CHAPTER 13: ASSESSMENT OF THE DEMERSAL SHELF ROCKFISH STOCK FOR 2006 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 2004 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 Southern Southeast Outside area (SSEO) from the 2005 survey were used. Yelloweye average weight and standard error data were updated using 2004 and winter 2005 port samples. New age data from the 2003 and 2004 fisheries are included.

Changes in the Assessment Results

The exploitable biomass estimate for yelloweye rockfish for 2006 is 19,558 mt, up 5% from the 2005 exploitable biomass estimate of 18,508.

Scientific and Statistical Committee Comments Specific to Demersal shelf rockfishes (DSR):

"The SSC appreciates the efforts by the authors to enumerate mortality in non-commercial fisheries and looks forward to seeing these estimates in future assessments, as available."

> Estimates of sportfish catch of yelloweye are included in this assessment as is an attempt to document DSR bycatch in the 2C halibut subsistence fishery.

"The SSC recommends that the authors provide further analysis and estimation procedures for the 10% ABC adjustment for non-yelloweye rockfish species."

> The ABC and overfishing definitions for DSR are based on the yelloweye numbers adjusted upward to account for other species. Prior to this year, that adjustment was 11% as yelloweye was estimated to account for 90% of the catch.
>
> The recent species composition of landed DSR from commercial fishticket data (all targets) shows that yelloweye represents 96% of total DSR landed over the past five years and the yelloweye numbers are now divided by 0.96 (a 4.2% adjustment). See table below for species composition.

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	Total
canary rockfish	3.95	3.12	3.75	3.39	0.43	14.64
China rockfish	0.13	0.20	0.18	0.12	0.03	0.66
copper rockfish	0.05	0.22	0.08	0.05	0.00	0.40
quillback rockfish	8.80	9.27	8.31	7.22	3.67	37.27
rosethorn rockfish	0.29	0.10	0.09	0.11	0.00	0.60
tiger rockfish	0.70	0.35	0.95	0.94	0.60	3.55
yelloweye rockfish	310.09	271.42	262.06	311.77	224.42	1379.77
Total DSR	324.02	284.68	275.42	323.60	229.16	1436.88
% yelloweye of DSR	95.70	95.34	95.15	96.34	97.93	**96.03**

ABC and Overfishing Levels

The ABC for DSR is set using Tier IV definitions with F=M=0.02 and adjusting 4.2% for the other species landed in the assemblage. The recommended ABC is 410 mt. This is coincidentally the same as the 2005 ABC level. The overfishing level (650 mt) was set using $F_{35\%}$=0.032 and adjusting 4.2% for the other species landed.

INTRODUCTION

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) (Figure 1).

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 1999).

Rockfishes are considered viviparous although different species have different maternal contribution (Boehlert and Yoklavich 1984, Boehlert et al. 1986, Love et al. 2002, Yoklavich and Boehlert 1995). 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).

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 2).

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 on 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. The current fishery targets yelloweye rockfish, and fishes 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 five years. Quillback rockfish accounted for 2.5% 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) has increased significantly over time, with a maximum price paid of $2.60 in 2003.

The 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. 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. In 2005 there were no directed fisheries in the CSEO and SSEO areas of the SEO district. This was because in 2005 sport fish catch data was available prior to the opening of the directed commercial fishery and the magnitude of the sport fish catch precluded a directed fishery in the absence of management action in the sport fishery.

Bycatch

Landed bycatch in the DSR fishery includes lingcod, Pacific cod, and other rockfishes. For example, in the 2002 directed DSR fishery landed weight included 413,055 round pounds of DSR, 48,000 lbs of lingcod, 20,500 lbs of Pacific cod, 9,000 lbs of dusky rockfish, 7,500 lbs of redbanded rockfish, 6,000 lbs of silvergrey rockfish, and 3,000 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 2004, reported DSR bycatch in the halibut fishery accounted for over 46% of the total reported DSR landings in the SEO subdistrict.

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 2004 over 22,000 pounds of DSR were landed above the 10% limit compared to 4,786 in 2000. In 2005, the first year of the federal full retention requirement over 37,000 lbs of DSR overages were landed in federal fisheries in Southeast. Prior to 2005 approximately 10% of the overages were taken as personal use or donations, in 2005, 80% of the overages were taken as personal use or donations.

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 is increasing, 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 and within year, by area. There is no linear relationship between the catch of halibut and the catch of DSR (Figure 3).

The IPHC has provided us with ratio data from recent longline surveys. Bycatch is 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. The 2005 IPHC survey bycatch of yelloweye by set, expressed as the percent of yelloweye weight to legal-sized halibut weight ranged from 0% to 76%, with area estimate means ranging from 4% in EYKT to 17% in CSEO. The overall rate for SEO was 9.3%.

Estimated total mortality of DSR in the halibut fishery in the SEO subdistrict has ranged between 130 mt to 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 indicates 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 appears 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. For

2005, it was estimated that a total of 328 mt of DSR would be caught in the SEO halibut fishery; 180 mt have been landed and reported as of October 19, 2005. Based on the 2004 halibut landing data, it is estimated that approximately 49.5% of the 2C (IPHC Regulatory Area) halibut quota and 13.4% of the 3A halibut quota are taken in SEO (IPHC web page). Total bycatch mortality of DSR in the halibut fishery is estimated using 10% bycatch mortality in 2C and IPHC statistical area 190 (Fairweather Ground) and a 5% bycatch mortality in the remaining portions of 3A east of 140°. Based on the 2005 halibut quotas and the distribution of commercial halibut harvest in 2004, the estimated total DSR mortality for the 2006 SEO halibut fishery is anticipated to be 356 mt. If the 2006 halibut quota is different from the 2005 quota the estimate will be revised.

Other Sources of Mortality

Although management of this stock has been conservative, the decline in the density estimates in the CSEO may be an indication that localized overfishing may be 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 stay in the same area over years (O'Connell 1991). Catch curve analysis of age data from CSEO suggests that total mortality is approaching 6% (natural mortality is estimated at 2% annually) (Table 2). 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 2). It is possible that mortality associated with the halibut fishery has been underestimated in CSEO. Alternately, a recent review of available sport fish catch data indicates that fishery is a source of significant and increasing exploitation. Sport fish harvest has not previously been accounted for in total catch statistics or TAC setting.

Sport fish Removals

There is a bag limit of 1 or 2 yelloweye per day and a bag limit of 3 to 5 non-pelagic rockfish depending on area. In 1999 (the last year these numbers are available) in area 2C, 97% of the non-pelagic rockfish catch was taken by non-residents. In 2C non-resident anglers fish predominately from charter vessels.[1]

There are three sources of data available from the sport fish fishery: Statewide Harvest Survey (SWHS), an annual mail-out survey to licensed anglers; charter logbook data, an annual logbook required of the charter industry; and creel data with landed species composition from select ports. The detail of data varies greatly between these three sources. There is no breakdown of species beyond the category of "rockfish" in the SWHS, the charter logbook data details pelagic and non-pelagic rockfish categories but no species data, and the creel data identifies landed catch to species for yelloweye, quillback, black, copper, and silvergrey rockfish.

Creel samplers are available in some ports but only at public access sites. There is no sampling of fish landed at private docks and lodges. There are no biological data beyond species composition taken from sport caught bottomfish.

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 4)[2]. Mortality estimates based on the SWHS catch data are more than double that of the logbook. Obviously there is significant uncertainty in all available estimates.

[1] http://www.fakr.noaa.gov/npfmc/current_issues/halibut_issues/CharterIFQ/Section3.pdf
[2] Unpublished data, Mike Jaenicke, Alaska Department of Fish and Game, Sport Fish Division, Douglas, AK.

Sport DSR Estimate – Methods[3]

Three primary data sources were used to obtain the estimates of total mortality (in metric tons) from the sport fishery in 2004 (Statewide Harvest Survey, 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 into various sectors (called SWHS Areas). 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 numbers of rockfish caught and released, is obtained as time permits. Charter operators are required to report in logbooks, the number of pelagic and non-pelagic rockfish harvested and released, as well as the fishing location for each day fished. The logbook is turned in annually. This logbook information was used to estimate the species composition (DSR vs. pelagic) of rockfish released.

The DSR harvest estimate was obtained by multiplying the SWHS harvest estimate (retained catch) for all rockfish in Areas B, D, and G by the species composition of the harvest obtained from creel surveys in Craig, Sitka, and Elfin Cove, respectively. Average weights obtained from the commercial fishery (7 lbs. for yelloweye and 2.5 lbs. for quillback and copper) were used to estimate the total weight of the retained catch. This estimate was reduced by 25%, to account for rockfish that were harvested outside of the SSEO, CSEO, and NSEO groundfish management areas. In 2004 the estimated weight of DSR retained in the sport fishery was 53.7 metric tons.

The total number of rockfish released was obtained by expanding the SWHS estimate of rockfish harvest in each area by the ratio of total catch (retained and discarded rockfish) to harvested rockfish obtained from the creel survey. In 2004, this ratio was 1.8, 1.5, and 2.1 for Craig, Sitka, and Elfin Cove, respectively. Charter logbooks for 1999-2004 demonstrated that DSR were retained at a much higher rate than pelagic rockfish. To account for this, the species composition of harvested rockfish (obtained from the creel survey) was reduced by 20% and applied to the released fish. This is considered to be a conservative estimate of the DSR species composition of released rockfish, especially since preliminary data indicate that 90% of yelloweye rockfish are retained. This estimate of total DSR released was multiplied by the average weights of yelloweye and other DSR rockfish obtained from the commercial fishery and reduced by 25% to account for rockfish caught and released outside the groundfish management areas. The total estimate of DSR released in the sport fishery in 2004 is 29.0 metric tons, and all of these fish are assumed to have died.

The sum of harvested and released mortality provide the total DSR mortality estimate. For 2004 the total estimated mortality of DSR in the sport fishery was 82.6 metric tons. In 2003 and 2002 the estimates were 74.1 and 87.4 metric tons, respectively.

These estimates rely on numerous assumptions. The Sport Fish Division will be modifying its creel and logbook programs to obtain more accurate estimates of species composition of harvested DSR, released DSR, weights of DSR, and locations of harvest.

