CHAPTER 14: ASSESSMENT OF THE DEMERSAL SHELF ROCKFISH STOCK FOR 2007 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. Relative to the December 2007 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 Central Southeast Outside area (CSEO) from the 2007 survey were used. Yelloweye average weight and standard error data were updated using fish captured as bycatch during the 2007 IPHC survey. No new ages are available at this time.

Changes in the Assessment Results
The exploitable biomass estimate for yelloweye rockfish for 2008 is 18,329 mt, down 6 % from the 2006 exploitable biomass estimate of 19,558 mt.

Scientific and Statistical Committee Comments Specific to Demersal shelf rockfishes (DSR):
"With regard to the recreational fishery, the SSC recommends expanding the document to include detailed sampling information and methods from the creel surveys, charter logbooks, and the statewide harvest surveys, as well as confidence bounds, used to derive total mortality estimates."

> In addition to the information included in this report the ADF&G would like to reference the discussion paper "ADF&G Procedures for Estimation of Recreational Catch of Pacific Halibut, Demersal Shelf Rockfish, and Sharks" by Meyer et al. (2007) which was submitted to the NPFMC in October, 2007. Detailed operational plans for the three harvest estimation projects (creel surveys, charter logbooks, and the Statewide Harvest Survey (SWHS)) were submitted to the SSC prior to the October 2007 Council meeting.

"The SSC is very concerned that budget limitations have curtailed continuation of the DSR surveys, and looks to the Plan Team and assessment authors for recommendations on how to continue assessments without the primary source of biomass information."

The budget was restored for FY08 only which allowed the prosecution of a DSR survey in August 2007. It is unknown at this time whether or not the funding will be available in the future.

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

DSR Species	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**Total**
canary rockfish	3.95	3.12	3.75	3.39	0.43	0.43	15.07
China rockfish	0.13	0.20	0.18	0.12	0.03	0.06	0.72
copper rockfish	0.05	0.22	0.08	0.05	0.00	0.01	0.41
quillback rockfish	8.80	9.27	8.31	7.22	3.67	2.85	40.12
rosethorn rockfish	0.29	0.10	0.09	0.11	0.00	0.07	0.66
tiger rockfish	0.70	0.35	0.95	0.94	0.60	0.37	3.91
yelloweye rockfish	310.09	271.42	262.06	311.77	224.42	199.40	1579.16
Total DSR	324.02	284.68	275.42	323.60	229.16	203.19	1640.07
% yelloweye of DSR	95.7	95.34	95.15	96.34	97.93	98.13	**96.29**

ABC and Overfishing Levels
The ABC for DSR is set using Tier IV definitions with F=M=0.02 and adjusting 4% for the other species landed in the assemblage. The ABC was set at 382 mt. The overfishing level (611 mt) was set using $F_{35\%}$=0.032 and adjusting 4% 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 (GOA). In 1988, the North Pacific Fisheries Management Council (NPFMC) divided the rockfish complex into three components for management purposes in the eastern Gulf: Demersal Shelf Rockfish (DSR), 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 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 this 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 (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 TAC.

Prior to 1992, DSR was recognized as a Fishery Management Plan (FMP) assemblage only in the waters east of 137^{o} W. longitude. In 1992 DSR was recognized in the East Yakutat Section (EYKT) and management of DSR extended westward to 140^{o} W. longitude. This area is referred to as the Southeast Outside (SEO) Subdistrict and is comprised of four management sections: East Yakutat (EYKT), Northern Southeast Outside (NSEO), Central Southeast Outside (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, NSEI and SSEI are managed entirely by ADF&G and are not included in this stock assessment (Figure 1).

FISHERY

Description of Fishery

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 96% (by weight) of the total DSR catch over the past six years. Quillback rockfish accounted for 2.4% of the landed catch. 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 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 2005 with the maximum price paid of $2.06, compared to the maximum of $2.60 in 2003.

The internal waters directed fishery is managed with seasonal allocations: 67 percent of the directed fishery quota is allocated between January 1 and March 14 and 33 percent is allocated between November 16 and December 31. In SEO regulations stipulate one season only for directed fishing for DSR opening January 5th until the allocation is landed or until the day before the start of the IFQ halibut season whichever comes first. The directed 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 bycatch (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 bycatch in the halibut fishery to the actual landings from full retention regulations in the commercial fishery.

Bycatch

Landed bycatch in the DSR fishery includes lingcod, Pacific cod, and other rockfishes. For example, in the 2004 directed DSR fishery landed weight included 371,802 round pounds of DSR, 82,000 lbs of lingcod, 4,400 lbs of Pacific cod, 18,000 lbs of dusky rockfish, 6,000 lbs of redbanded rockfish, 5,700 lbs of silvergrey rockfish, and 6,300 lbs of black rockfish. The magnitude of at-sea discard in the directed DSR fishery is difficult to quantify, as this is an unobserved fleet. However, logbook data indicates primary discarded bycatch includes dogfish, skates, and halibut.

Discards

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 on slope rockfish in the eastern Gulf from the late 1960s through the mid-1970s. DSR mortality during the halibut longline fishery continues to account for a significant portion of the total allowable catch (TAC). In 2006, reported DSR bycatch in the halibut fishery accounted for over 96% of the total reported DSR landings in the SEO subdistrict. This is a change from 46% in 2004 and reflects the lack of a directed fishery in 2006.

The allowable bycatch limit of DSR during halibut fishing is 10% of the halibut weight. Fishery-wide the 10% rule reflects overall bycatch of DSR against halibut. 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. Seven years later, in mid-season 2005, the final rule was published and fishermen must now retain and report all DSR caught; 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 all DSR landed in state waters of Southeast Alaska be 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. The amount of DSR landed has significantly increased with these management actions: in state water fisheries in Southeast in 2006 over 34,000 pounds of DSR were landed above the 10% limit compared to 22,000 in 2004. In 2006, the second year of the federal full retention requirement over 56,000 lbs of DSR overages were landed in federal fisheries in Southeast compared to 37,000 lbs landed in 2005. Prior to 2005 approximately 10% of the overages were taken as personal use or donations. In 2005 and 2006, 80% and 87% of the overages were taken as personal use or donations, respectively.

Until full retention of DSR is achieved it will be difficult to discern how accurate the estimates of DSR mortality are for the halibut fishery. Although compliance continues to increase, only a portion of bycatch is landed and reported on fishtickets. 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. International Pacific Halibut Commission (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).

The IPHC has provided us with ratio data from longline surveys from 1996 to the present. In years prior to 2007 bycatch was estimated based on sampling the first 20 hooks of each skate of gear. There are obviously some problems in estimating total bycatch using this sampling approach. DSR tend to be contagiously distributed because they are habitat specific in their distribution. In 2007 the IPHC accounted for all rockfish caught on the longline survey and has provided those data to the Department by set. Because the results of the 2007 IPHC longline survey have not yet been made public, the IPHC cannot release the 2007 survey ratio of yelloweye to halibut by set, using the actual catch of yelloweye until mid-December 2007. At that time the ratio of actual yelloweye caught to actual halibut caught in the 2007 survey will be used in our prediction of bycatch of yelloweye in the 2008 commercial halibut fishery. Until then we will use the estimate from the ratio obtained by sampling the first 20 hooks of each skate as in the past.

Estimated total mortality of DSR in the halibut fishery in the SEO Subdistrict has ranged between 130 and 355 mt annually. Before the implementation of the halibut Individual Fishery Quota (IFQ) fishery, we estimated unreported mortality of DSR during the halibut fishery based on IPHC interview data. For example, the 1993 interview data indicated a total mortality of DSR of 13% of the June halibut landings (by weight) and 18% of the September halibut landings. These data have been more difficult to collect under the halibut IFQ fishery and appear to be less reliable than previous data. In recent years we have used IPHC catch statistics to determine the percent of the halibut catch taken in each of the 4 DSR management areas in the SEO district.

In previous stock assessments 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 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.

In 2006 and in the current assessment a new method was 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.[2] 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 2006 halibut landing data, it is estimated that approximately 44% of the 2C (IPHC Regulatory Area) halibut quota and 11% of the 3A halibut quota were taken in SEO. Using this 2006 distribution of commercial halibut harvest, the 2007 halibut quotas, and the ratios of yelloweye to halibut from the 2007 IPHC longline survey, the estimated total DSR mortality associated with the 2007 SEO halibut fishery is anticipated to be 261 mt (table 2). This compares to 173 mt of yelloweye actually landed to October 17, 2007 and underscores the concern regarding continued unreported mortality associated with the halibut fishery. The estimation method described above will be used to anticipate the bycatch of yelloweye in the directed halibut fishery in 2008 once the 2008 halibut quotas have been made public.

Other Sources of Mortality

Although management of this stock has been conservative, the continued decline in the density estimates in the CSEO may be an indication that localized overfishing is occurring. Harvest limits are set by management area based on density and habitat. Our harvest strategy 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 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 mortality associated with the halibut fishery has been underestimated in CSEO. Alternately, a review of available sport fishery catch data done in 2005 indicated that fishery is a source of significant and increasing exploitation. Sport fish harvest had not previously been accounted for in total catch statistics or TAC setting but has been accounted for in recent years (2006-2007).

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

Sport Fishery Removals[4]

Prior to 2006, the daily bag limit in the Southeast Alaska sport fishery for nonpelagic (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.

In 2006, the Division of Sport Fish instituted restrictions on the nonpelagic rockfish sport fishery in Southeast Alaska to curtail DSR removals down to the BOF allocation of 66 metric tons for the 2006 season. A daily bag limit of 3 non-pelagic rockfish, of which only one could be a yelloweye rockfish, with a possession limit of six fish of which only two may be a yelloweye rockfish, was established for both resident and nonresident anglers in Southeast Alaska. All nonpelagic rockfish caught had to be retained until the bag limit was reached. In addition in 2006, the nonresident anglers had an annual limit of three yelloweye rockfish. Finally, charter operators and crewmembers could not retain non-pelagic rockfish while clients were on board the vessel.

There are three sources of data available from the sport fish fishery: Statewide Harvest Survey (SWHS), an annual mail-out survey of households containing licensed anglers; mandatory charter logbook data; and creel survey data with landed species composition from select ports. The detail of data varies greatly between these three sources. The SWHS estimates are for all rockfish species combined. Charter logbook data are reported for the pelagic and non-pelagic rockfish assemblages but no species specific data was required until 2006, when the non pelagic category was broken into yelloweye rockfish and other non-pelagic species. The creel data identifies landed catch and released fish by all seven DSR species.

Creel survey samplers are available in some 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 beyond species composition taken from sport-caught rockfish. Beginning in 2006, length and weight of all harvested rockfish species is being collected at all sampled ports, and harvest and release information is collected for each DSR species, as well as the main slope (other rockfish) and pelagic rockfish species.

The SWHS estimates are significantly higher than the logbook estimates for both catch and harvest (retained catch) with the retained catch matching more closely (Figure 3)[3]; however, it should be noted that the SWHS estimates represent both charter and private angler catch and harvest while the logbook estimates only represent the charter angler catch and harvest. Mortality estimates based on the SWHS catch data are more than double that of the logbook. There is significant uncertainty in all available estimates.

Sport DSR Estimate – Methods[4]

Three data sources were used to obtain the estimates of total mortality (in metric tons) from the sport fishery in 2006 (SWHS, creel surveys, and charter logbooks). The SWHS estimates the number of all rockfish (DSR and pelagic) harvested (retained catch). These harvest estimates are broken down by SWHS Area. SWHS Areas B, D, and G roughly correspond to SSEO, CSEO, and NSEO groundfish management areas. Creel surveys are conducted at various ports in SE Alaska, including Craig, Sitka, and Elfin Cove. The primary purpose of these surveys is to estimate salmon harvest and collect coded-wire-tags from salmon. Other information, including numbers and species composition of rockfish harvested and released, and length and weight data, is obtained as time permits. Charter operators are required to report in logbooks the number of pelagic rockfish, yelloweye rockfish, and other non-pelagic

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

[4] This section was provided by Mike Jaenicke, marine Harvest Studies Coordinator, Sport Fish Division, Douglas, AK.

rockfish harvested and released, as well as the primary ADF&G groundfish statistical area fished each day. The logbook data for each day is completed before the end of the trip and is submitted on a weekly basis. The creel survey information was used to estimate the species composition of DSR released, while the logbook data was used as a secondary source of information for species composition (Yelloweye, other non-pelagics, and pelagics) of harvested and released rockfish and release rates.

The DSR harvest estimate was obtained by multiplying the finalized 2006 SWHS harvest estimate (retained catch) for all rockfish in Areas B (23,425 fish, SE=2,152), D (34,159, SE=2,572), and G (4,986, SE=833) by the species composition of the harvest obtained from creel surveys in Craig, Sitka, and Elfin Cove, respectively (Table 4). There were some discrepancies between 2006 logbook data and creel survey data regarding the percent yelloweye harvest in the SSEO area: 14% based on the creel survey versus 37% based on the logbook data. The value of 30%, which corresponds to the same percentage yelloweye in the rockfish harvest for both CSEO and NSEO, was selected to represent the SSEO yelloweye percentage, although this may still be biased. Future analysis of the logbook and creel data may indicate that this 30% value needs to be adjusted up and down.

