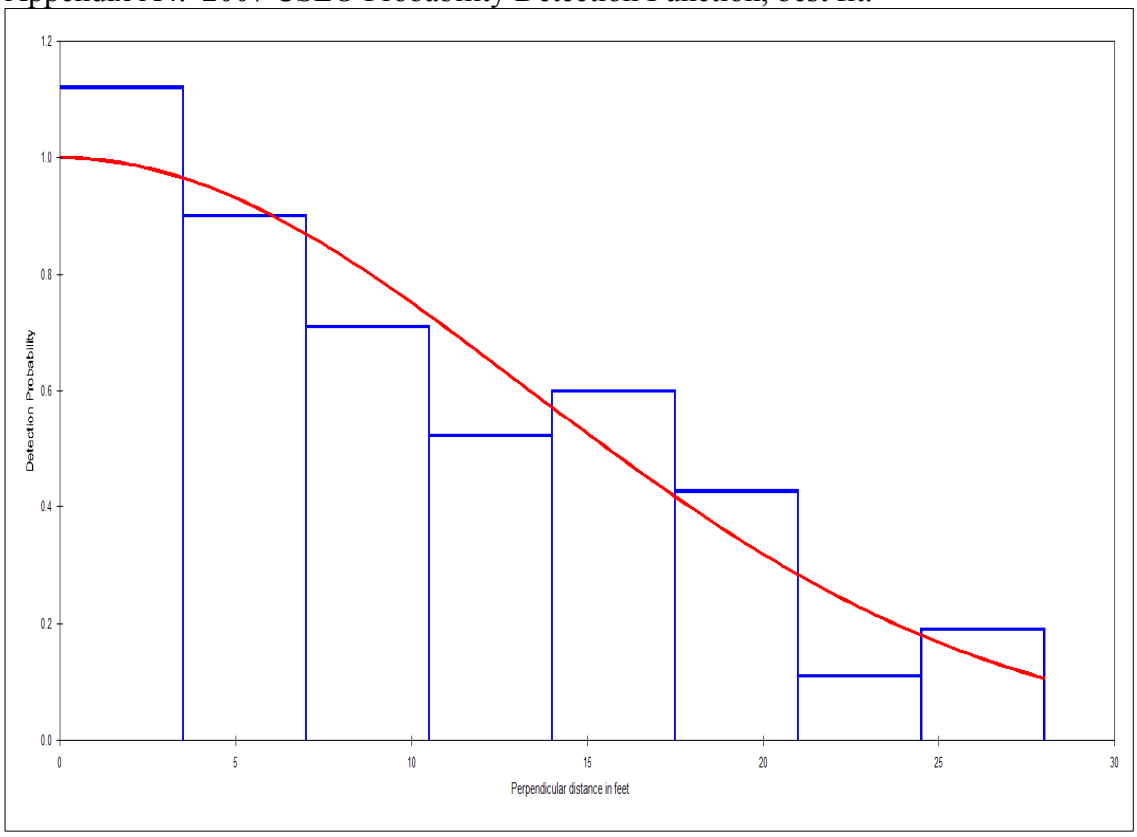
Appendix A2. 2003 EYKT Probability Detection Function, best fit.