Subsistence removals

There is very little information available regarding mortality of DSR associated with subsistence fisheries in SEO. The NPFMC collects information on the recently formalized halibut subsistence fishery through a voluntary mail survey. There is non-specific information collected

[3] This section was provided by Rocky Holmes, Regional Director, Sport fish Division, Douglas, AK.

on rockfish catch (numbers) in the halibut longline subsistence fishery but there is only broad location data (northern southeast, southern southeast, and the Sitka LAMP area). In 2003 the survey indicated 9,900 rockfish had been taken in area 2C and in 2004 this number increased to 13,092 rockfish[4]. The catch came mostly from the Southern Southeast Area (7,249) followed by the Sitka LAMP area (4,205) and then the northern southeast area (1,391). The IPHC halibut longline survey data for area 2C was used to determine rockfish species composition of this catch[5]. These data indicate that 55.5% of the rockfish catch was comprised of DSR species. Consequently, 7,266 of the rockfish reported might be categorized as DSR. 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.

Commercial Catch History

The history of domestic landings of DSR from SEO are shown in Table 4. 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.

Directed fishery landings from SEO in 2005 totaled 41 mt in 2005, bycatch landings totaled 192 mt, 96% of which were landed in the halibut fishery. The directed commercial DSR fisheries in the CSEO and SSEO were not opened in 2005 because it was estimated that sport fish harvests (landed catch) were significant and combined the two directed fisheries would likely result in exceeding the TAC.

DATA

Fishery Data

In addition to catch data listed in Table 4, catch per unit effort 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 stage-of-maturity 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 5 years. Biological information detailed below is reported for yelloweye rockfish only.

Commercial fishery catch per unit effort (CPUE) expressed as round pounds of yelloweye rockfish per hook for vessels using conventional gear has been fairly stable in CSEO and shows an increase in SSEO in 2005 after a decline in 2002 and 2003 (Figure 5). 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.

Mortality Estimates

[4] Personal communication, Jim Fall, Subsistence Division, ADF&G, Anchorage, AK
[5] Personal communication, Tom Kong, IPHC, Seattle, Wa.

An estimate of Z=0.0174 (± 0.0053) from a 1984 "lightly-exploited" stock in SSEO is used to estimate M=0.02 (Table 4). 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 year (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 recent 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 2). 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 5. 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 6). 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 aged 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 6a-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 6c-d). Maximum age is 93, with very few fish older than

60. The SSEO samples had an average age of 36 years. The 2004 distribution from EYKT is multi-modal (Figure 6e-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.

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 7); the CSEO section during 1990, 1994, 1995, 1997, and 2003 (figure 8); the NSEO section in 1994 and 2001; and the SSEO section in 1994, 1999 and 2005 (figure 9). A total of 606 dives have been made with 325 line transects run for assessment purposes since 1989 (figure 10). 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. Variance estimates can be calculated 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 result in some 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 recorded (Buckland 1985). 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. The sonar gun was also used during the transect when necessary to reconfirm distances.

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.

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.

A line transect estimator (Buckland et al. 1993) was calculated and the best fit model selected from several detection functions using Version 3.5 Release 6 of the software program DISTANCE (Laake et al. 1998, Thomas et al. 2003) (Appendix 1). A principal function of the DISTANCE software is to estimate f(0). The program can either be run with default and best fit settings or can be used with set sighting intervals and truncation of a portion of the right limb of the sighting data. Estimated probability detection functions (pdf) generally exhibited the "shoulder" (i.e., an inflection and asymptote in the pdf for perpendicular distances 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 size for the 2005 SSEO survey data are 33 transects and 282 yelloweye observed. Sample size, number of yelloweye observed, and meters surveyed is shown by area and year in Table 7.

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 actual 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.

2005 Density Estimates

New density surveys were conducted during 2005 in SSEO (Figure 9). Yelloweye rockfish density for this stock assessment is based on the last best estimate by management area. The EYKT and CSEO areas were last surveyed in 2003 and NSEO was surveyed in 2001. Density estimates by area range from 1,420 to 3,557 adult yelloweye per km^2 (Table 8).

The density estimate for SSEO in 2005 was 2,196 adult yelloweye/km^2 (CV=17.16%). This is higher than the previous estimate obtained in 1999 of 1,879 adult yelloweye/km^2 (CV=17.11%), however the difference is not significant. The model is a hazard rate model with 11 cutpoints ending 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 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 mi from the start position. Longline sets must have at least a 0.04 yelloweye/hook catch rate to be included in the data. Prior to the 2002 assessment the commercial logbook data were not buffered and our estimate of yelloweye habitat was based on hand drawing 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 2006 will concentrate on ground-truth of rocky habitats and evaluation of the logbook approach for defining habitat.

Sidescan Sonar

In 1996 we conducted a side-scan sonar/bathymetric survey for a 536 km^2 area in the CSEO section. The National Ocean Services (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 was rocky.

Multibeam Sonar

In 2001 we conducted a multibeam survey for two areas in the Southeast: a portion of CSEO off of Larch Bay and a portion of SSEO off Hazy Islands. National Marine Fisheries Service Auke Bay Lab surveyed an adjacent area offshore of the Larch Bay site. Of the 293.7 km^2 surveyed offshore of Larch Bay, 112 km^2 were identified as yelloweye habitat based on interpretation of the multibeam data. A total of 385 km^2 were surveyed off Hazy Island, 105.5 km^2 of which was identified as yelloweye habitat.

In 2002 we conducted a multibeam survey for a portion of the east bank of Fairweather Ground. Of the 219 km^2 area surveyed, 75 km^2 was identified as yelloweye habitat. Based on this information, the estimated yelloweye habitat area for the EYKT area was reduced from 757 km^2 to 742 km^2.

Area Estimates

Total area of yelloweye habitat for the SEO is estimated to be 3,360 km^2 (Table 8). 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 correct habitat. Beginning in 2003, both start and end positions are required to be reported in logbooks. This will allow us to use the middle of the set as our buffered area although these data are limited given the diminishing directed fishery. Field work in 2006 will concentrate on ground-truth of rocky habitats and evaluation of the logbook approach for defining habitat.

Exploitable Biomass Estimates

Estimates of exploitable biomass (adult yelloweye), with associated standard error, by year and area, are listed in Table 8. New information added this year includes new density estimates for SSEO and 2004/winter 2005 average weight data and standard error of the average weight data for CSEO, EYKT and SSEO. The total exploitable biomass for 2006 is estimated to be 19,558 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 4.2% of other DSR species, the recommended 2006 ABC is 410 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 650 mt. This was derived by applying a fishing rate of $F_{35\%}=0.032$ against the biomass estimate for yelloweye rockfish and accounting for 4.2% 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 2003 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 530 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 410 mt (including 4% for other DSR).

Scenario 3: F equals the 5-year average F from 1995 to 1999. 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 410 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 265 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 345 mt (including 4% other DSR species).

The sport fish catch comes mostly from the charter industry, and this is a growing segment of total removals in Southeast Alaska. The quality of the catch estimates from the sport fish sector is uncertain and there is also a problem with timeliness of data availability. The sport fish surveys were not designed for timely management. Because of the magnitude of the catch from this sector and from the bycatch in the commercial halibut fishery, the directed commercial fishery will not open in any area of SEO in 2006 in an effort to keep total catch within the TAC. The ADF&G may not allocate resources to specific user groups. Given the recent growth in the sport fish catch (e.g. 54% more yelloweye landed in the 2004 Sitka charter fishery compared to 2002) significant management action in the sport fish fishery will have to be taken as well if the catch is to remain within the TAC. This issue is in front of the Board of Fisheries at their February 2006 meeting and management regulations may be adopted at that time.

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 and fall	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 of using logbook data as a proxy in areas without geophysical surveys.
- Fishery independent fishery surveys to collect biological data (limitations on directed fisheries are limiting collection of biological data).
- Better estimation of DSR bycatch in the commercial halibut fishery.
- Fecundity study specific to southeast Alaska yelloweye rockfish.

SUMMARY

M	0.020
2006 Biomass Estimate	19,558
F_{ofl} ($F_{35\%}$)	0.032
Max F ($F_{40\%}$)	0.026
F_{abc}	0.020
F ($_{avg\ 94\text{-}98}$)	0.020
F ($_{50\%\ F\ max}$)	0.013
Overfishing Level Includes 4.2% for other DSR	650 mt
Maximum Allowable ABC	530 mt
Recommended 2006 ABC Includes 4.2 % for other DSR	410 mt
2007 ABC	410 mt
2007 OFL	650 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. 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 3. Estimates of rockfish catch in the Southeast sportfish fisheries using statewide harvest survey data and creel data: numbers in round pounds. Table provided by Region 1 Sportfish Division, Douglas, AK.

2004 Harvest Weight by Species (Harvest * Avg. Weight)

	PWI	Sitka	Glacier	Total
yelloweye	28567.54	86378.03	21408.24	136353.8
quillback	4479.725	1072.667	642.94	6195.332
copper	6418.913	308.6448	35.258	6762.815
other	5986.481	1861.988	234.362	8082.831
total	45452.66	89621.33	22320.8	157394.8
25% Reduction	34089.49	67216	16740.6	118046.1
Metric Tons	15.49522	30.55273	7.609365	**53.65731**
Expanded for Catch (Total Mortality)				
by Creel Data	28.52803	45.10804	16.22806	89.86413
by Logbook Data	23.19651	39.23506	13.89887	76.33044
by SWHS Catch	41.34009	101.617	27.30603	170.2631

2004 Rockfish Release Estimates (SWHS Est *Creel Catch Expansion)

	PWI	Sitka	Glacier
yelloweye	2746.027	4702.91071	2771.189
quillback	1205.706	163.525844	233.031
copper	1727.633	47.0522475	12.77912
other	1611.245	283.8562	84.94355
Avg Wt			
YE	7	7	7
Other	2.5	2.5	2.5

2004 Released DSR Weight by Species (Harvest * Avg. Weight)

	PWI	Sitka	Glacier	Total
yelloweye	19222.19	32920.375	19398.32	71540.89
quillback	3014.265	408.81461	582.5774	4005.657
copper	4319.082	117.630619	31.94779	4468.661
other	4028.113	709.6405	212.3589	4950.112
total	30583.65	34156.4607	20225.21	84965.32
25% Reduction	22937.74	25617.3455	15168.91	63723.99
Metric Tons	10.42624	11.644248	6.894958	**28.96545**

2004 Total Sport Mortality - Released + Harvested

PWI	Sitka	Glacier	Total
25.92147	**42.1969734**	**14.50432**	**82.62276**

Table 4. Reported landings of demersal shelf rockfish (mt round weight from domestic fisheries in the Southeast Outside Subdistrict (SEO), 1982-2005[a].