The average round weights (in lb) of the seven DSR species sampled in 2006 in the SEO areas at the outer coast ports were multiplied by the respective estimated harvest of each species, to estimate the total harvested biomass by DSR species by SWHS area. Average weights of each of the seven DSR species varied by area. For example, the average weights of yelloweye rockfish were 8.44, 7.96, and 9.19 for SSEO, CSEO, and NSEO, respectively (Table 4). For years prior to 2006, Sport Fish Division had utilized average weights of winter commercial fishery DSR (7.0 lb for yelloweye and 2.5 lb for all other DSR species) to calculate an estimated total biomass mortality of DSR for SSEO, CSEO, and NSEO.

Examination of the spatial distribution of non-pelagic rockfish harvest using logbook and creel data indicated that the retained catch should be reduced by 35% for SSEO and NSEO, and 10% for CSEO (Table 4), to account for rockfish that were harvested outside of the SSEO, CSEO, and NSEO groundfish management areas. In 2006 the estimated weight of DSR retained in the sport fishery was 65.57 metric tons.

The biomass of released DSR was also estimated for each SEO area. Release rates for the 2006 season were available from the onsite creel surveys (release rate by DSR species) and the charter logbook database (release rate for yelloweye and then a release rate for the combined non-pelagic rockfish). Examination of the release rate by area for yelloweye and other DSR species generally agreed between the onsite creel survey and the logbook data. The release rates from the onsite creel survey for the seven DSR species were utilized to estimate the number and biomass released by DSR species (Table 4). In cases where the release rate for a particular DSR species was 0% for the creel data, the logbook data release rate was applied. The release rate information for the two main DSR species (yelloweye and quillback) tended to be higher based on the creel survey information, and lower with the logbook data. Future analysis of these 2 databases will be required to resolve these differences and to arrive at the best release rate values to use for SSEO, CSEO, and NSEO areas. The total estimate of DSR released in the sport fishery in 2006 is 9.53 metric tons, and all of these fish are assumed to have died.

The sum of harvested and released mortality provides the total DSR mortality estimate. For 2006 the total estimated mortality of DSR in the sport fishery was 75.10 metric tons (Table 4).

These estimates rely on numerous assumptions. The Sport Fish Division beginning in 2006 modified its creel and logbook programs to obtain more accurate estimates of species composition of harvested and released DSR, weights of DSR, and locations of harvest. Evaluation of the more defined information is ongoing to improve the estimation of the DSR removals in the SEO areas.

Subsistence removals
There is very little information available regarding mortality of DSR associated with subsistence fisheries in SEO. The NPFMC collects information on the halibut subsistence fishery through a voluntary mail survey. There is non-specific information collected on rockfish catch (numbers) in the halibut longline subsistence fishery and there is only broad location data (northern southeast, southern southeast, and the Sitka LAMP area). 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 2005 the voluntary mail survey indicated 7,764 rockfish had been taken in area 2C and in 2006 this number increased to 11,483 rockfish[5]. The catch came mostly from the Southern Southeast Area (5,517) followed by the Sitka LAMP area (4,035) and then the northern southeast area (1,931). In 2006 in an effort to obtain additional information on the species composition of subsistence caught rockfish, the subsistence division of ADF&G conducted an additional call out survey of "high harvesting households". These households fished predominantly in the Sitka LAMP area. Preliminary results from this survey indicate that 64% of the rockfish caught from this area were DSR species. These data have not been fully analyzed and it is anticipated that a more accurate estimate of the total harvest of DSR species in the subsistence fishery will be available by next year.[6]

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. Bycatch landings in 2006 totaled 203 mt, 97% of which were landed in the halibut fishery.

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. 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 96%, by weight, of DSR landed in all commercial fisheries in SEO during the past 6 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 had been fairly stable in CSEO through 2004 and showed an increase in SSEO in 2005 after a decline in 2002 and 2003 (Figure 4). CPUE is also slightly higher in EYKT compared to 2004 and 2003. Overall CPUE is generally higher for snap-on gear than for conventional longline gear.

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[5] Personal communication, Jim Fall, Subsistence Division, ADF&G, Anchorage, AK
[6] Personal communication, David Koster, Subsistence Division, ADF&G, Anchorage, AK

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 5). 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 for calculating Z yields estimates of 0.033 when using his fish parameters, and 0.038 when using his combined parameters, and a maximum age of 121 years (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).

Catch curve analysis of available age data was run 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 indicate that we may be exceeding our harvest policy of 2 percent in the CSEO area..

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 sample 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 is not a tight relationship between growth-zone-derived ages and radiometric ages, Andrews et al. conclude support for age that exceeds 100 years from their observation that as ages derived from growth zones approached and exceeded 100 years, the sample ratios measured approached equilibrium. 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.

In CSEO, the area with the longest directed fishery harvest history, a bimodal pattern has been present in the age distribution since 1992 and the oldest ages have declined in frequency over time (Figures 5a-b). Maximum age for fish sampled from CSEO in 2003 is 110 years and the average age is 34.5. There is a strong mode at 33 years and a secondary mode around 25/26 years, the strength of these modes is reverse from early distributions. In the SSEO samples the 2004 age data have a bimodal distribution with a strong mode at 17 years indicating recruitment and smaller modes at 44/45 years (Figures 5c-d). Maximum age is 93 years, with very few fish older than 60 years. The SSEO samples had an average age of 36 years.

The 2004 distribution from EYKT is multi-modal (Figure 5e-f). The strongest mode is at 31 with secondary modes at 14 and 43. There appears to be significant recruitment of fish 13-14 years old.

No new age data are available largely due to the curtailment of the directed fishery. However we were able to obtain otoliths from yelloweye captured as bycatch in the IPHC longline survey in the summer of 2007. Those otoliths had not been aged in time for this stock assessment but will be presented in the update for 2009.

Survey Data

Traditional abundance estimation methods (e.g., area-swept trawl surveys, mark recapture) are not considered useful for these fishes 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). We have surveyed the Fairweather Ground in the EYKT section in 1990, 1994, 1995, 1997, 1999, and 2003 (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). A total of 683 dives have been made with 385 line transects run for assessment purposes since 1989 (Figure 9). Although line transect data are collected for four of the eight DSR species (yelloweye, quillback, tiger, rosethorn), and for juvenile as well as adult yelloweye, included here are density estimates for adult yelloweye rockfish only. Density estimates are limited to adult yelloweye because it is the principal species targeted and caught in the 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 length 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 run per dive with each transect lasting 30 minutes. During each transect, the submersible's 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. Horizontal visibility was usually good, 5-15 m. All fish observed from the starboard port were individually counted and their perpendicular distance from the transect line recorded (Buckland 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 on the transect line, a critical assumption when employing line transects. The forward camera also enabled counts of fish that avoided the sub as the sub approached and to remove fish that swam into the transect because of interaction with the submersible. Yelloweye rockfish have distinct coloration differences between juveniles and adults, so observations of the two 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 to 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.

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 in addition to collecting the position of the submersible using five minute time intervals, we also collected positional 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. A 9-point running average was used to smooth the edited WinFrog data. All smoothed, edited and raw data were visually examined using ArcGIS to identify any erroneous data. Line lengths were calculated using the smoothed data and these data were used in the calculation of density for 2007.

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 $f(0)$. 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 2007 CSEO survey are 60 transects and 301 yelloweye observed. Sample size, number of yelloweye observed, and meters surveyed 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, 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.

2007 Density Estimates

New density surveys were conducted during 2007 in CSEO (Figure 7). Yelloweye rockfish density for this stock assessment is based on the latest best estimate by management area. The EYKT and SSEO areas were last surveyed in 2003 and 2005 respectively, NSEO was surveyed in 2001. Density estimates by area range from 1,068 to 3,557 adult yelloweye per km^2 (Table 9).

The density estimate for CSEO in 2007 was 1,068 adult yelloweye/km^2 (CV=12.7%). This is significantly lower than the previous estimate obtained in 2003 of 1,865 adult yelloweye/km^2 (CV=11.22%). The model from which the 2007 estimate is derived is a half-normal model with 8 cutpoints truncated at 28 ft (Appendices A and B).

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. Beginning in 2002, we revised estimates of area of yelloweye habitat using the following protocol: 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 1993-2000 commercial logbooks, buffered to 0.5 nautical miles from the start position. Longline sets must have at least a 0.04 yelloweye/hook catch rate to be included in the data. We continue to use this 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 new estimates are based on confidential logbook information, maps are not available. Field work in 2008 will concentrate on the evaluation of the logbook approach for defining habitat. Additionally we would like to investigate the possibility of contributing to and accessing the usSEABED database to further ground truth our estimation of rocky habitat.

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 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 have received the geologic interpretation and have not as yet replaced fishermen logbook estimates of rocky habitat in that area for the multibeam data. This new data set will be incorporated in our estimate of rocky habitat for the EYKT area during 2008.

In 2005 we conducted a one day multibeam survey for a small portion of the SSEO area off Cape Addington. These data have yet to be interpreted and will likely be worked up in 2008. 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 3,350 km^2 (Table 9). The estimates of yelloweye habitat are highly subjective. Although a defined protocol allows for a standard interpretation there is no way to estimate variance of these data. The buffered fishing log data most likely does not represent the true placement of habitat because fishermen often start their sets outside of productive habitat to ensure the majority of hooks land in the preferred habitat. Beginning in 2003, both start and end positions were required to be reported in logbooks. This information could allow us to use the middle of the set as our buffered area although these data are limited given the diminishing directed fishery. In addition to updating our area estimates using fisherman logbook data we will investigate evaluating our area extents using the habitat information collected from our submersible surveys coupled with the usSEABED database. This database consolidates all the data collected from NOAA and other surveys regarding the condition of the ocean floor in the Gulf of Alaska. This work will continue during 2008 and may represent the most significant possible change in this stock assessment for next year.

Exploitable Biomass Estimates
Estimates of exploitable biomass (adult yelloweye), by year and area are listed in Table 9. New information added this year includes new density estimates for CSEO and average weight data obtained from the IPHC summer longline survey and standard error of the average weight data for CSEO, EYKT, NSEO and SSEO (Appendix B1). The total exploitable biomass for 2008 is estimated to be 18,329 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 a harvest rate lower than the maximum allowed under Tier 4. By applying F=M=0.02 to this biomass and adjusting for the 4% of other DSR species, the recommended 2008 ABC is 382 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 611 mt. This was derived by applying a fishing rate of $F_{35\%}$=0.032 against the biomass estimate for yelloweye rockfish and accounting for 4% 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 2008 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 496 mt (including 4 % 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 382 mt (including 4% for other DSR).

Scenario 3: F equals the 5-year average F from 2003 to 2007. 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 382 mt (including the 4% 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 248 mt (including 4% other DSR).

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

OTHER CONSIDERATIONS

The Pacific Fishery Management Council has recently 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 325 mt (including 4% other DSR species).

Factors contributing this year in minor amounts to the reduced biomass include 1) the use of our improved method of estimating transect line length in the DSR survey, and 2) a slight (10 km^2) reduction in our estimation of rocky habitat in CSEO. These are only minor contributions. The continued decline in the biomass for CSEO could indicate overfishing or some other cause. Only CSEO was surveyed in 2007. SSEO, EYKT and NSEO were surveyed in 2005, 2003 and 2001, respectively. The declines suggested by the marked decrease in the estimated yelloweye densities in CSEO could be paralleled by declines in other areas.

In 2007 we used average weights obtained from the bycatch of yelloweye caught in the IPHC longline survey. In the past average weights were obtained from port sampling the directed DSR fishery. There could be some differences in gear selectivity between the IPHC survey and commercial vessels targeting DSR resulting in a bias toward the harvest of larger yelloweye in the IPHC survey.

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 sportfish fishery. For the 2008 TAC of 382 mt this equates to a 61mt TAC for sportfish fisheries and a 321 TAC for commercial 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 2006 and 2007 TAC the target for sportfish removals of DSR in the SEO was 66 mt. In 2006 removals totaled 75.26 mt and the preliminary number for removals from the 2007 season is 69 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. Adult yelloweye have been found in the stomachs of longline caught lingcod and halibut but this may be opportunistic feeding as the yelloweye 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, some 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 includes 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 and charter catches including spatial and temporal data.
- Better estimation of rockfish habitat through more complete geophysical surveys and field evaluation using logbook data as a proxy in areas without geophysical surveys, as well as other sources of habitat information (usSEABED).
- Fishery independent fishery surveys to collect biological data (limitations on directed fisheries are limiting collection of biological data).
- 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.

SUMMARY

M	0.020
2008 Biomass Estimate	18,329
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 4% for other DSR	611 mt
Maximum Allowable ABC	496 mt
Recommended ABC Includes 4% for other DSR	382 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 2007 SEO commercial halibut fishery by depth, using the 2007 IPHC survey data and the 2006 halibut landed catch by depth and area distribution percentages.