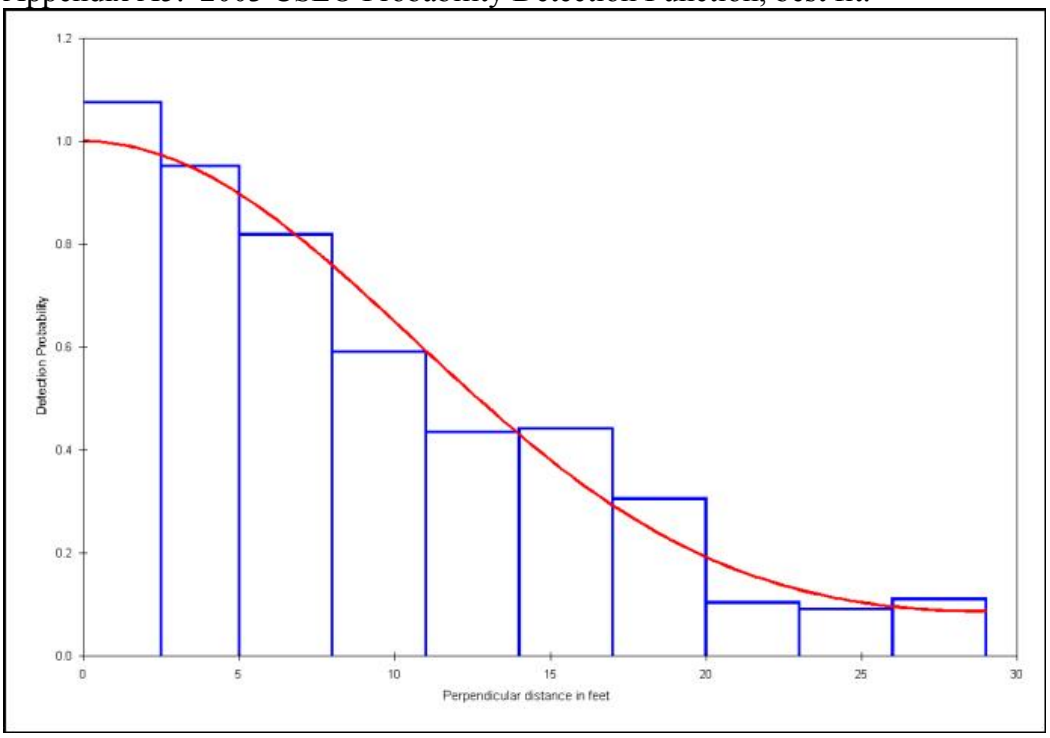
Appendix A3. 1999 EYKT Probability Detection Function.



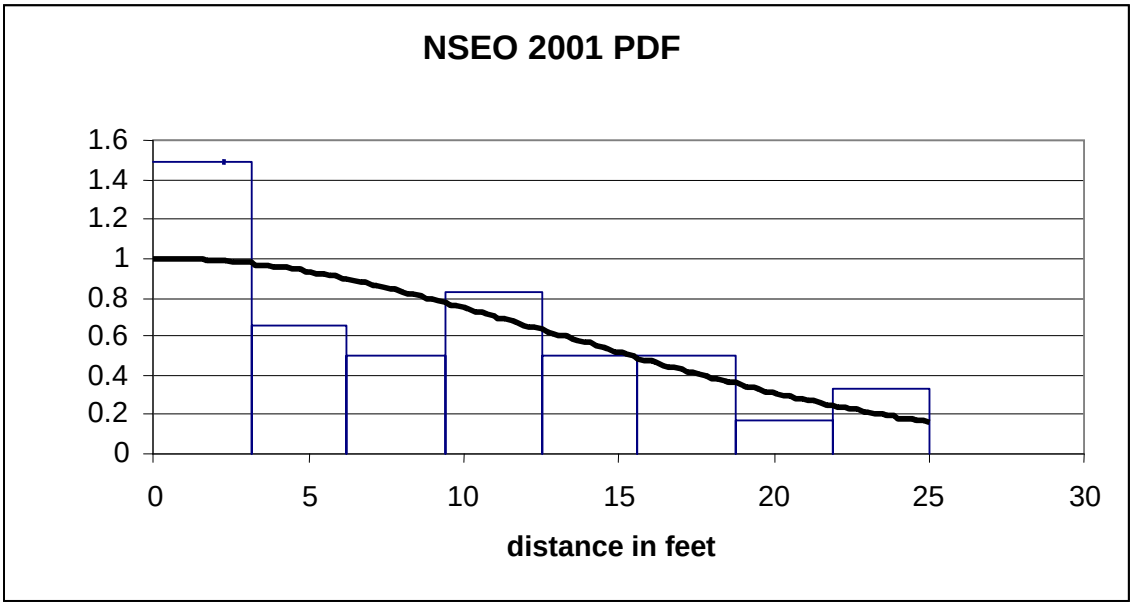
Appendix A4. 2007 CSEO Probability Detection Function, best fit.