	Research	Directed Landings		Bycatch Landings		Total	
YEAR	Catch	AREA 65	AREA 68	AREA 65	AREA 68	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

[a] Landings from ADF&G Southeast Region fishticket database through November 5, 2005.
[b] Estimated unreported DSR mortality associated with halibut fishery and sport fishery not reflected in totals.
[c] No ABC prior to 1987, 1988-1993 ABC for FMP area 65 only.

Table 5. 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 6. 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 7. 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
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
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 8. 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.)	Habitat (km^2)	Point Est (mt)	Biomass L 90% CL (mt)
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		**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		**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		**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		**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		**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		**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		**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		**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		**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		**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		**30453**

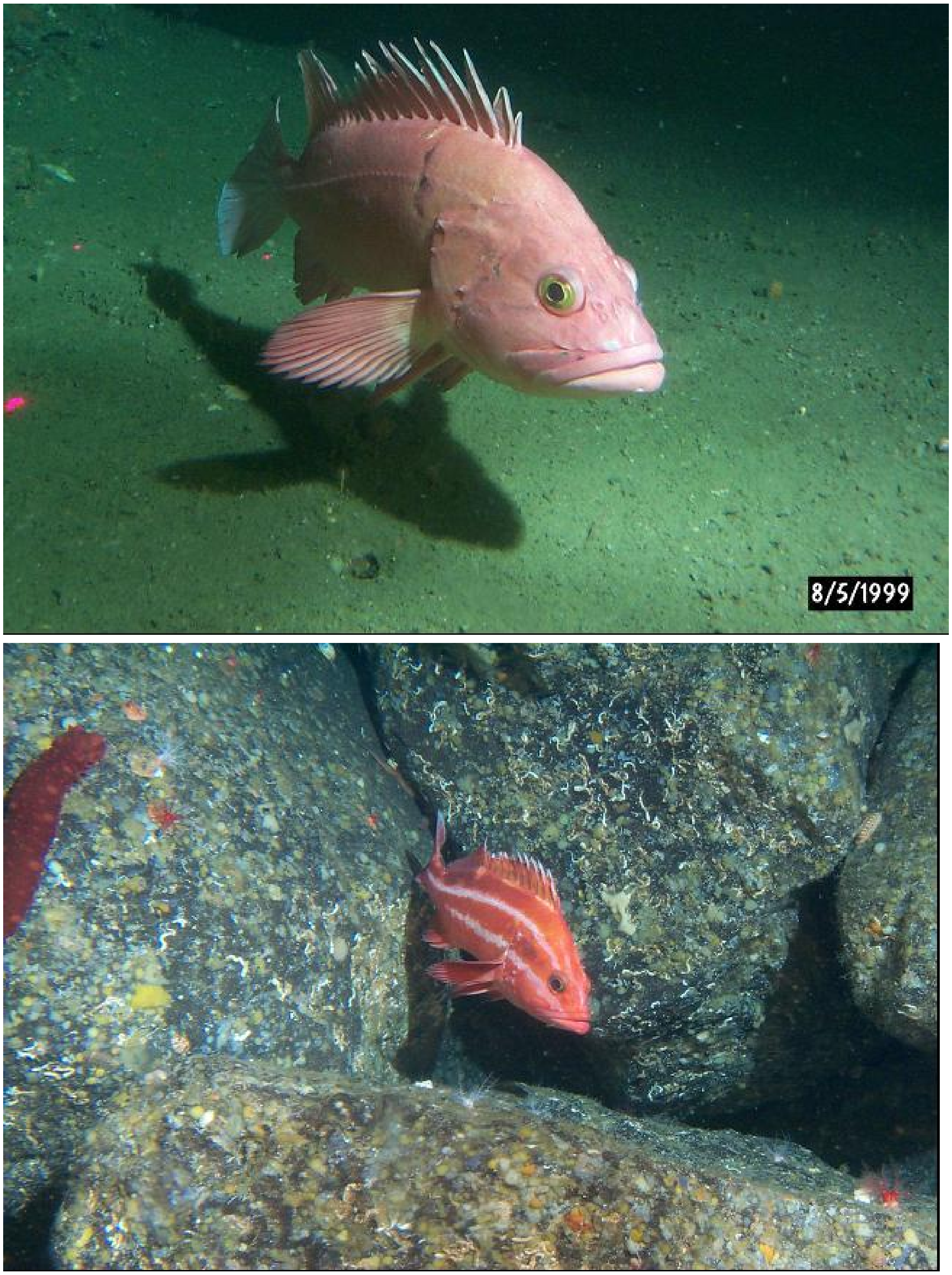


Figure 1. Adult yelloweye rockfish (top panel) and juvenile yelloweye rockfish (lower panel), southeast Alaska.

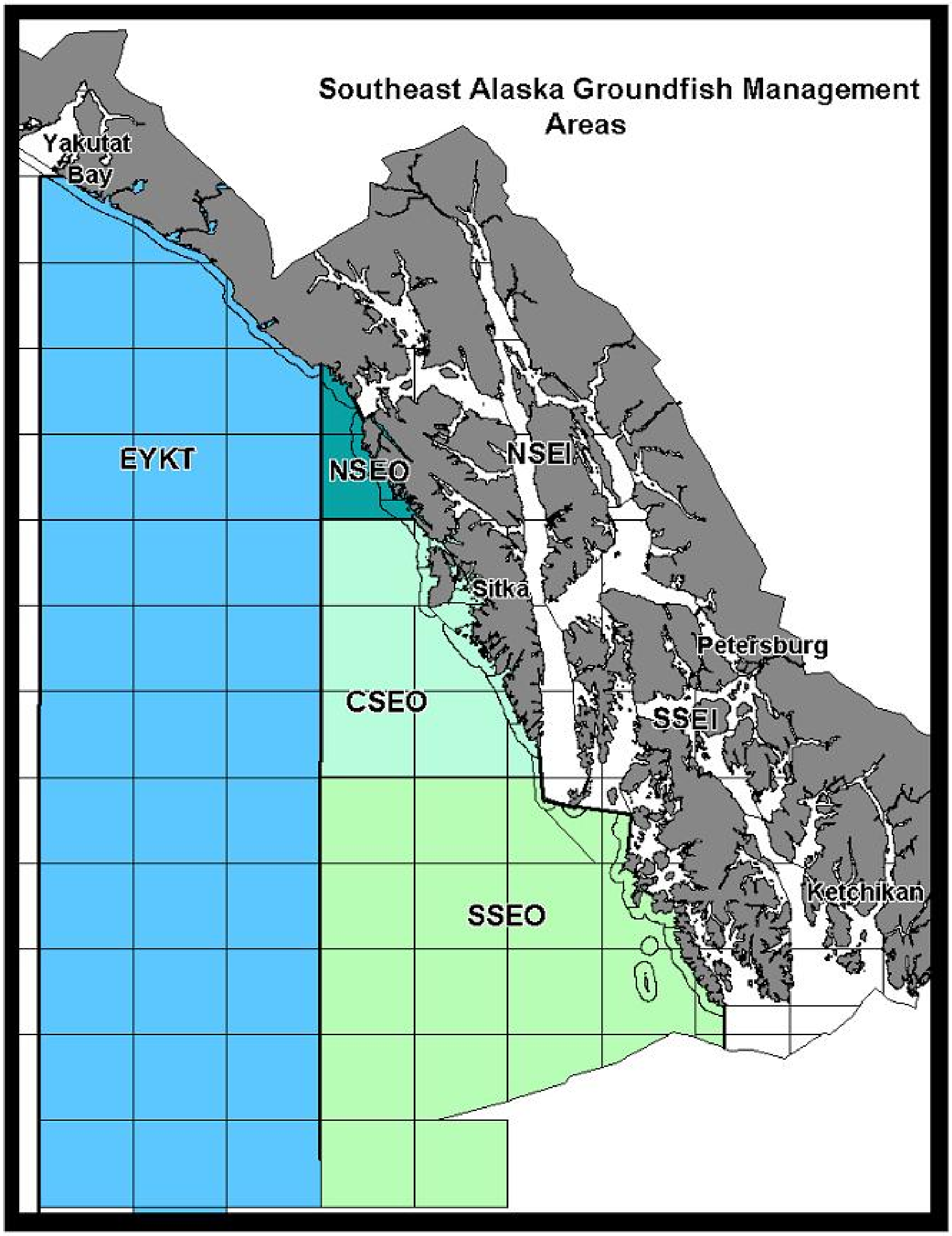


Figure 2. The Eastern Gulf of Alaska with Alaska Department of Fish and Game groundfish management areas: the EYKT, NSEO, CSEO, and SSEO sections comprise the Southeast Outside (SEO) Subdistrict.

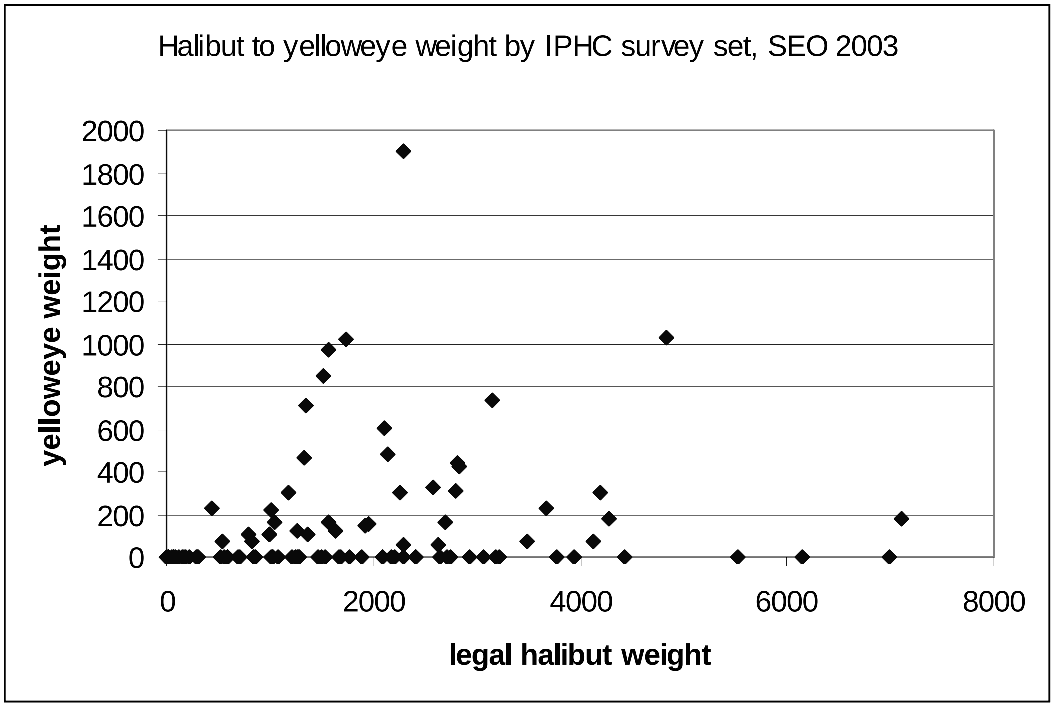


Figure 3. Catch of yelloweye (rd weight) versus halibut rd weight, legal fish) for 2003 IPHC longline survey in SEO survey stations.