Depth strata	Yelloweye bycatch rate	# survey stations	% halibut catch from stratum	Est. yelloweye mort. point (mt)	Lower 95% CI	Upper 95% CI
<100 fm EYKT w/o Fairweather	0.0193	42	5.7% 3A	13.06	12.83	13.28
<100 fm remaining area of SEO	0.323189	37	15.2% 2C + 0.5% 3A	208.79	172.51	245.07
100-200 fm SEO	0.021298	32	25.3% 2C + 7.3% 3A	39.27	38.42	40.13
Totals				**261.12**	**223.76**	**298.48**

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

AREA	YEAR	SOURCE	Z	n
SSEO	1984	Commercial Longline	.017*	1049
CSEO	1981	Research Jig	.020*	196
CSEO	1988	Research Longline	.042	600
EYKT	2000-2002	Commercial Longline ages 24-62	.04	295
CSEO	2000-2002	Commercial Longline Ages 20-60	0.056	514
SSEO	2000-2002	Commercial Longline (ages 24-67)	0.03	602
SE		Hoenigs equation max age 121 (parameters combined taxa)	0.038	
SE		Hoenig's equation max age 121 (fish parameters)	0.033	

*Z approximately equal to 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 2006 using statewide harvest survey, charter logbook, and creel data: Numbers in round pounds. Table provided by Region 1 Sportfish Division, Douglas, AK.

Finalized 2006 SWHS harvest estimate of rockfish (all species)

	POW Island	Sitka	Glacier Bay	Total
Number of fish	23,425	34,159	4,986	62,570
SE	2,152	2,572	833	
Lower 95% CI	19,342	29,159	3,504	
Upper 95% CI	27,927	39,072	6,697	

Species Composition in Rockfish Harvest (based on 2006 onsite creel survey or logbook data)

	POW Island	Sitka	Glacier Bay
Yelloweye	30.00%	31.91%	28.89%
Quillback	14.50%	5.24%	10.97%
Copper	3.05%	1.39%	1.79%
Canary	2.52%	2.40%	1.34%
Tiger	0.32%	1.00%	1.57%
China	2.10%	0.43%	3.58%
Rosethorn	0.11%	0%	0%

Average weights (lb) of sport harvested DSR
(based on 2006 onsite creel survey sampling)

	POW Island	Sitka	Glacier Bay
Yelloweye	8.44	7.96	9.19
Quillback	2.53	2.65	3.25
Copper	2.49	2.41	3.95
Canary	2.35	3.02	3.59
Tiger	4	3.28	3.97
China	1.8	2.39	2.16
Rosethorn	***2.5***	***2.5***	***2.5***

(For Rosethorn used 2.5 lb from commercial landings, as no sport weights available)

2006 Harvest (lb) by Species (Harvest * Avg. Weight)

	POW Island	Sitka	Glacier Bay	Total
Yelloweye	59,312	86,765	13,238	159,315
Quillback	8,593	4,743	1,778	15,114
Copper	1,779	1,144	353	3,276
Canary	1,387	2,476	240	4,103
Tiger	300	1,120	311	1,731
China	885	351	386	1,622
Rosethorn	64	0	0	64
Harvest (lb)	72,322	96,600	16,304	185,226
Harvest (mt)	32.81	43.82	7.36	84.02
% in SEO	65%	90%	65%	
Harvest (mt)	21.32	39.44	4.81	**65.57**

Table 4-(continued)

Release rates (from onsite creel survey or logbook data)

	POW Island	Sitka	Glacier Bay
Yelloweye	20%	4%	14%
Quillback	41%	18%	5%
Copper	14%	27%	8%
Canary	14%	1%	8%
Tiger	14%	4%	8%
China	55%	34%	18%
Rosethorn	0%	100%	0%

Release (lb)	POW Island	Sitka	Glacier Bay	Total
Yelloweye	9,638	3,424	1,366	14,428
Quillback	3,818	937	60	4,814
Copper	188	371	20	579
Canary	147	29	14	190
Tiger	32	46	18	96
China	689	166	55	910
Rosethorn	0	0	0	0
Release (lb)	14,512	4,973	1,531	21,017
Release (mt)	6.58	2.26	0.69	**9.53**

2006 TOTAL SPORT (CHARTER AND PRIVATE) REMOVALS = RELEASE+HARVESTED

	POW Island	Sitka	Glacier Bay	Total
Removals (mt)	27.91	41.69	5.50	**75.10**

Table 5. Reported landings of demersal shelf rockfish (mt round weight from domestic fisheries in the Southeast Outside Subdistrict (SEO), 1982-2007[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	360
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	11	0	0	129	53	193	410

[a] Landings from ADF&G Southeast Region fishticket database and NMFS weekly catch reports through October 26, 2007.

[b] Estimated unreported DSR mortality associated with halibut fishery and sportfishery not reflected in totals.

[c] No ABC prior to 1987, 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
Wt 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 fish/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	3360
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)
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**
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**

Table 9-continued. 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)**
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		**30453**
1\995	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		**20188**

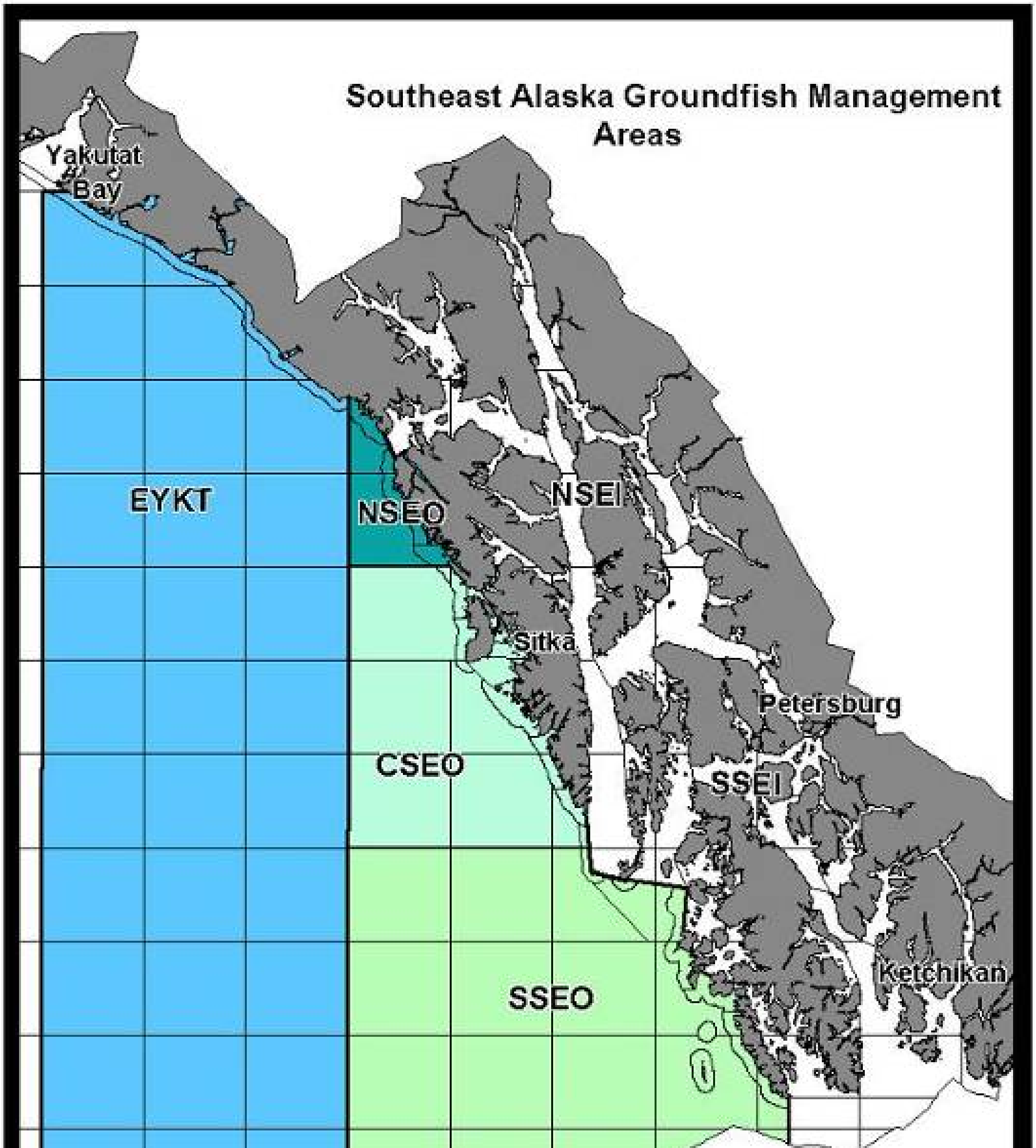


Figure 1. The Eastern Gulf of Alaska with Alaska Department of Fish and Game groundfish management areas: the EYKT, NSEO, CSEO, and SSEO sections comprise the Southeast Outside (SEO) Subdistrict.

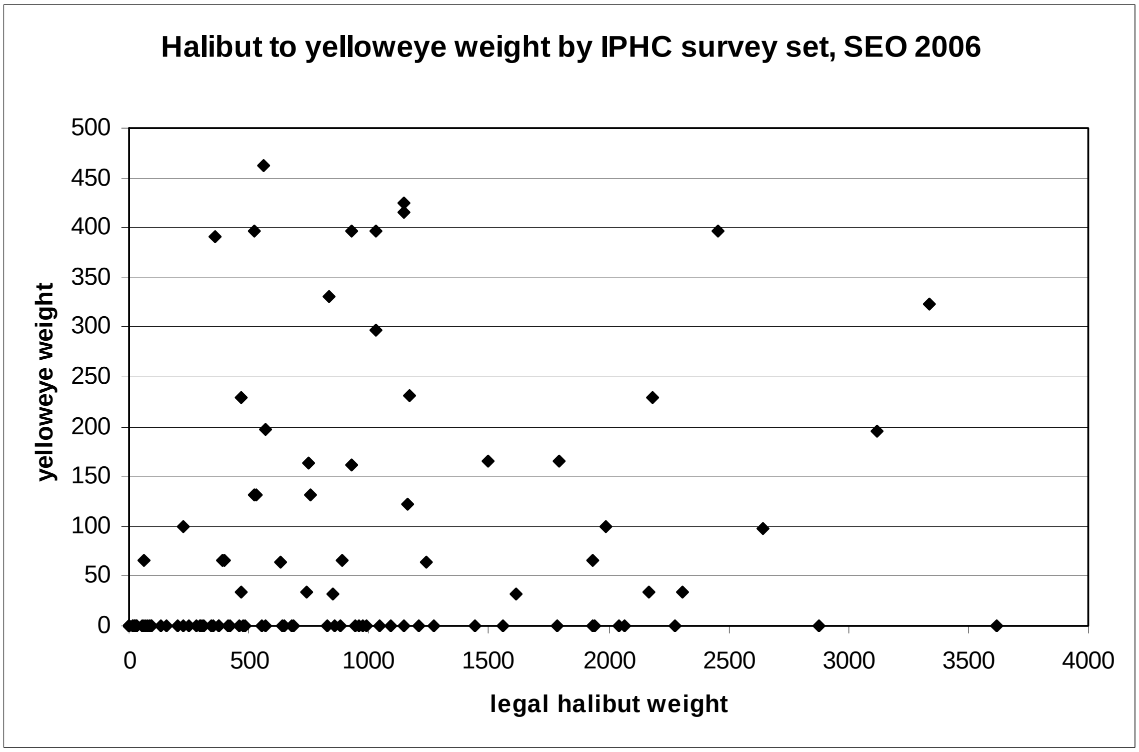
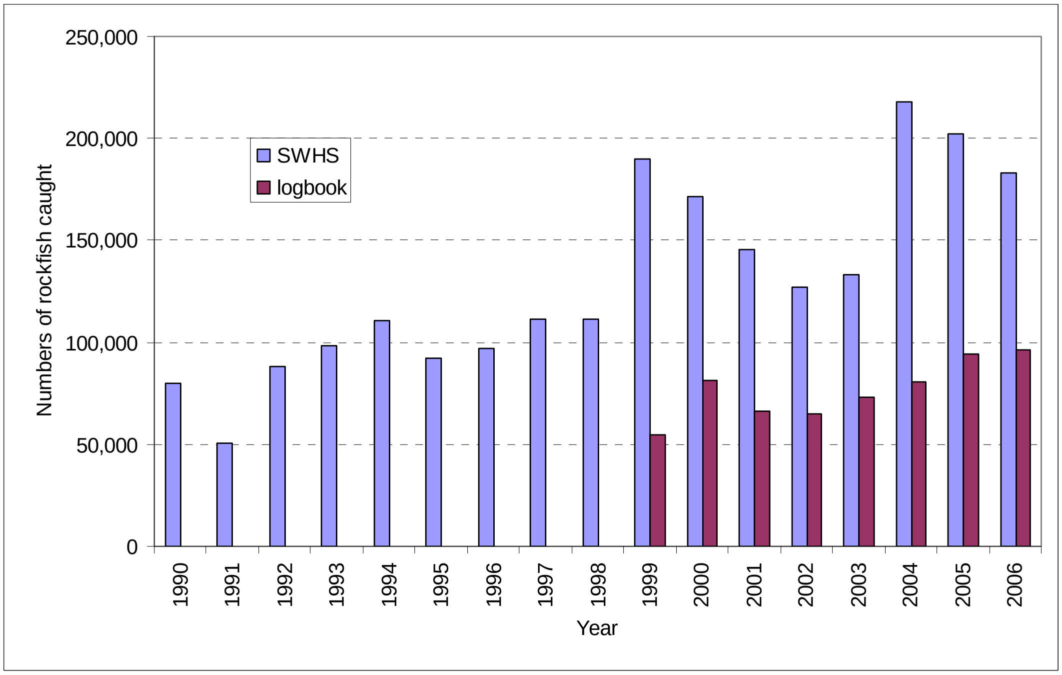


Figure 2. Catch of yelloweye (rd weight) versus halibut rd weight, legal fish) for 2006 IPHC longline survey in SEO survey stations.