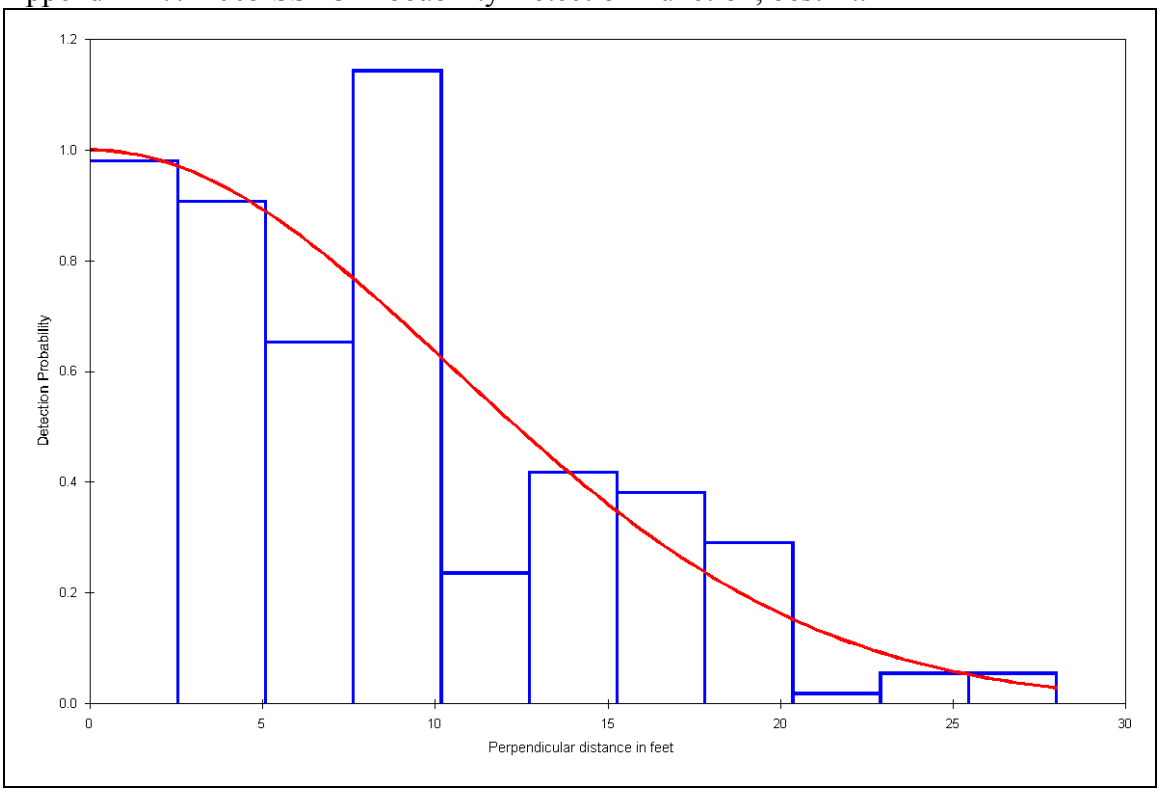
Appendix A5. 2003 CSEO Probability Detection Function, best fit.