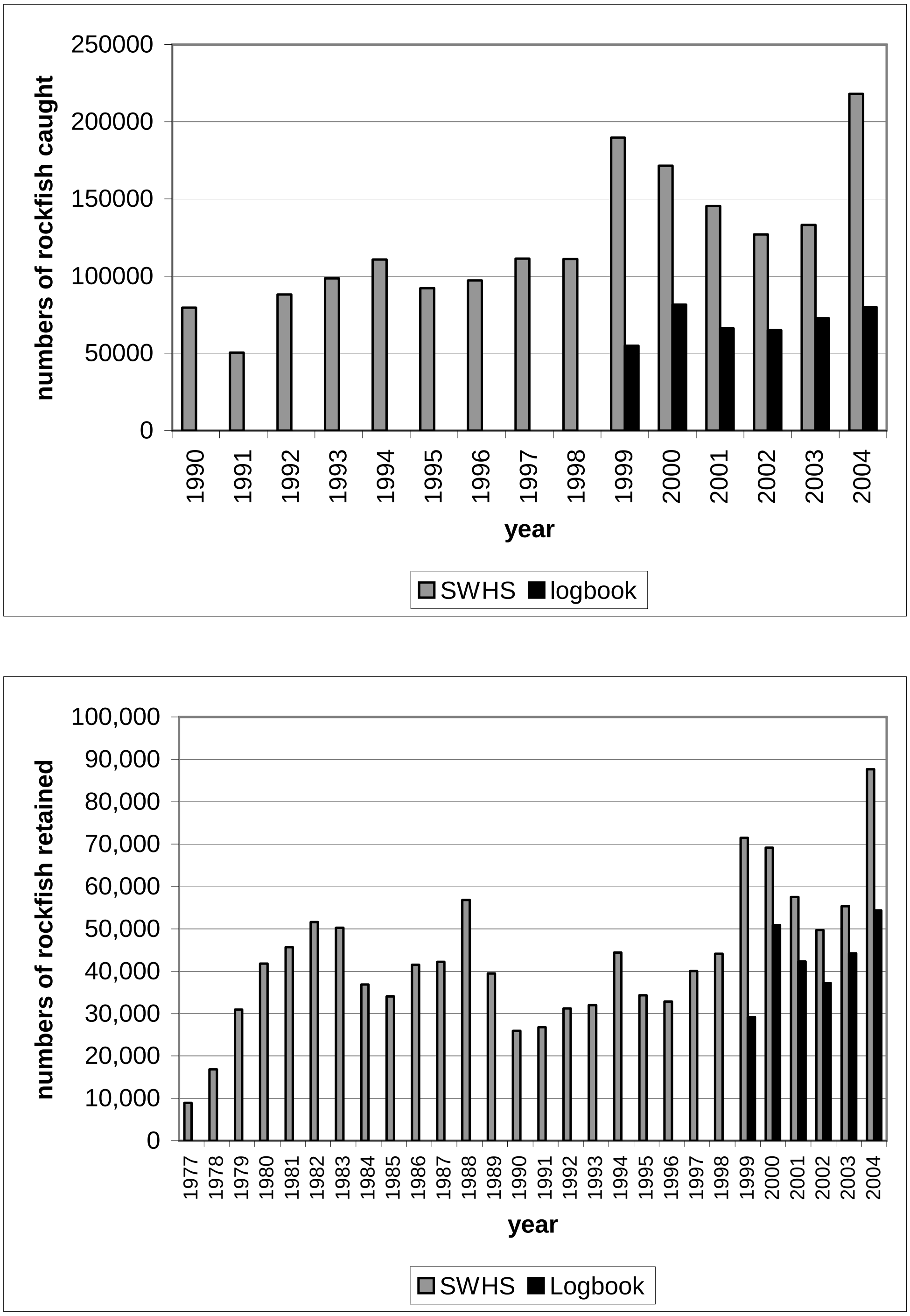


Figure 4. Numbers of rockfish caught and retained in the Southeast Alaska sportfish fishery by year: statewide harvest survey estimates compared with charter logbook data.

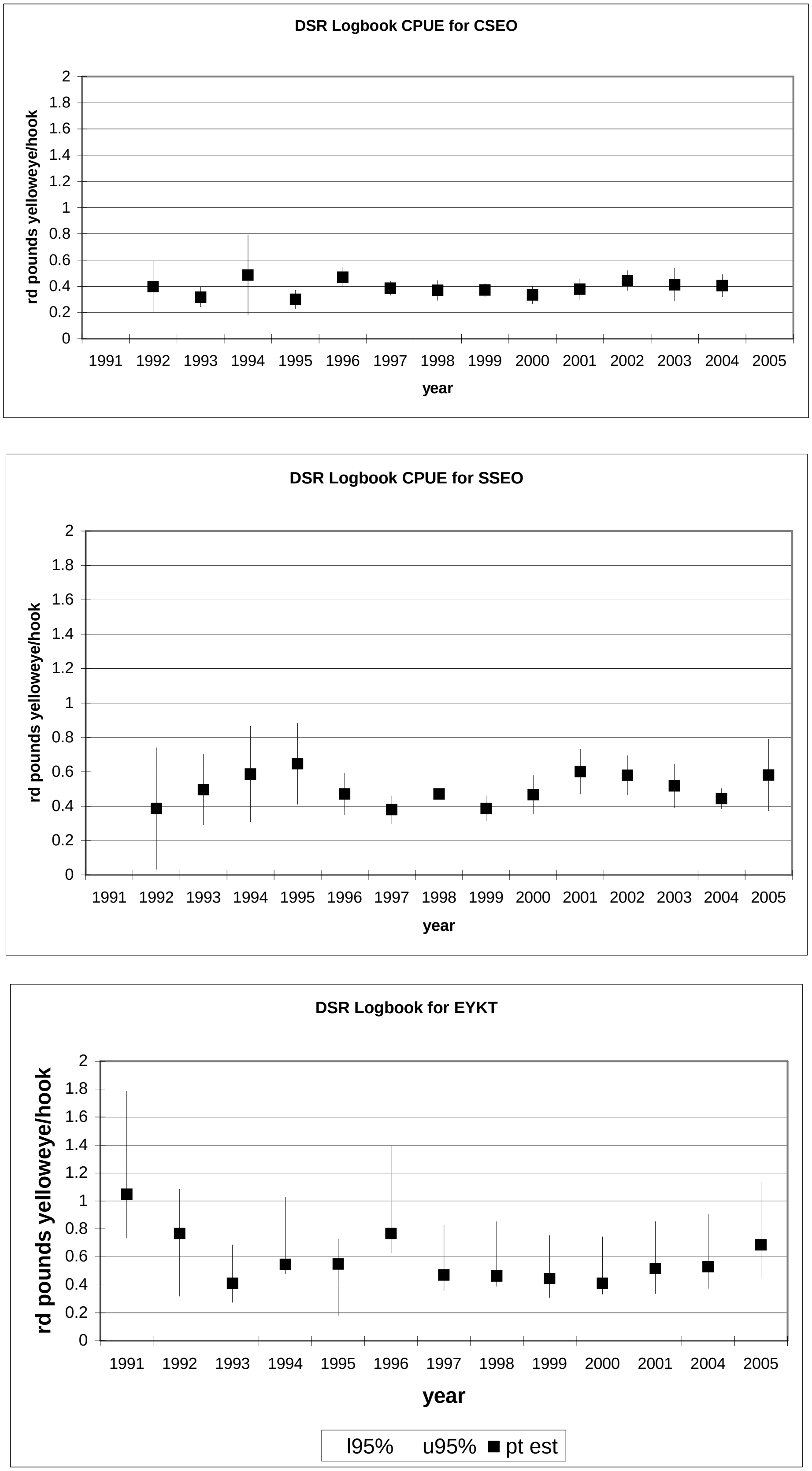


Figure 5. Commercial fishery catch per unit effort data, conventional longline gear, by area, and year.