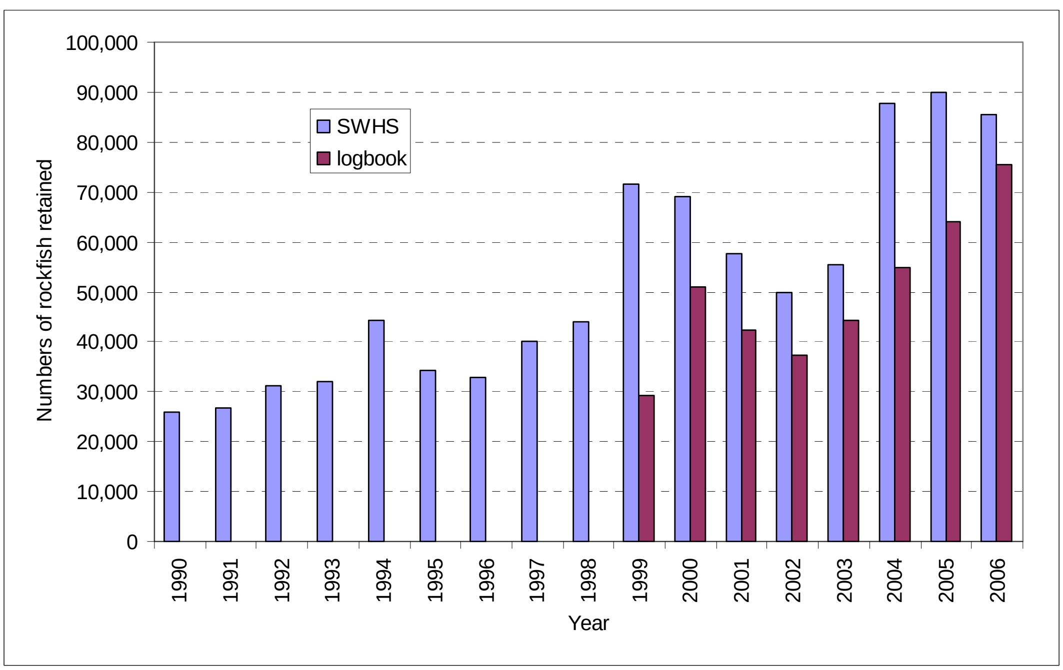


Figure 3. Numbers of rockfish caught and retained in the Southeast Alaska sportfish fishery by year: statewide harvest survey estimates compared with charter logbook data.

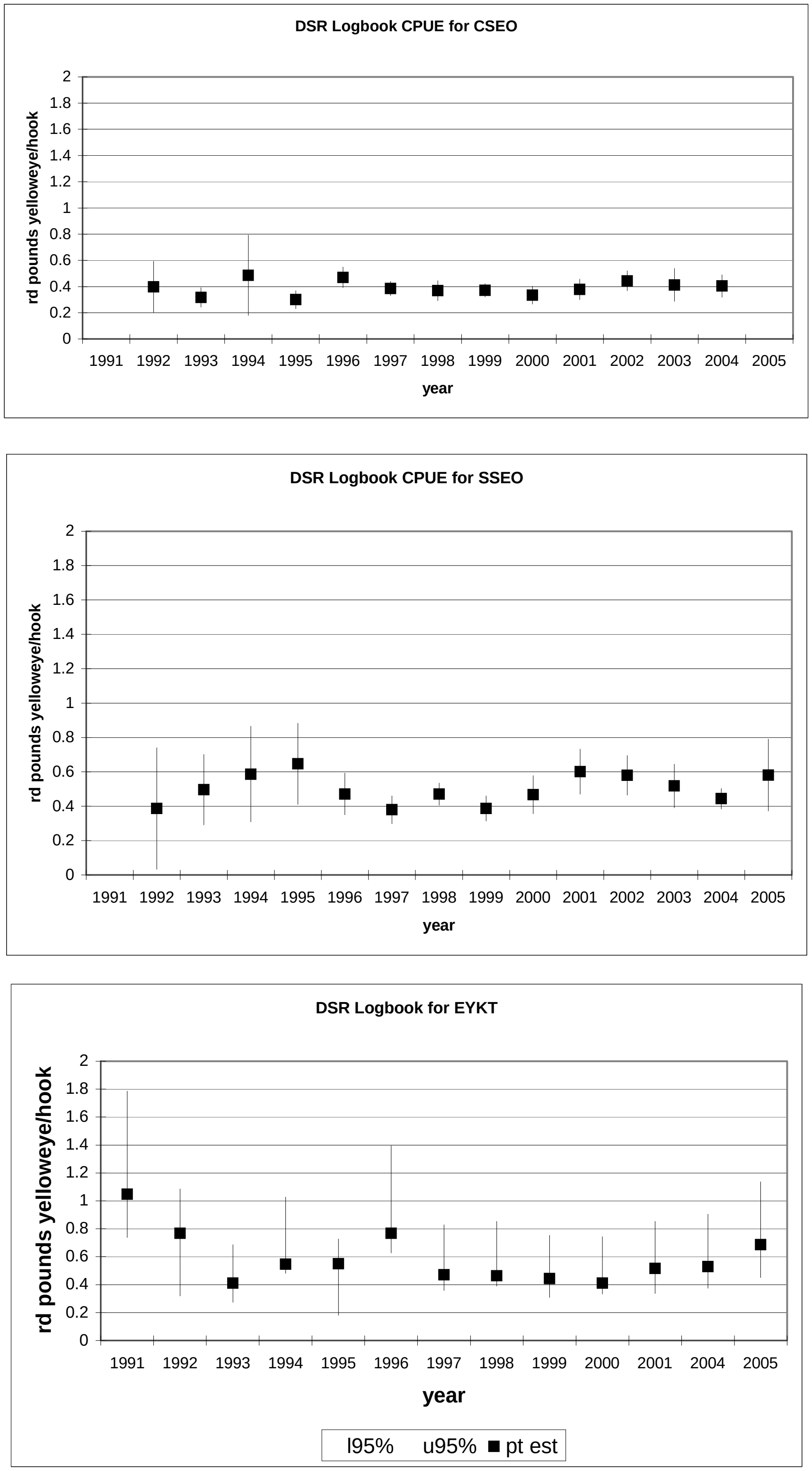


Figure 4. Commercial fishery catch per unit effort data, conventional longline gear, by area, and year.

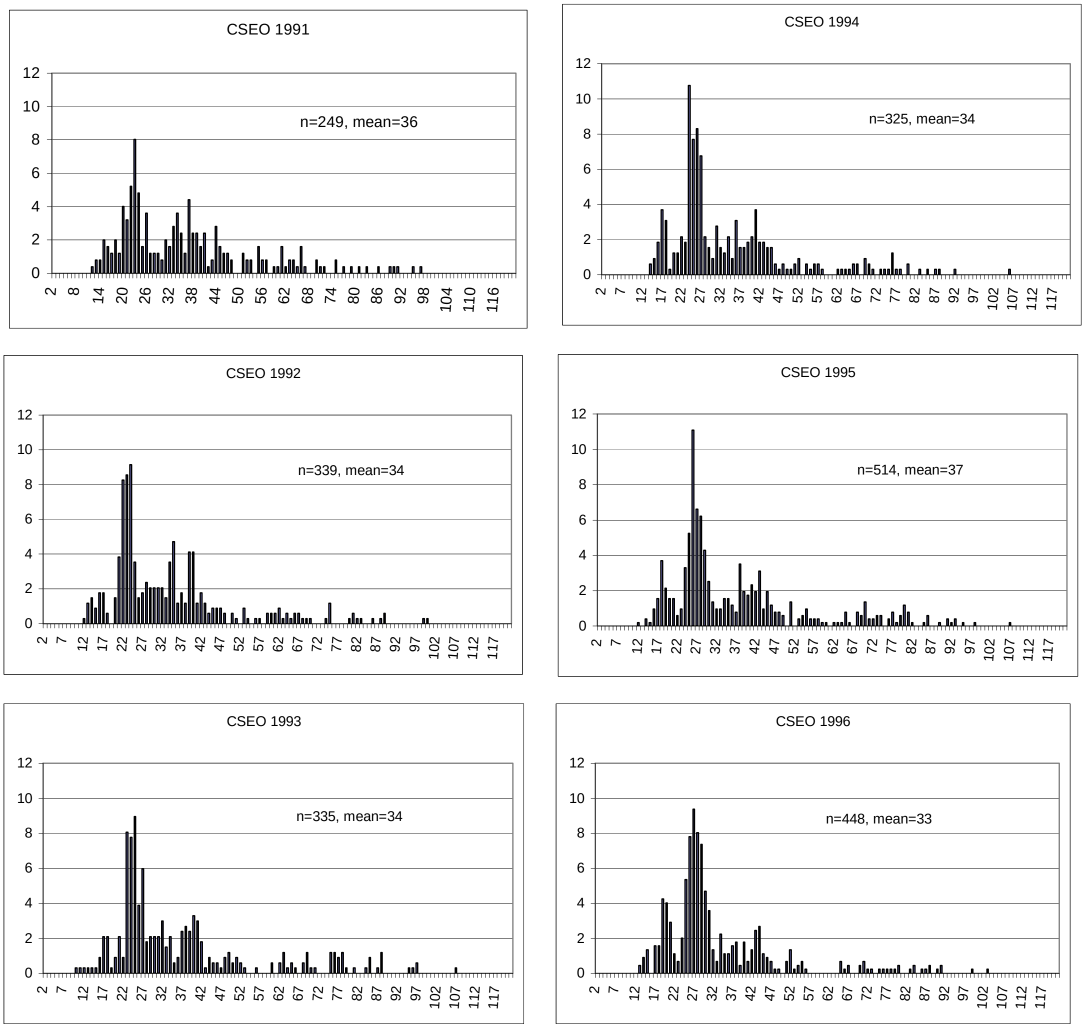


Figure 5a. Yelloweye rockfish age frequency distributions from CSEO port samples, 1991-1996.

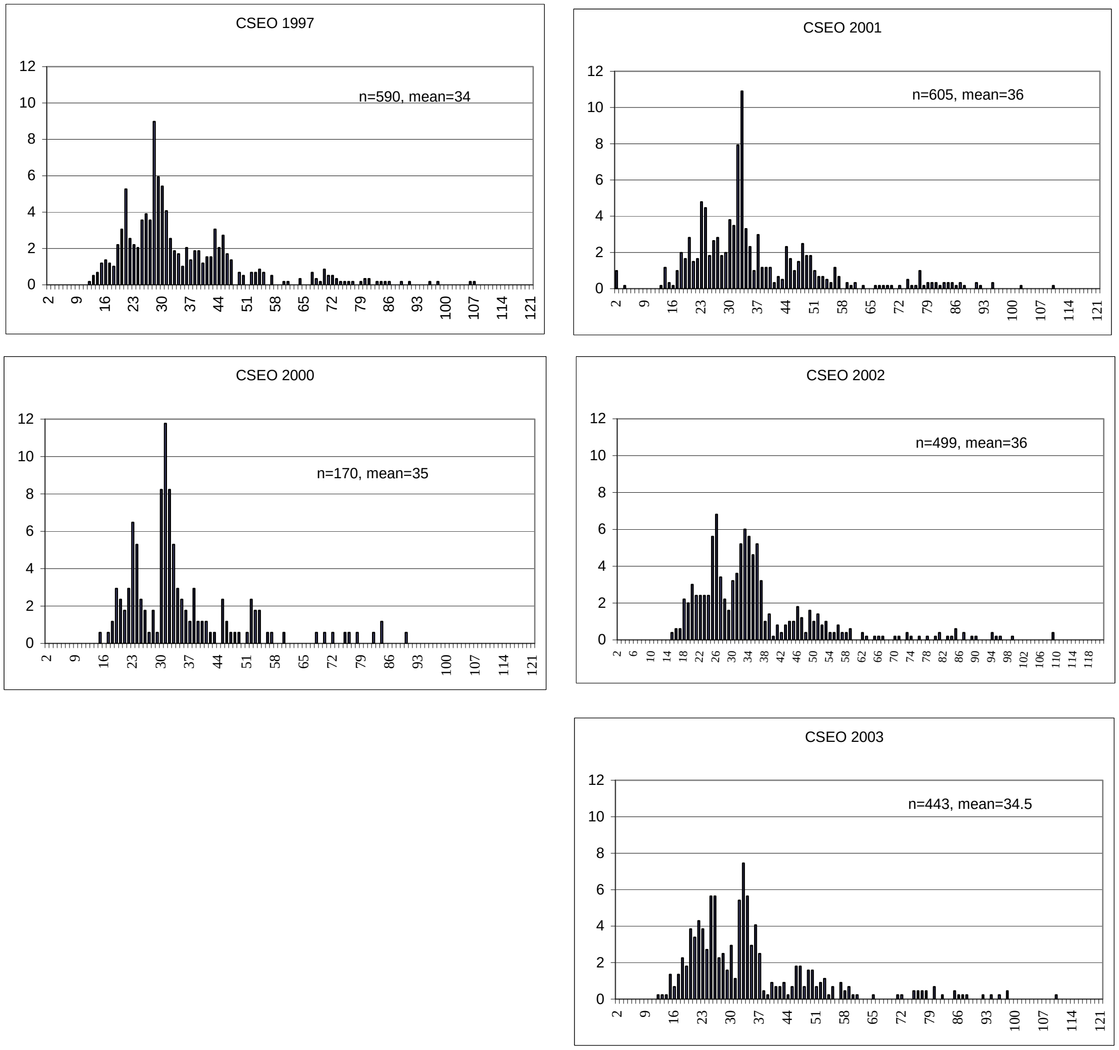


Figure 5b. Yelloweye rockfish age frequency distributions from CSEO port samples, 1997-2003.