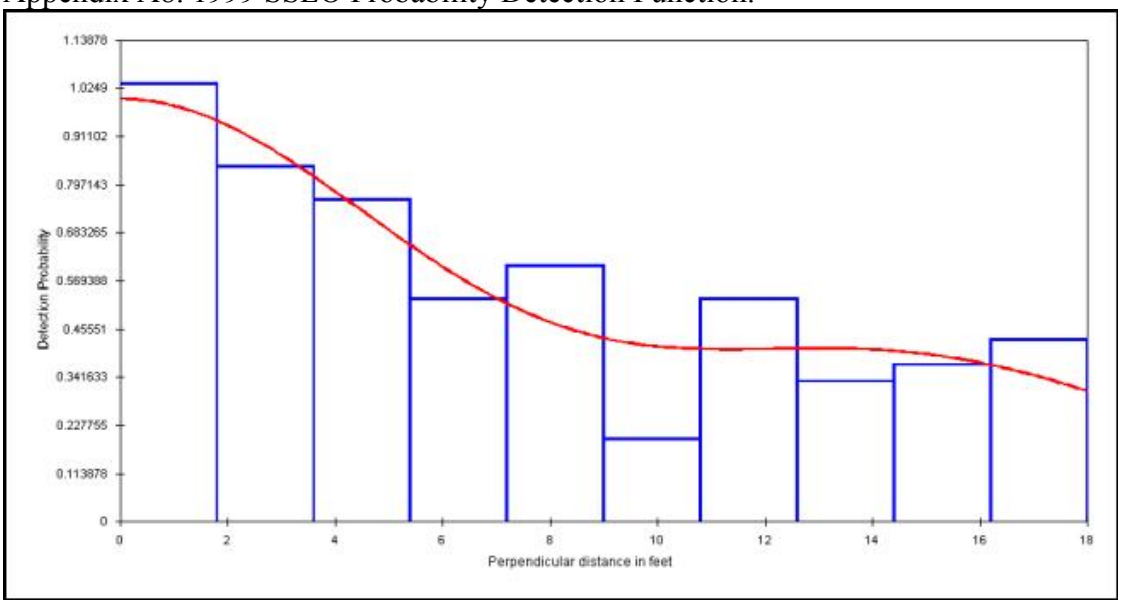
Appendix A6. 2001 NSEO Probability Detection Function.



Appendix A7. 2005 SSEO Probability Detection Function, best fit.



Appendix A8. 1999 SSEO Probability Detection Function.



APPENDIX B1.

Estimates used for determination of an acceptable biological catch (ABC) of demersal shelf rockfish in the SEO management areas. Estimates of density were produced using the program Distance version 5.0 release 2. In 2009 all estimates for the EYKT management area were updated, and weight and biomass estimates were updated for other management areas.

Area	Detection Function Description	Density [D] (no. ye/km2)	s.e. [D]	cv[D]	AIC	Chi-square	k # transects	L- length all transects
SSEO	hazard rate	2196.3	376.93	0.172	956	0.36	33	29907
CSEO	half normal cosine	1067.6	135.74	0.127	1121	0.09	60	55640
NSEO		1420	446.40	0.314	189	0.69	6	4474
EYKT	half normal cosine	1929.8	320.13	0.166	784	0.88	37	29891.74

Area	n/L	s.e. [n/L]	f(0)	# yelloweye observed	var[n]	cv[f(0)]	cv[n]	df
SSEO	0.0094	0.0016	0.0710	282	2315.282	0.018	0.171	32.7
CSEO	0.0052	0.0006	0.0624	290	1151.245	0.050	0.117	81.6
NSEO	0.0067	0.0018	0.0645	30	64.854	0.160	0.268	9.2
EYKT	0.0073	0.0010	0.0818	217	954.859	0.007	0.142	66.5

Area	[D] Lower 95% CL	[D] Upper 95% CL	[D] Lower 90% CL	[D] Upper 90% CL	Avg. weight (kg)	s.e.[w]	cv[w]
SSEO	1552	3108	1646	2931	3.53	0.10	0.029
CSEO	830	1374	865	1318	3.57	0.05	0.015
NSEO	709	2844	809	2493	3.35	0.10	0.030
EYKT	1389	2682	1466	2540	3.99	0.06	0.016

Area	Area of Rocky Habitat (km2)	Biomass (kg) for Area [bk]	Biomass (t) for Area [bm]	[Var(bk)]	cv(bk)	[bk] Lower 90% CL (kg)	[bk] Upper 90% CL (kg)
SSEO	732	5675151	5675	9.74799E+11	0.1740	4271835	7539464
CSEO	1404	5351110	5351	4.68859E+11	0.1280	4339080	6599181
NSEO	472	2245304	2245	5.02728E+11	0.3158	1352114	3728525
EYKT	744	5723657	5724	9.1135E+11	0.1668	4358461	7516472

Area	[bm] Lower 90% CL (mt)	[bm] Upper 90% CL (mt)	Yelloweye F=.02 (mt)	DSR ABC ye/.97 (mt)
SSEO	4272	7539	85.44	88.08
CSEO	4339	6599	86.78	89.47
NSEO	1352	3729	27.04	27.88
EYKT	4358	7516	87.17	89.87

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