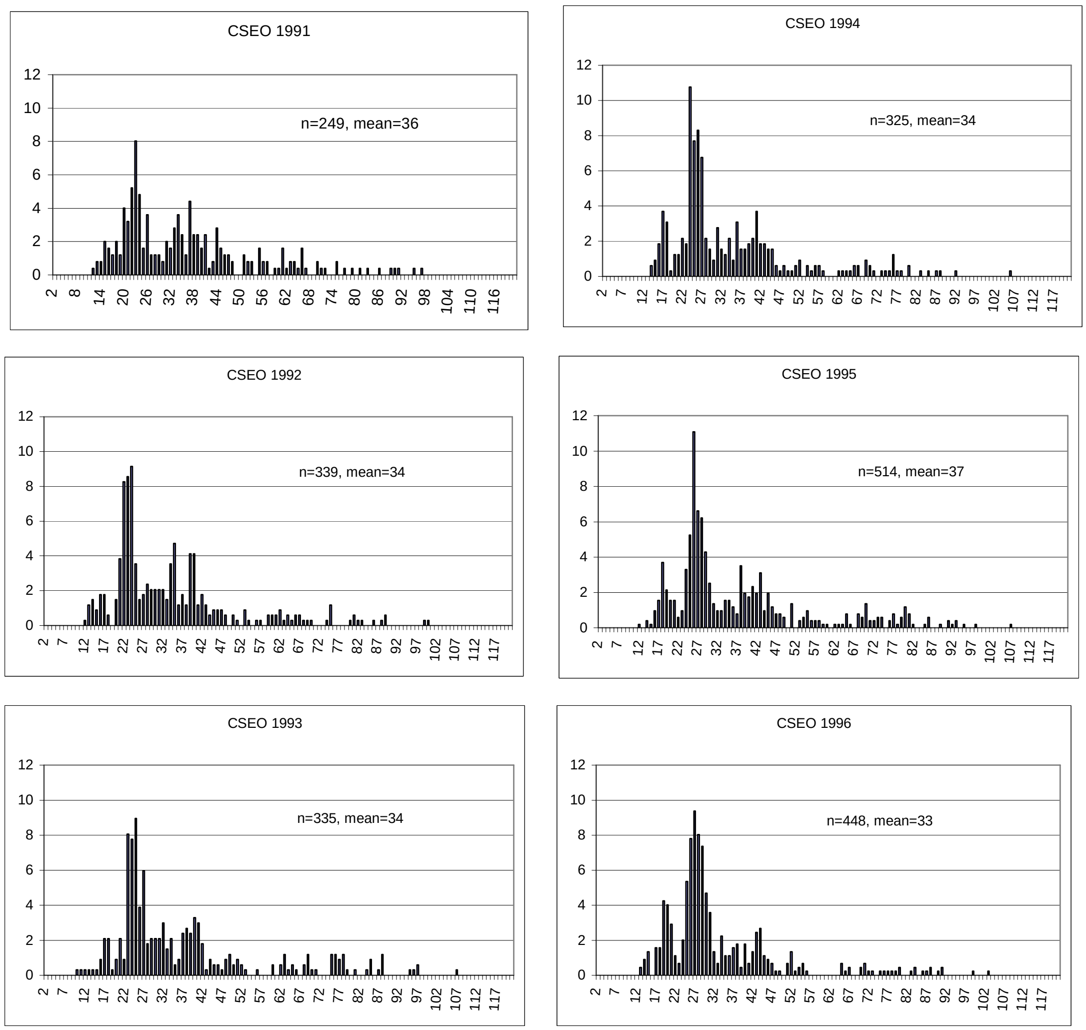


Figure 6a. Yelloweye rockfish age frequency distributions from CSEO port samples, 1991-1996.

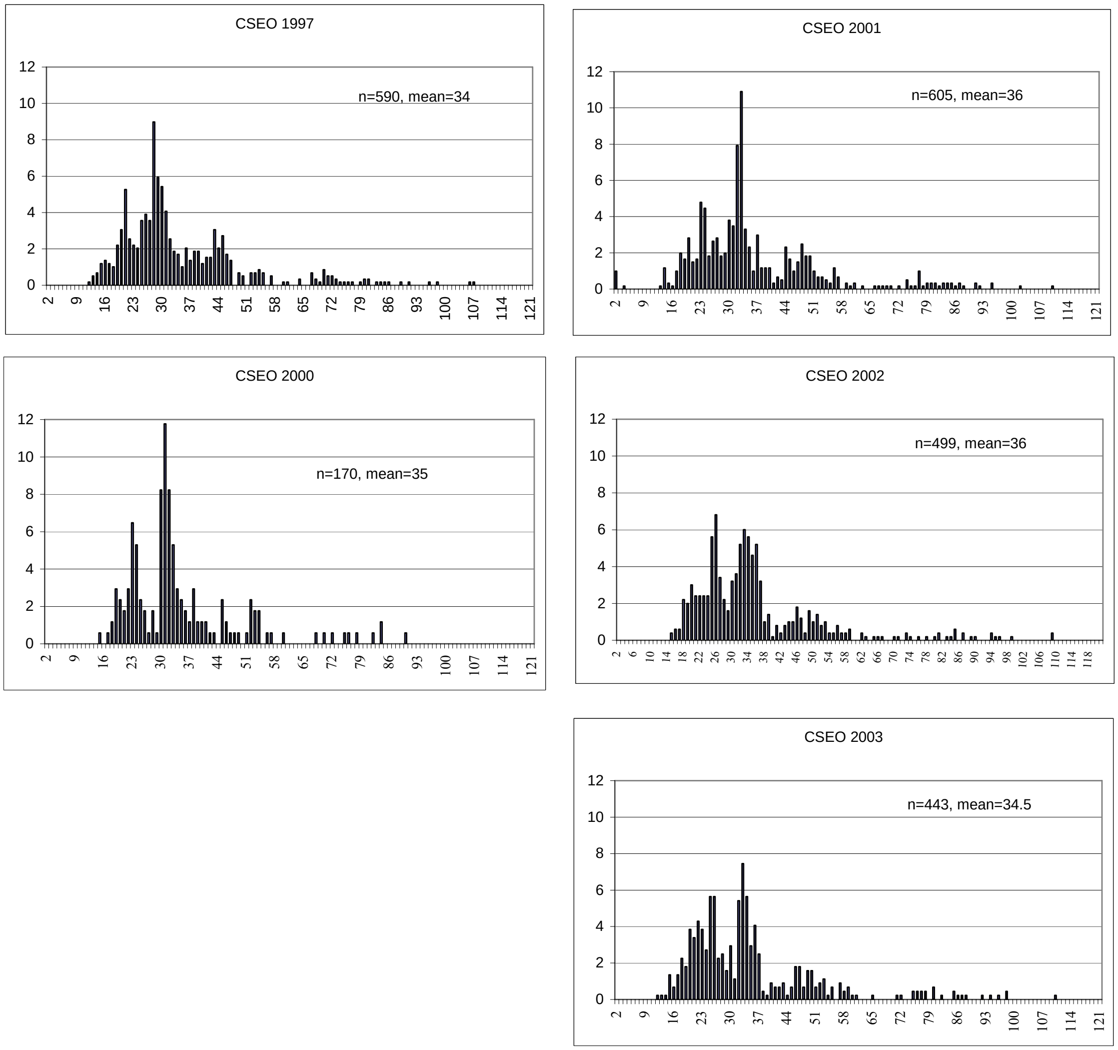


Figure 6b. Yelloweye rockfish age frequency distributions from CSEO port samples, 1997-2003.

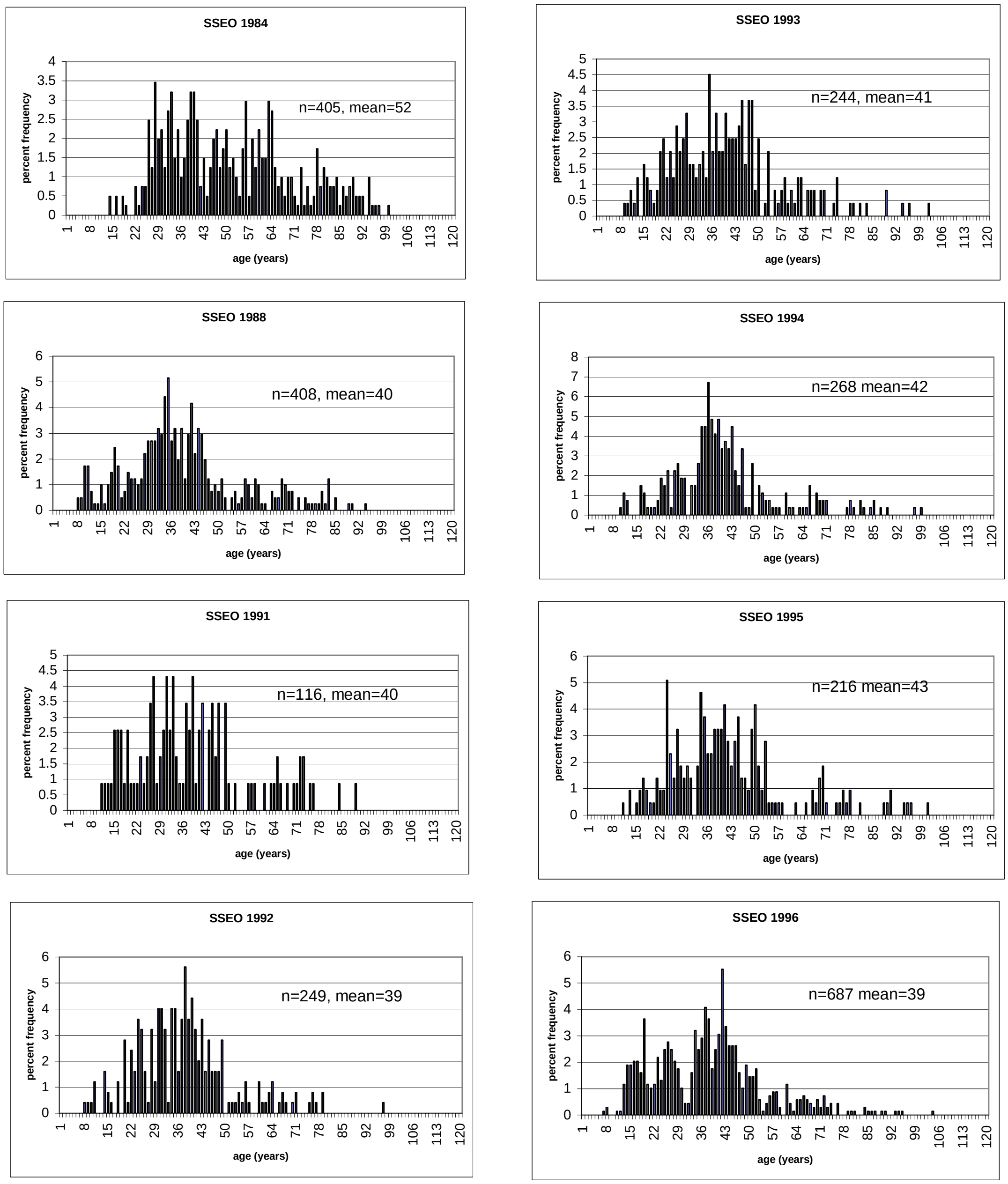


Figure 6c. Yelloweye age frequency distributions from SSEO port samples, 1984-1996.