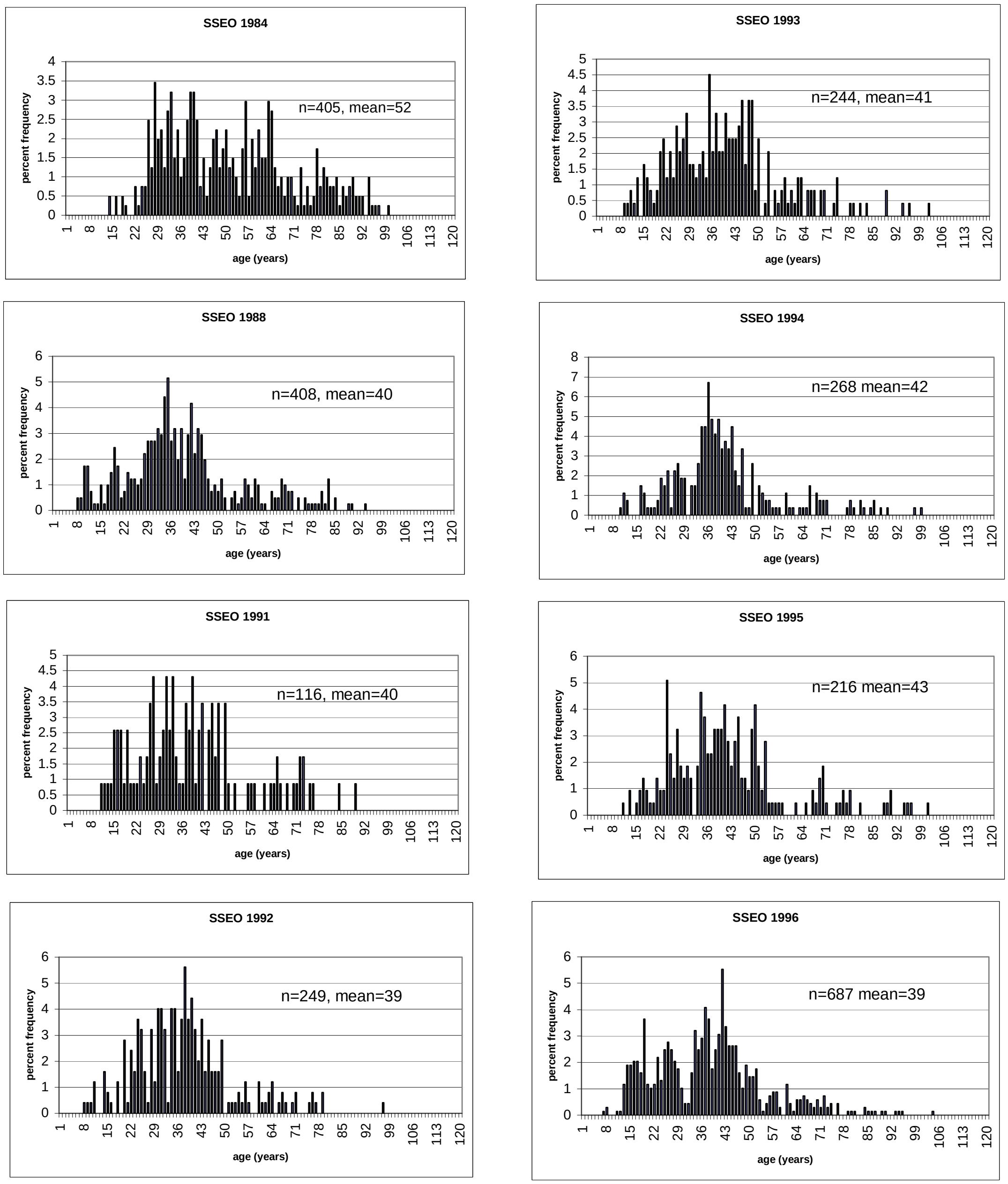


Figure 5c. Yelloweye age frequency distributions from SSEO port samples, 1984-1996.

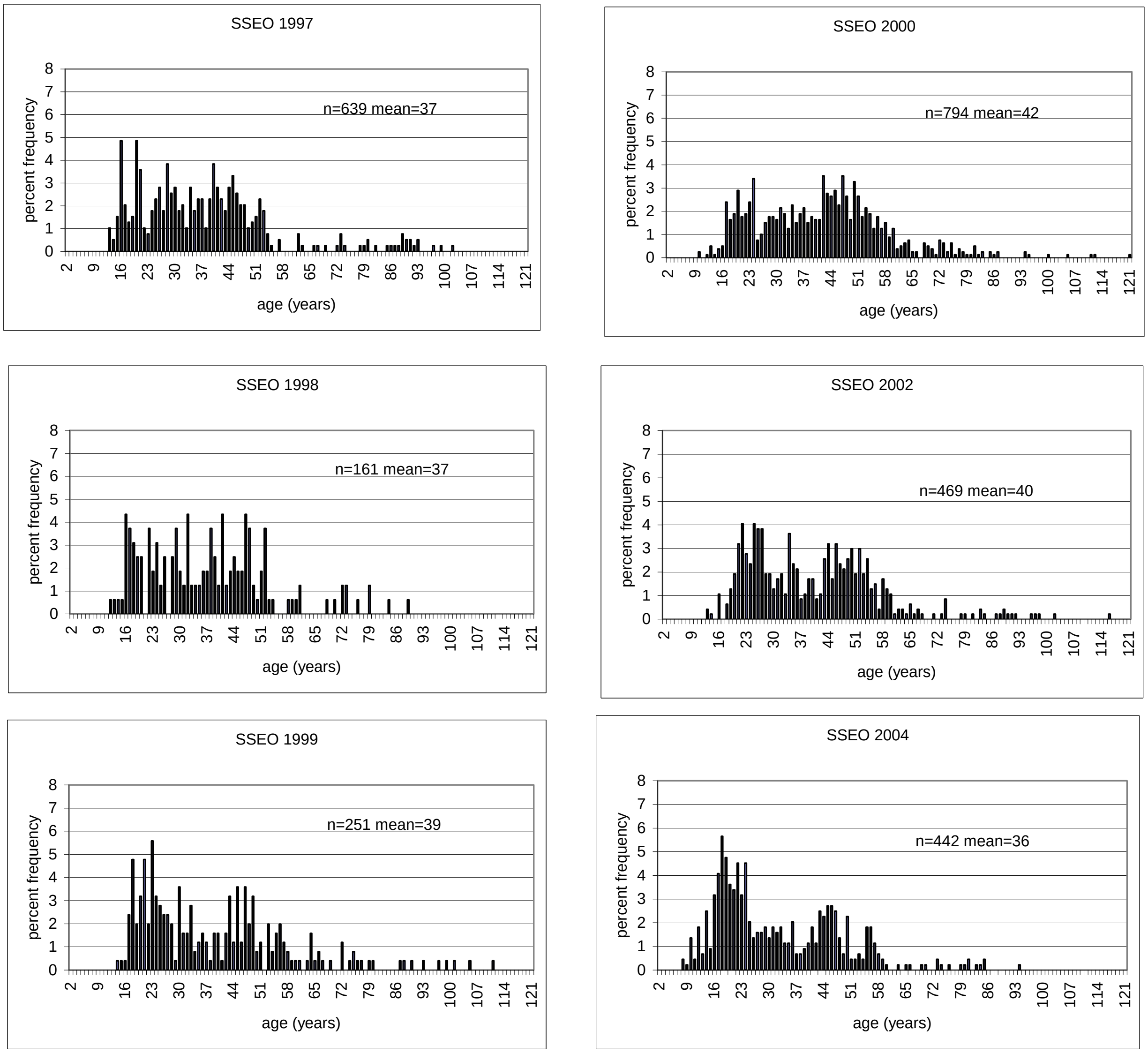


Figure 5d. Yelloweye age frequency distributions from SSEO port samples, 1997-2004.

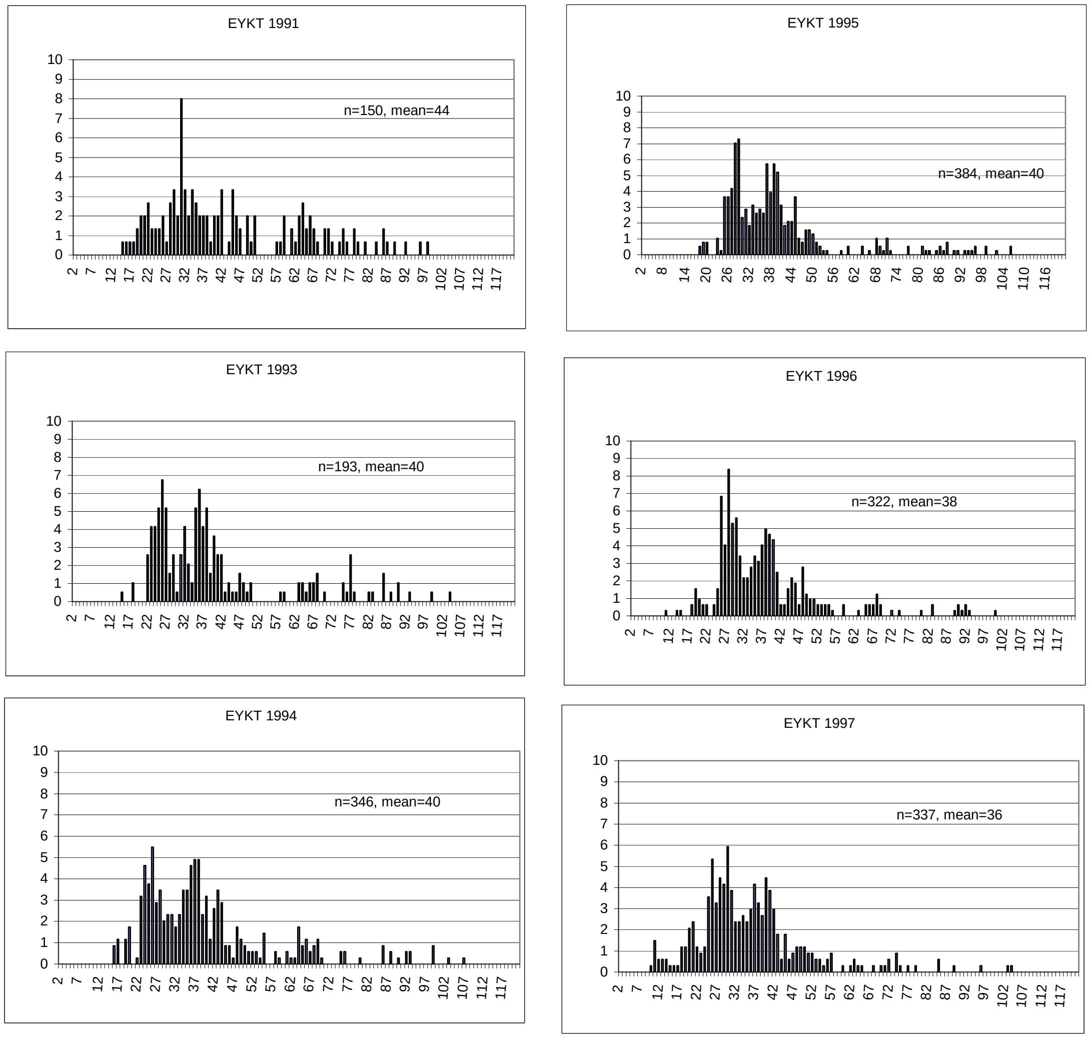


Figure 5e. Yelloweye rockfish age frequency distributions from EYKT commercial port samples, 1991-1997.