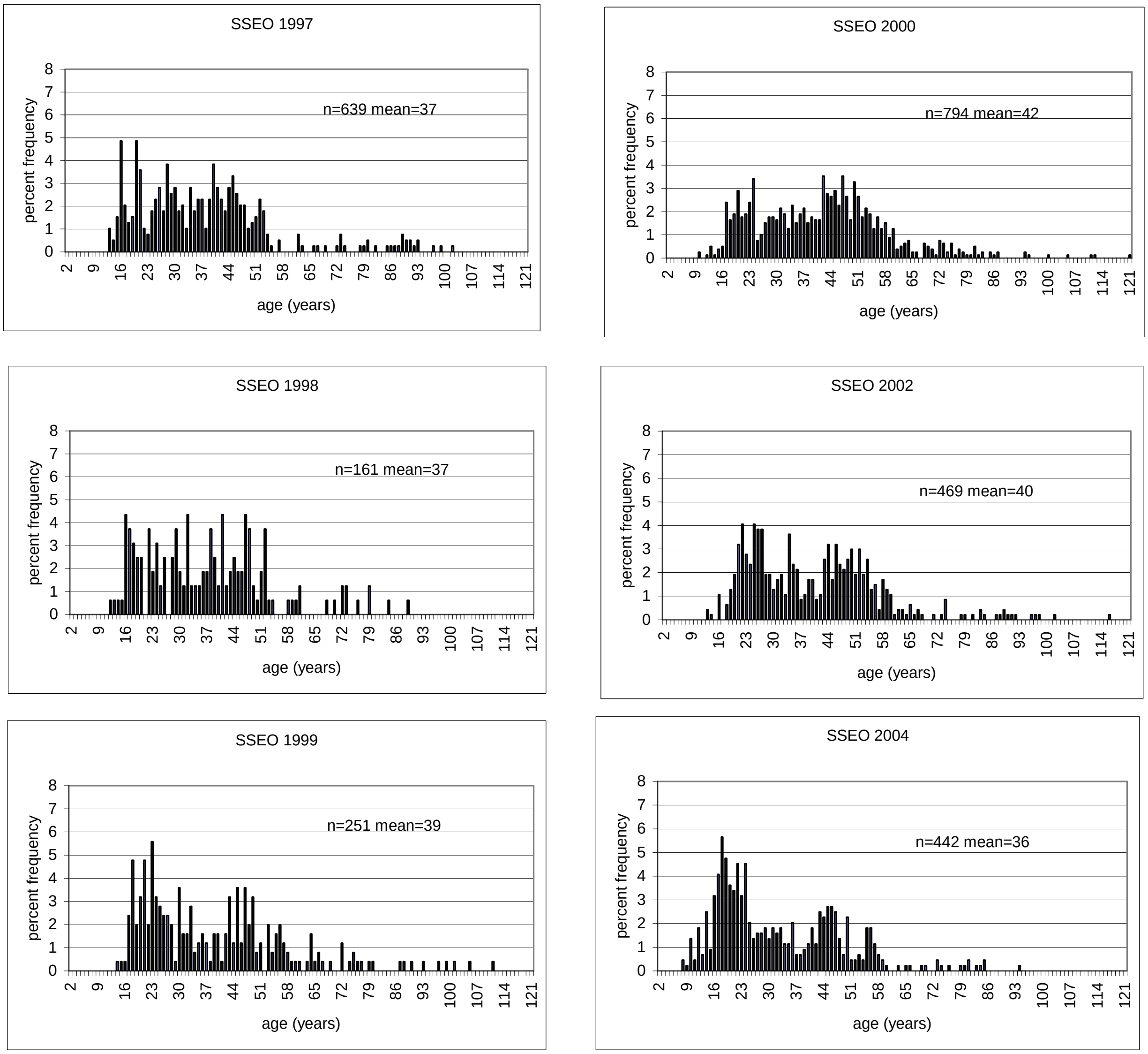


Figure 6d. Yelloweye age frequency distributions from SSEO port samples, 1997-2004.

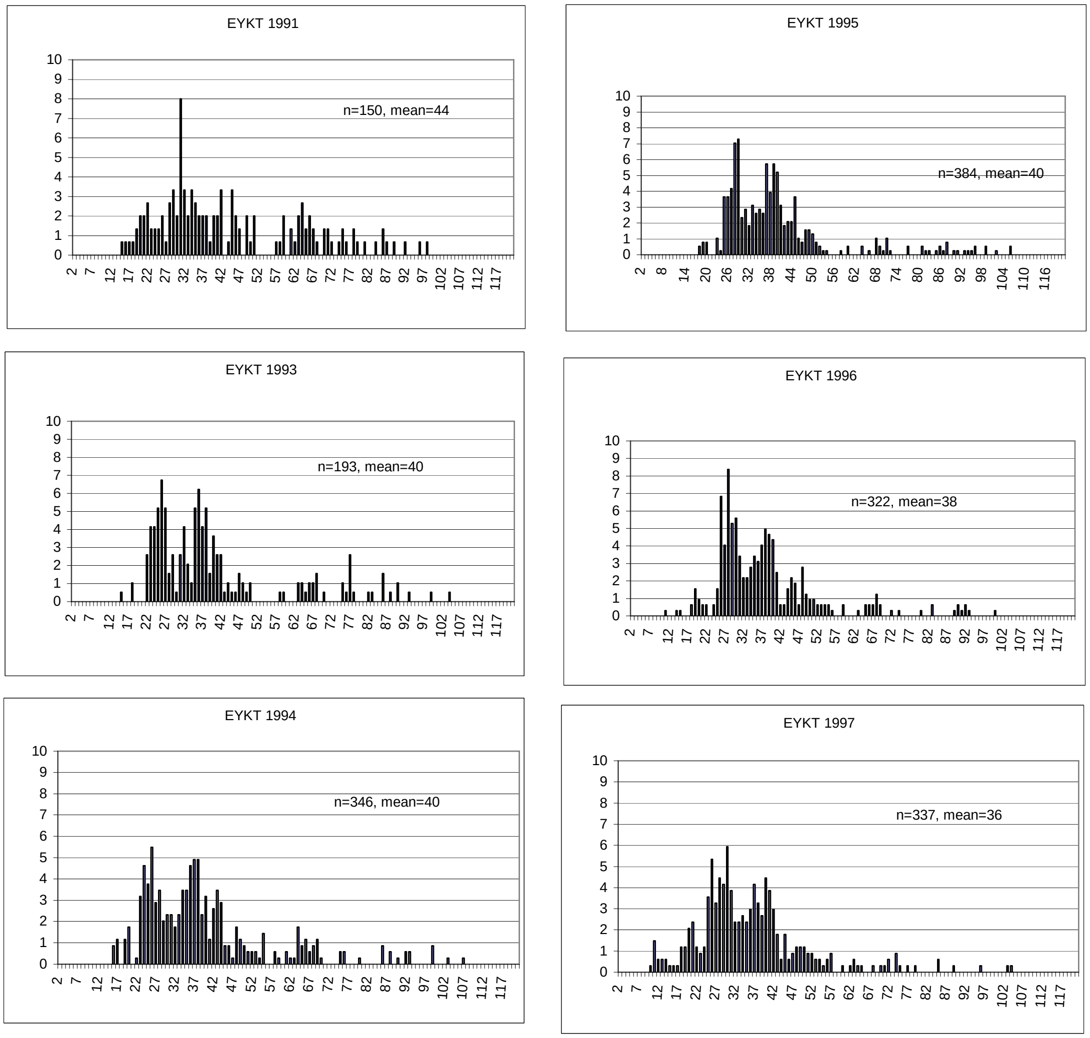


Figure 6e. Yelloweye rockfish age frequency distributions from EYKT commercial port samples, 1991-1997.

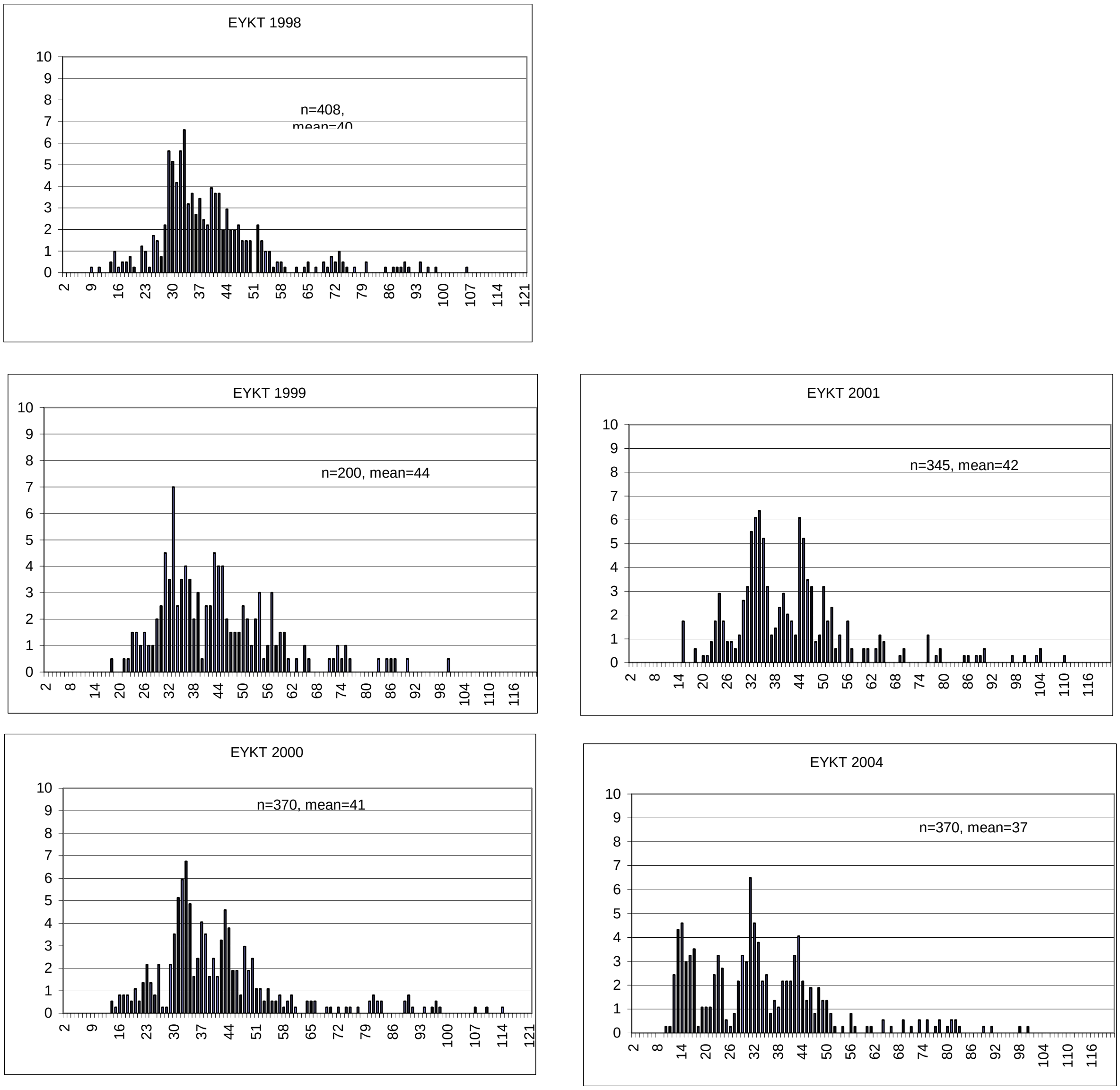


Figure 6f. Yelloweye rockfish age frequency distributions from EYKT commercial port samples, 1998-2004.