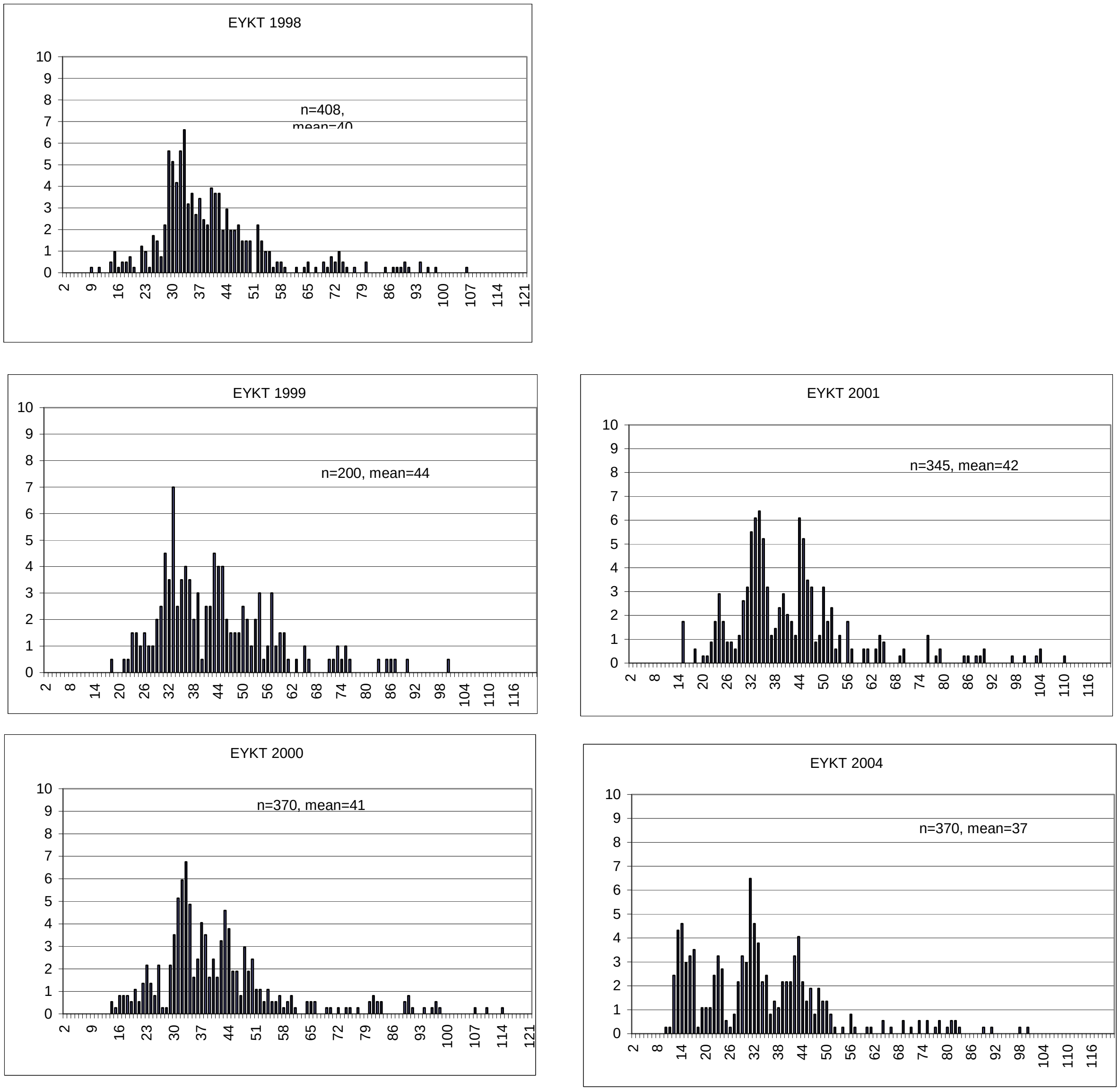


Figure 5f. Yelloweye rockfish age frequency distributions from EYKT commercial port samples, 1998-2004.

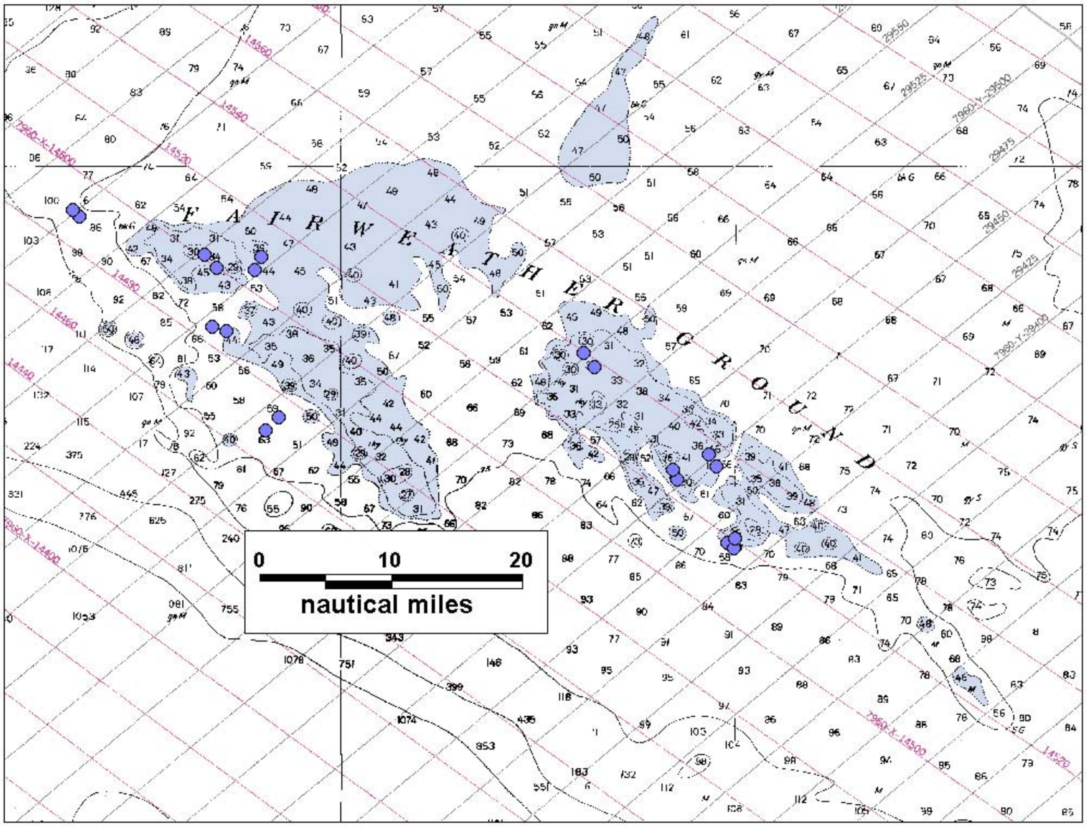


Figure 6. Start locations for line transect dives in EYKT during 2003.

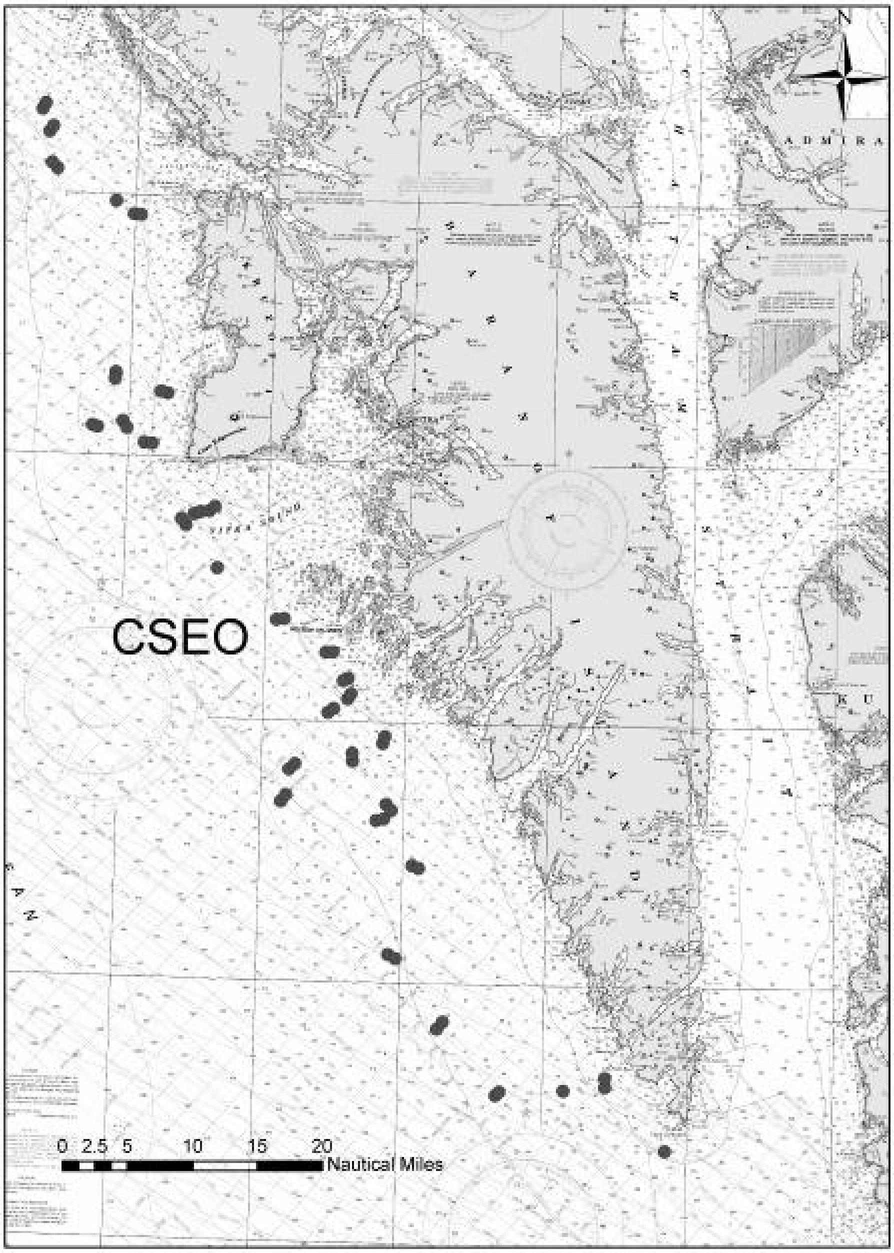


Figure 7. Start location for line transect submersible dives in CSEO during 2007.

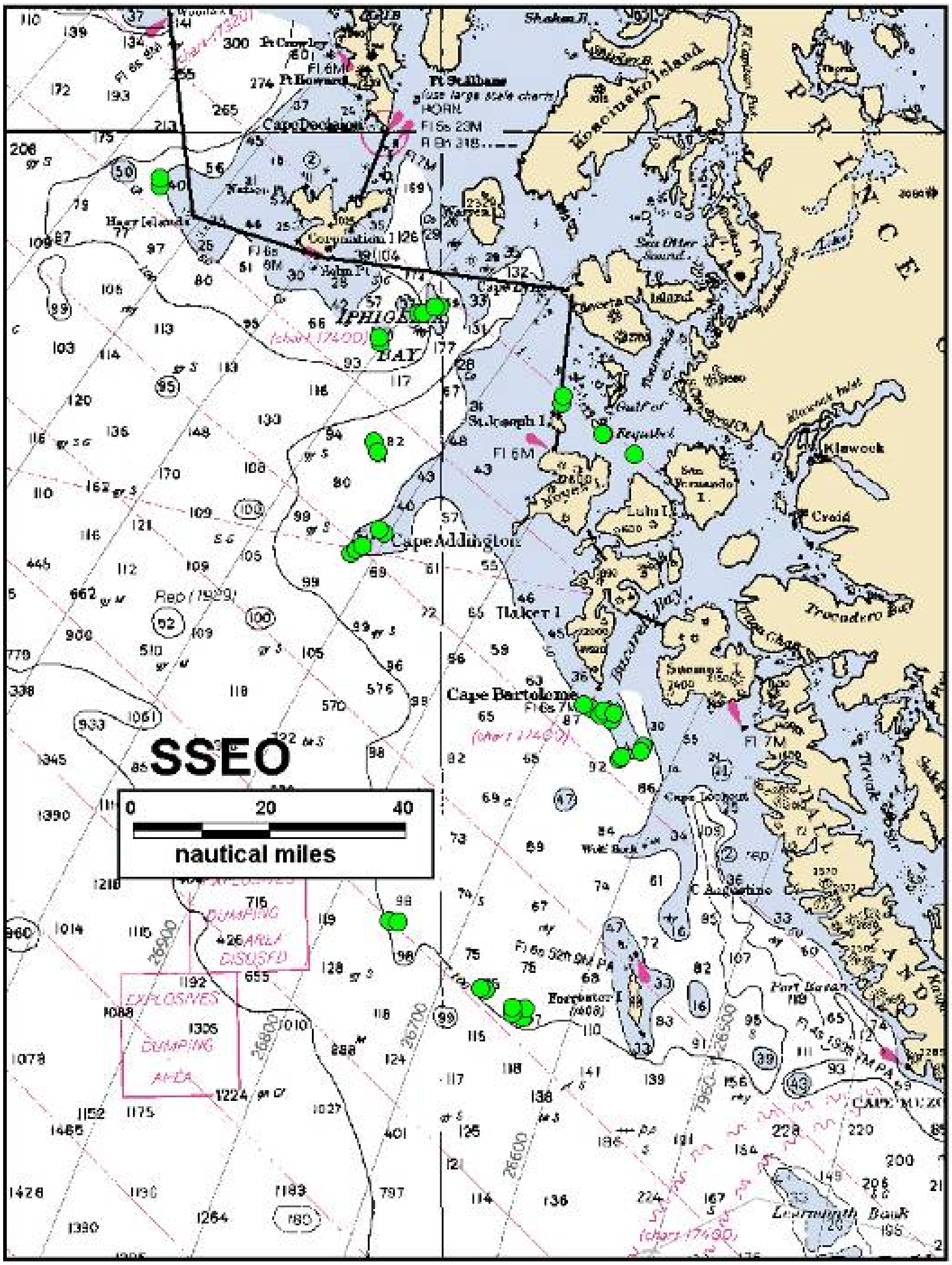


Figure 8. Start locations for line transect submersible dives SSEO 2005.