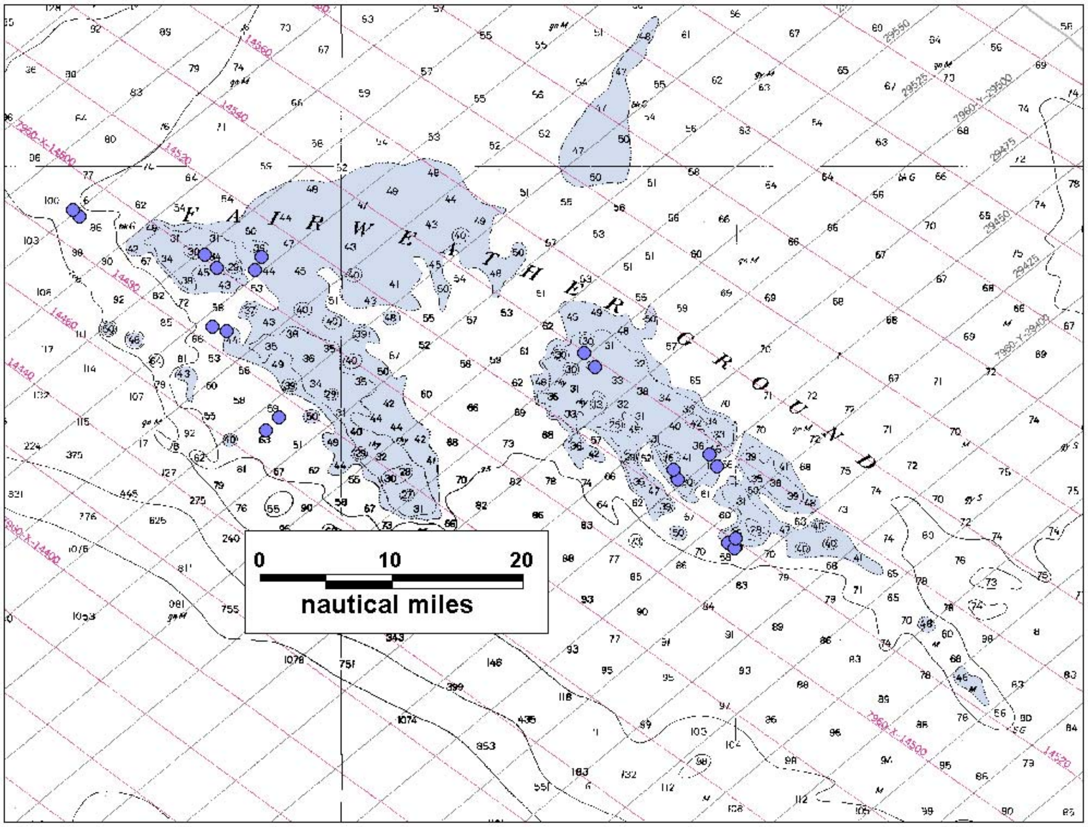


Figure 7. Start locations for line transect dives in EYKT during 2003.

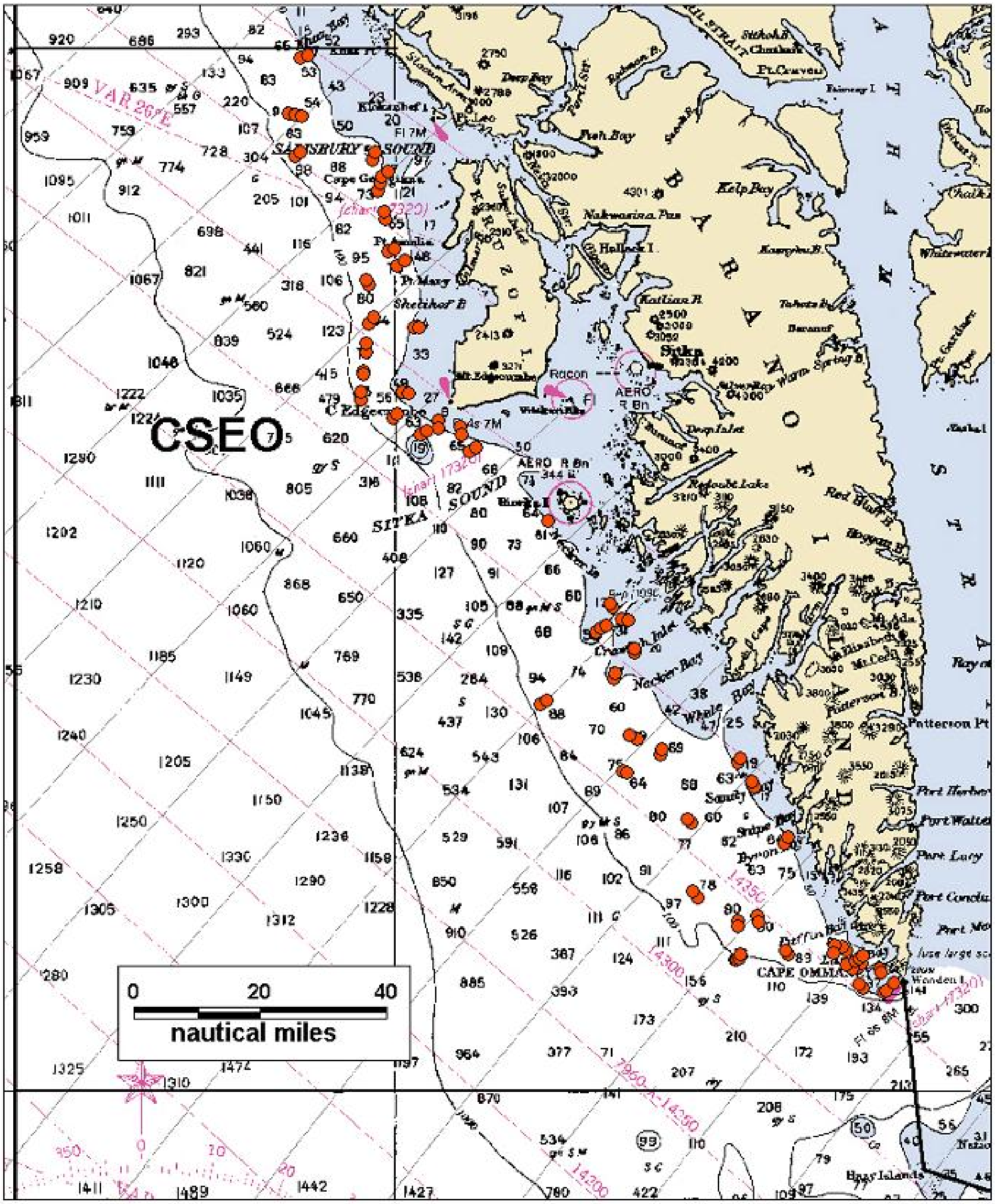


Figure 8. Start location for line transect submersible dives in CSEO during 2003.

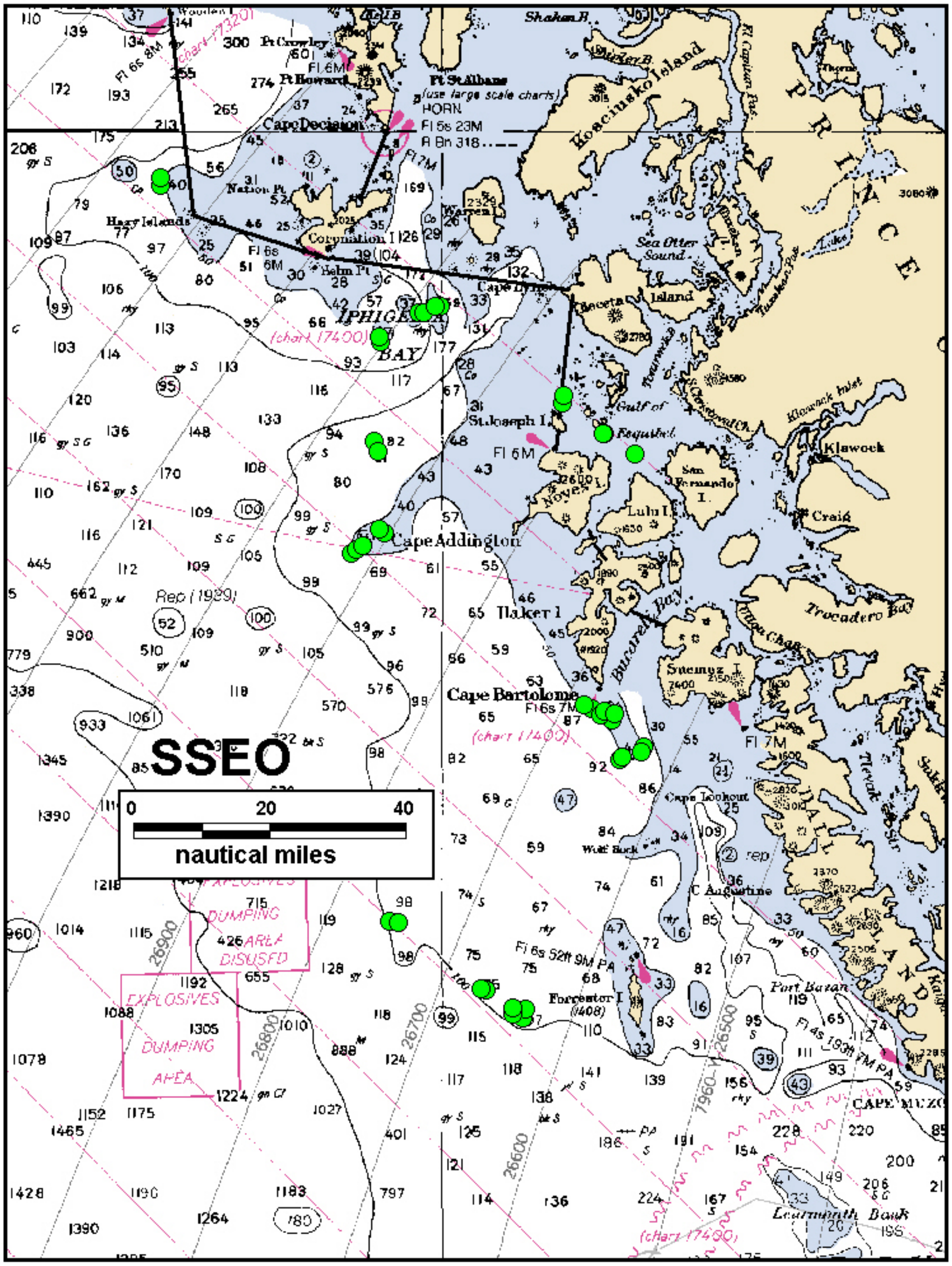


Figure 9. Start locations for line transect submersible dives SSEO 2005.