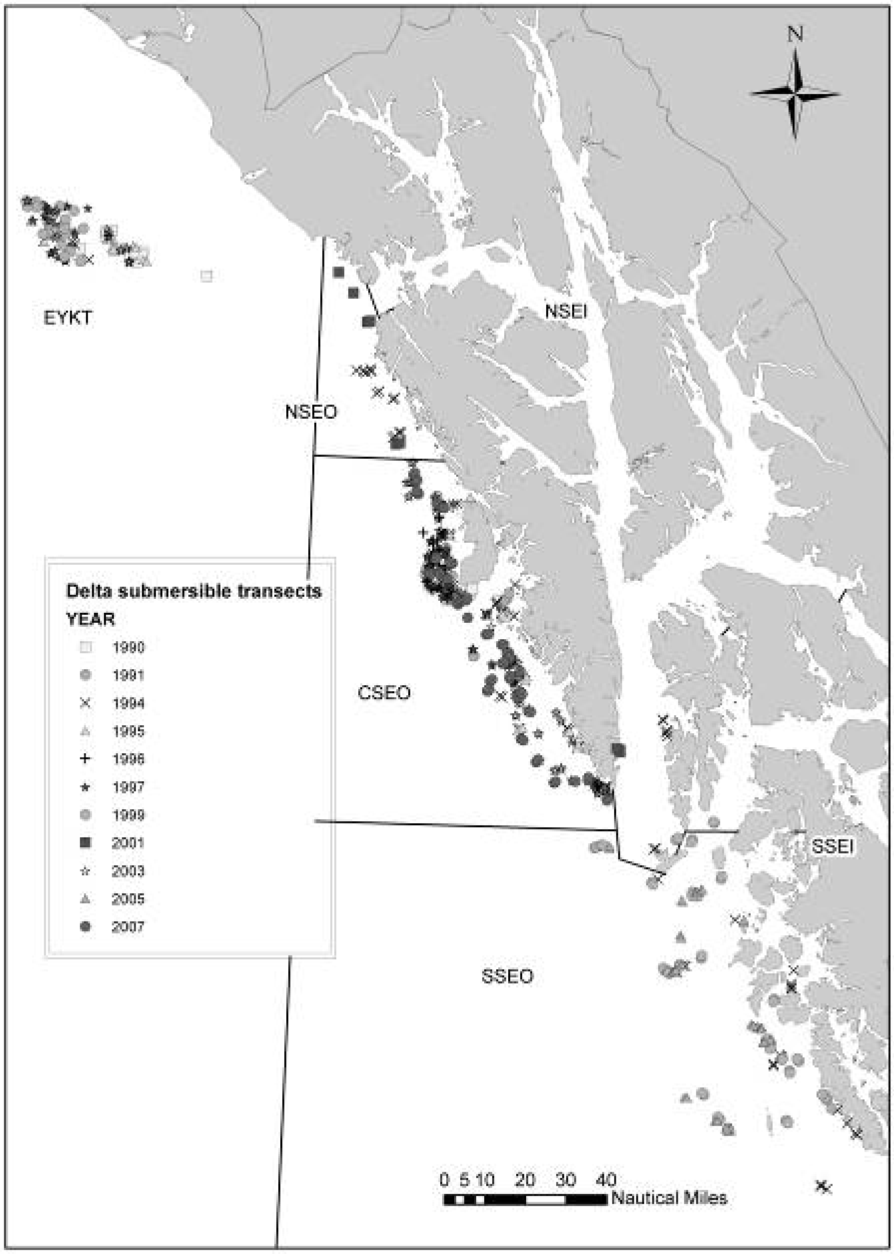
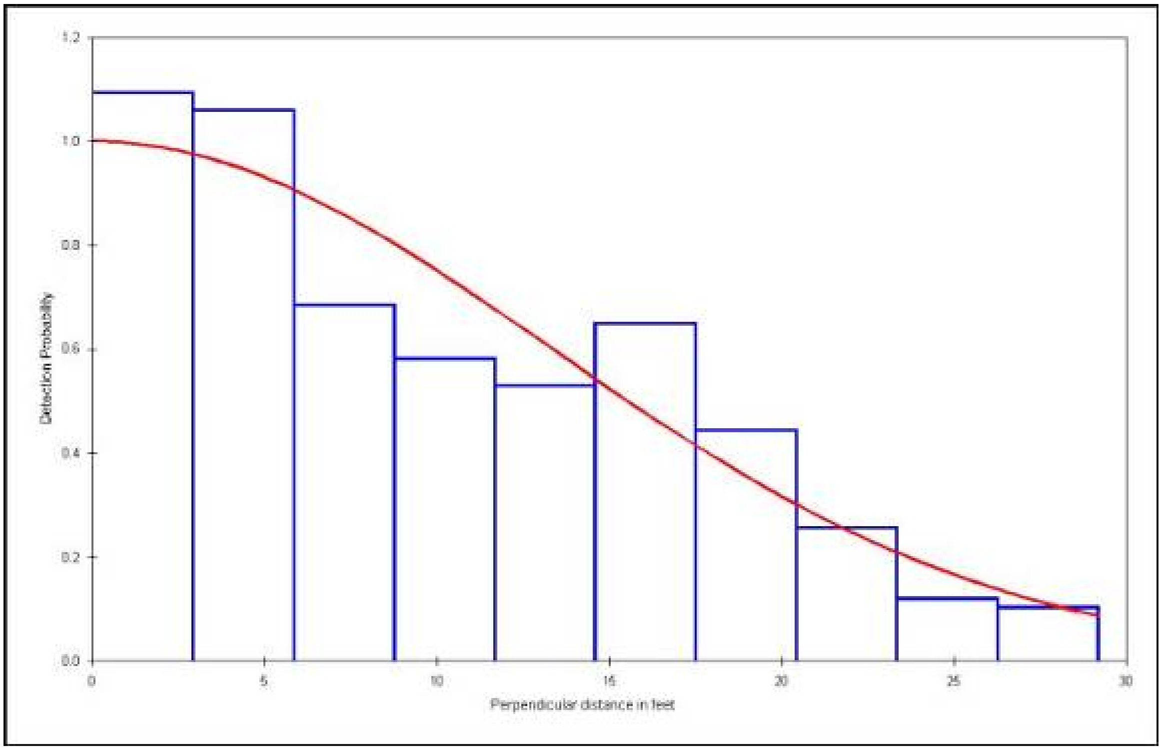


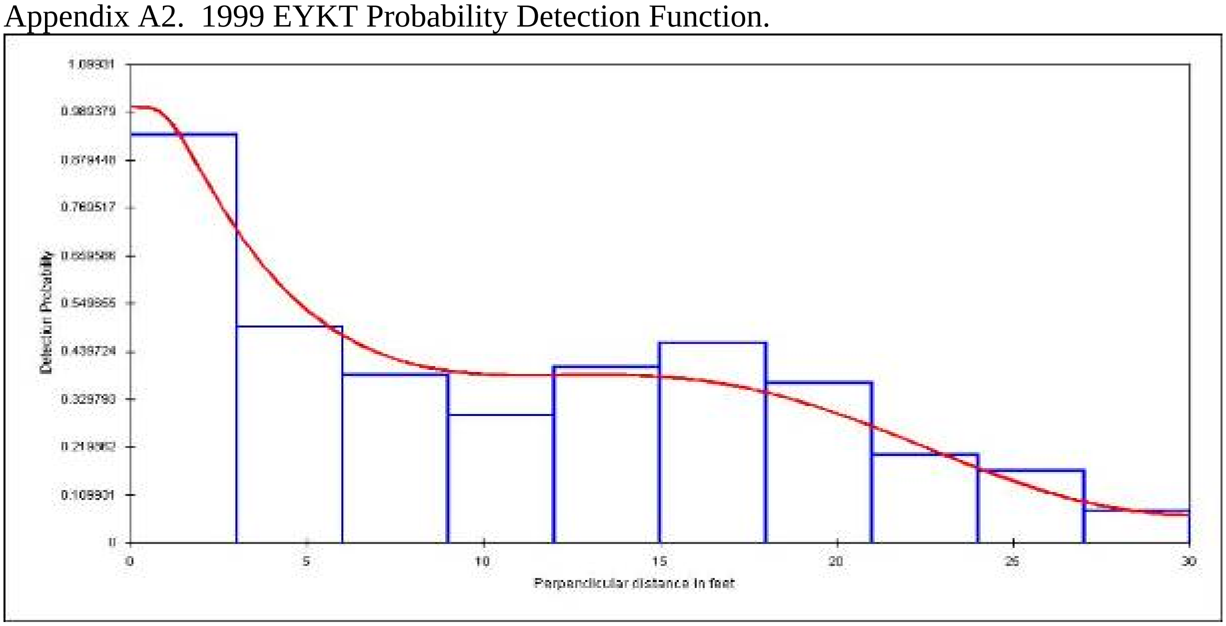
Figure 9. Start locations for submersible research dives in SEO, all years.

APPENDIX A. DISTANCE OUTPUT FOR STOCK ASSESSMENTS 1997-2007

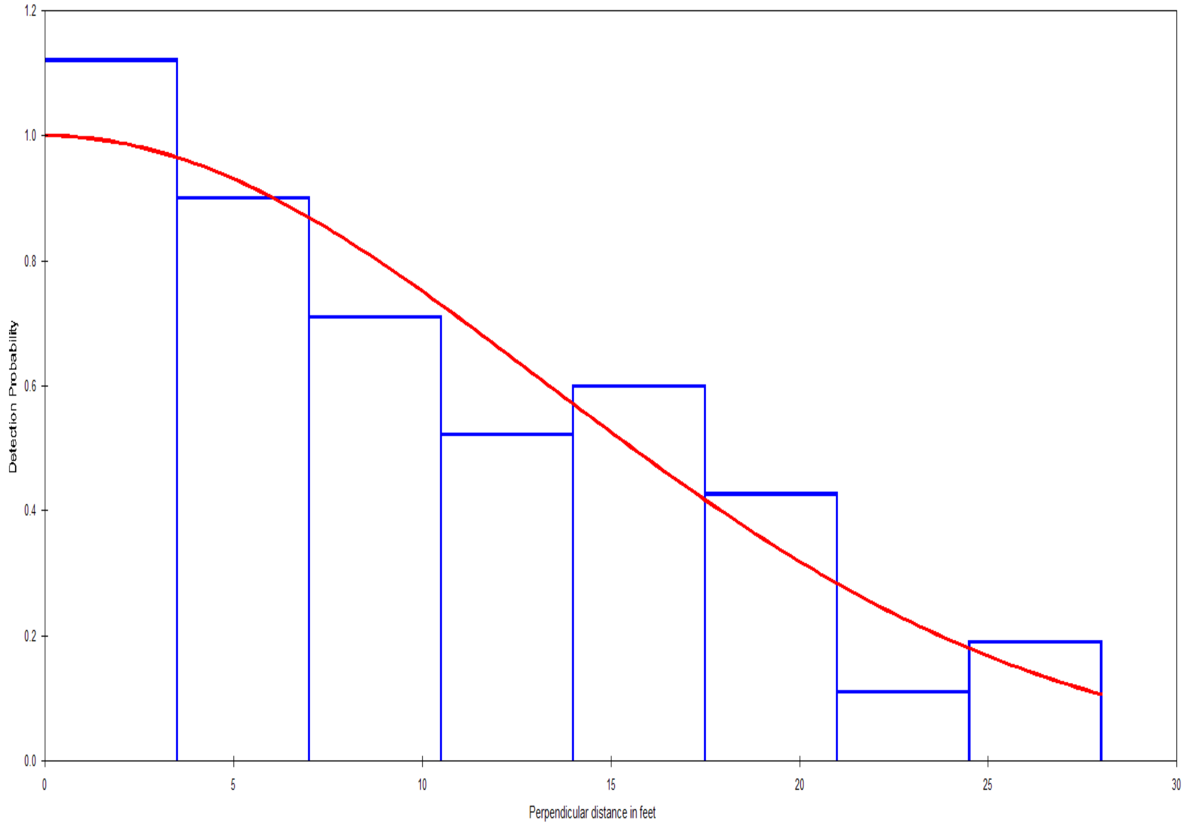
Appendix A1. 2003 EYKT Probability Detection Function, best fit.



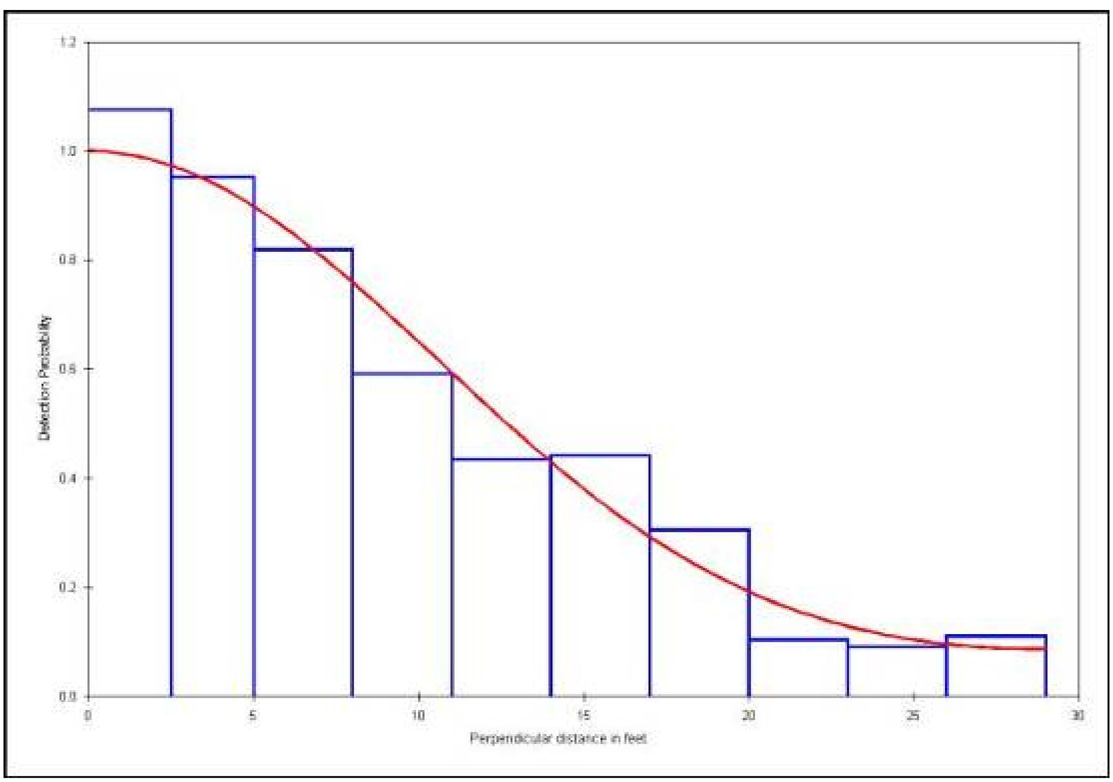
Appendix A2. 1999 EYKT Probability Detection Function.



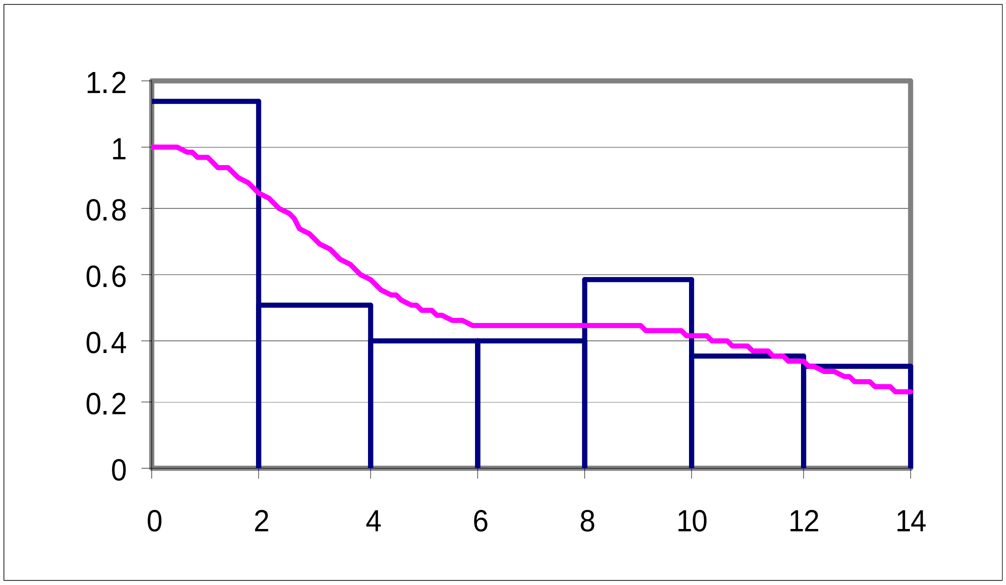
Appendix A3. 2007 CSEO Probability Detection Function, best fit.



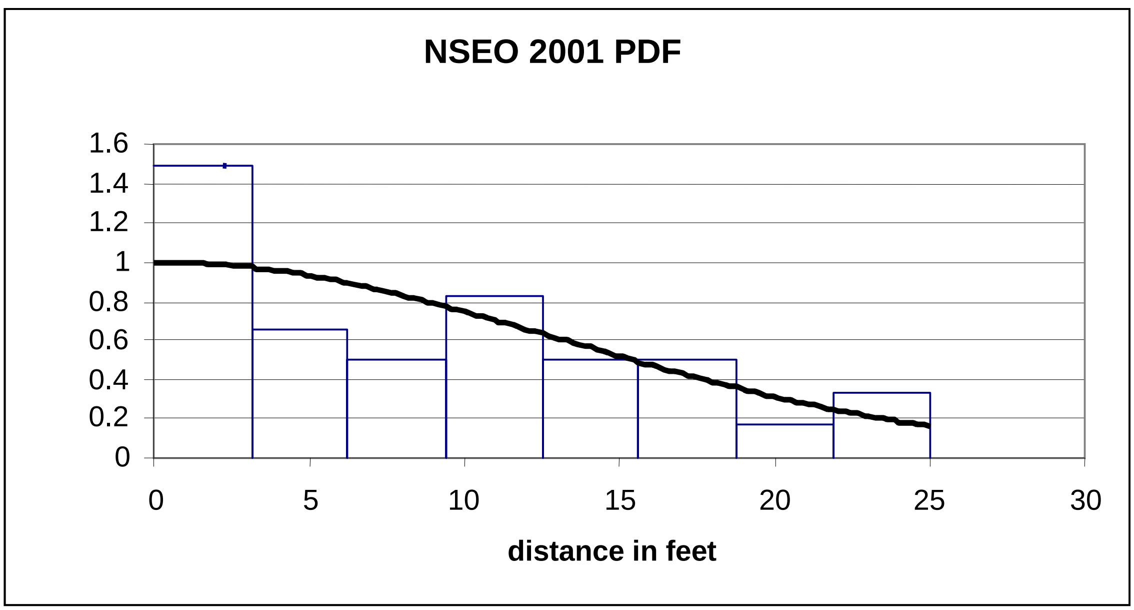
Appendix A4. 2003 CSEO Probability Detection Function, best fit.



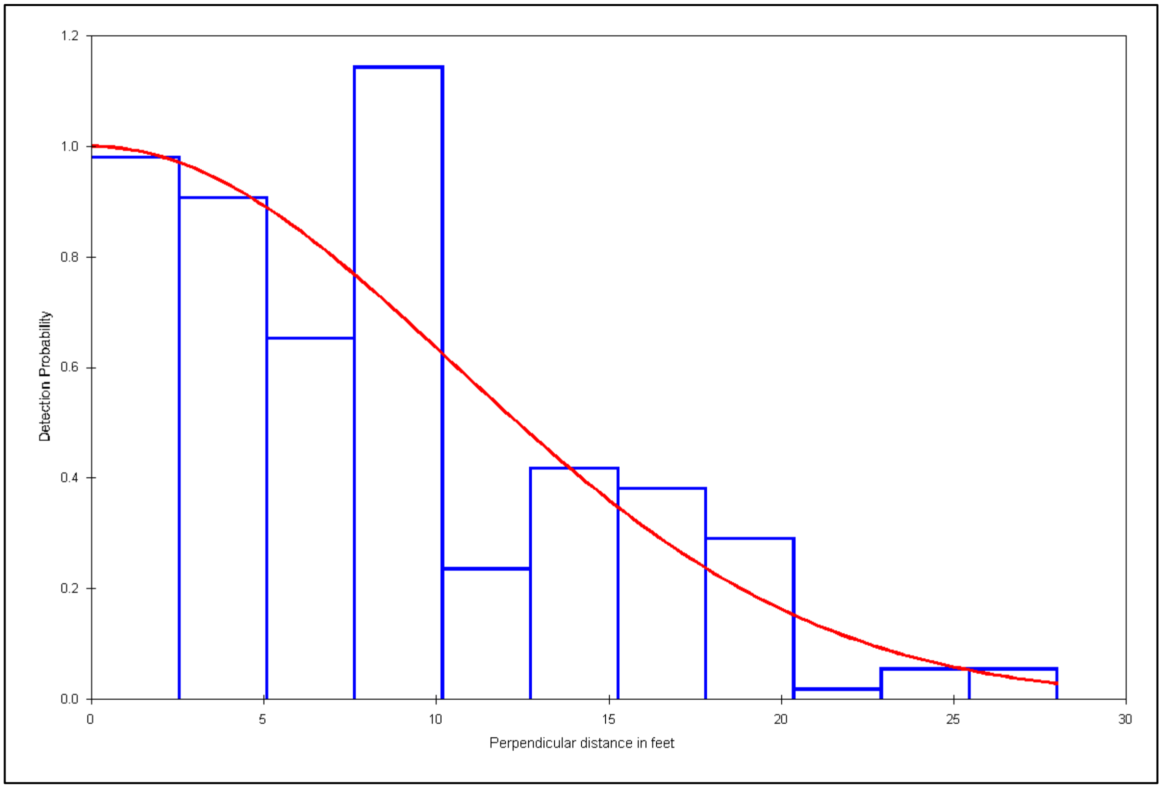
Appendix A5. 1997 CSEO Probability Detection Function.



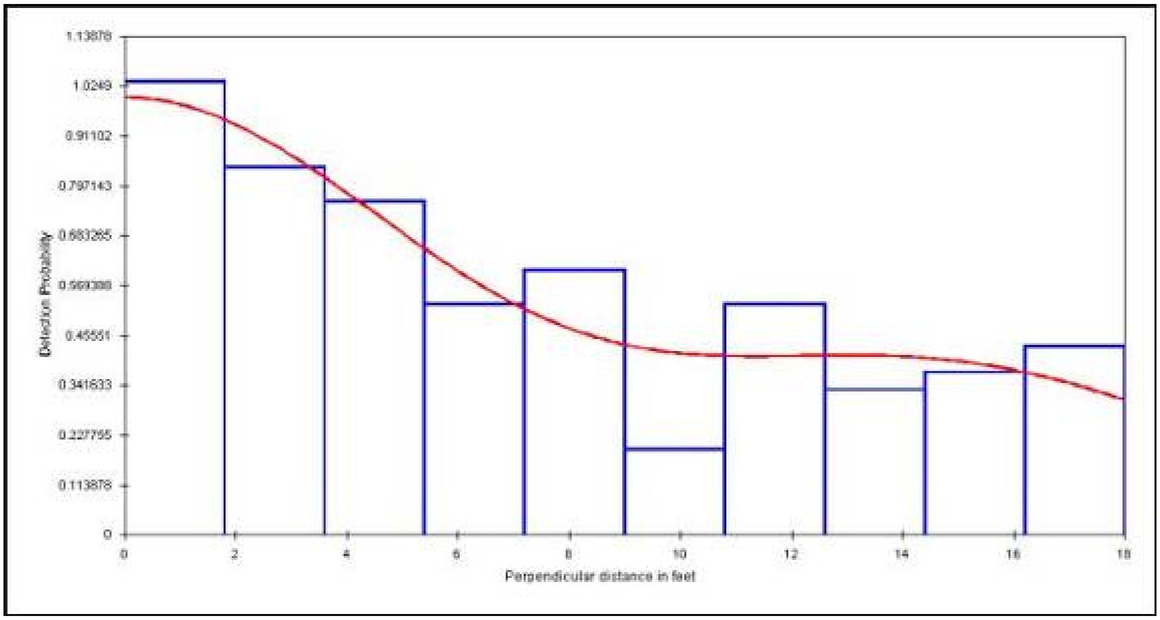
Appendix A6. 2001 NSEO Probability Detection Function.



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



Appendix A8. 1999 SSEO Probability Detection Function.



Appendix B1.
From program Distance version 5.0 release 2, November 2007.

Area	Detection Function Description	Density [D] (no. ye/km2)	s.e. [D]	cv[D]	AIC	Chi-square	k	L
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	3557.2	611.84	0.172	1379	0.15	20	18503

Area	n/L	s.e. [n/L]	f(0)	n	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	0.0175	0.0029	0.0621	323	2806.254	0.046	0.164	23.0

Area	Lower 95% CL	Upper 95% CL	Lower 90% CL	Upper 90% CL	Avg. weight (kg)	s.e.[w]	cv[w]
SSEO	1552	3108	1646	2931	3.77	0.06	0.016
CSEO	830	1374	865	1318	3.23	0.07	0.022
NSEO	709	2844	809	2493	3.04	0.23	0.076
EYKT	2499	5064	2655	4767	4.36	0.18	0.041

Area	Area of Rocky Habitat (km2)	Biomass (kg) for Area [bk]	Biomass (mt) for Area [bm]	[Var(bk)]	cv(bk)	Lower 90% CL (kg)	Upper 90% CL (kg)
SSEO	732	6060997	6061	1.09064E+12	0.172304708	4574529	8030486
CSEO	1404	4841481	4841	3.89812E+11	0.128958307	3919477	5980373
NSEO	472	2037530	2038	4.34122E+11	0.323371501	1212837	3422989
EYKT	742	11507969	11508	4.14156E+12	0.176841128	8622480	15359079

Area	Lower 90% CL (mt)	Upper 90% CL (mt)	Yelloweye F=.02 (mt)	DSR ABC ye/.96 (mt)
SSEO	4575	8030	91.49	95.30
CSEO	3919	5980	78.39	81.66
NSEO	1213	3423	24.26	25.27
EYKT	8622	15359	172.45	179.63

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