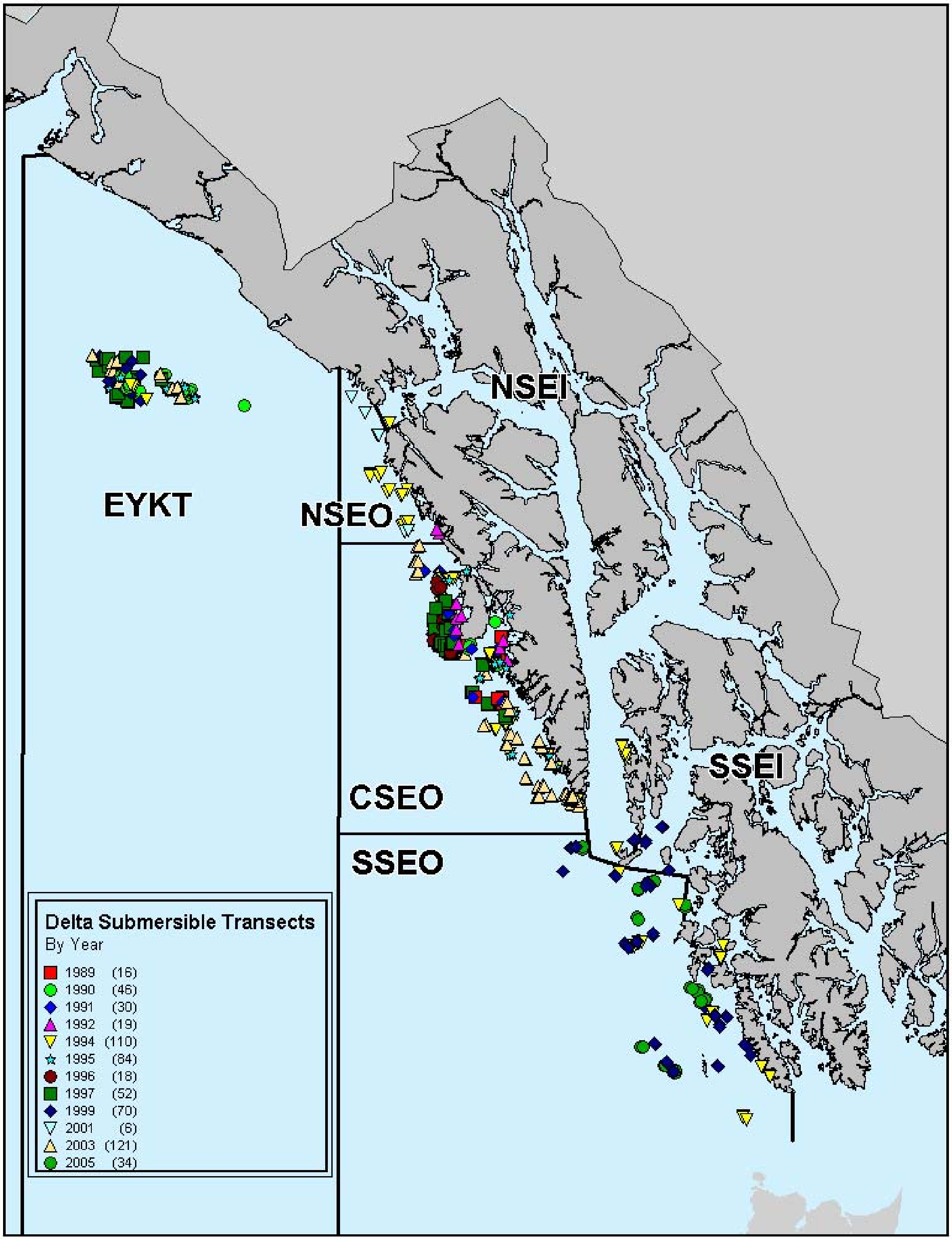
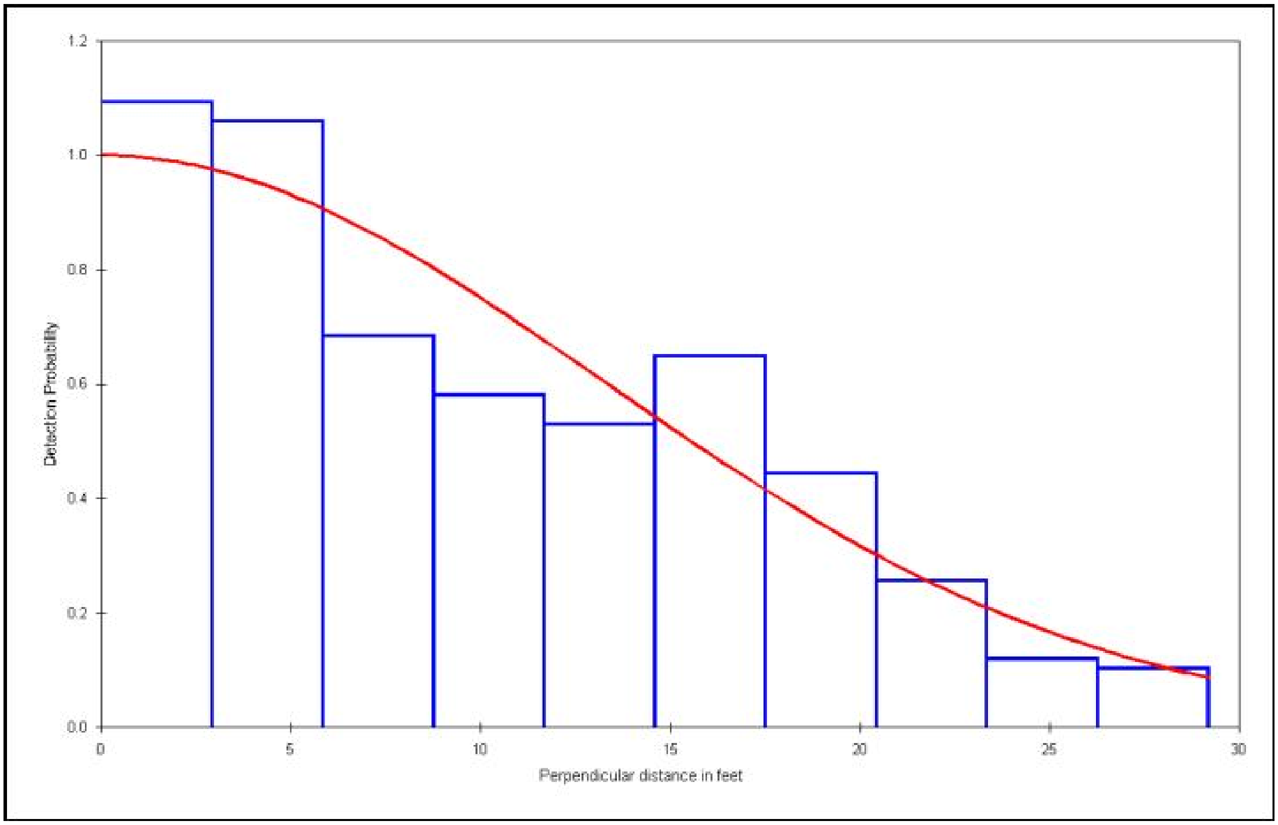


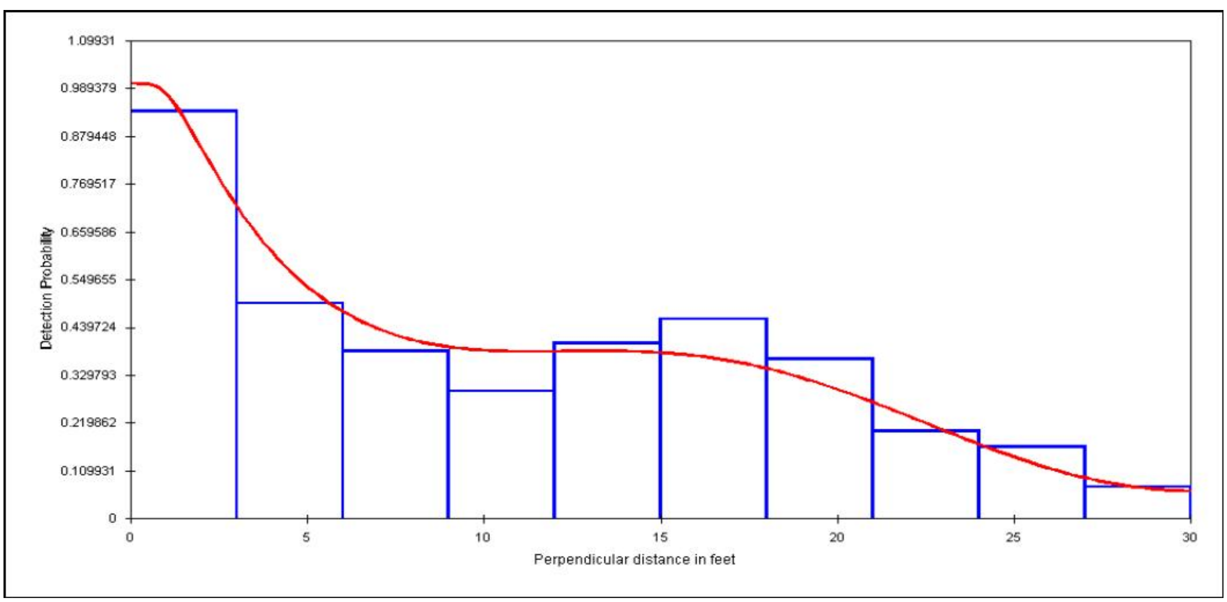
Figure 10. Start locations for submersible research dives in SEO, all years.

APPENDIX I. DISTANCE OUTPUT FOR 2005 ASSESSMENT

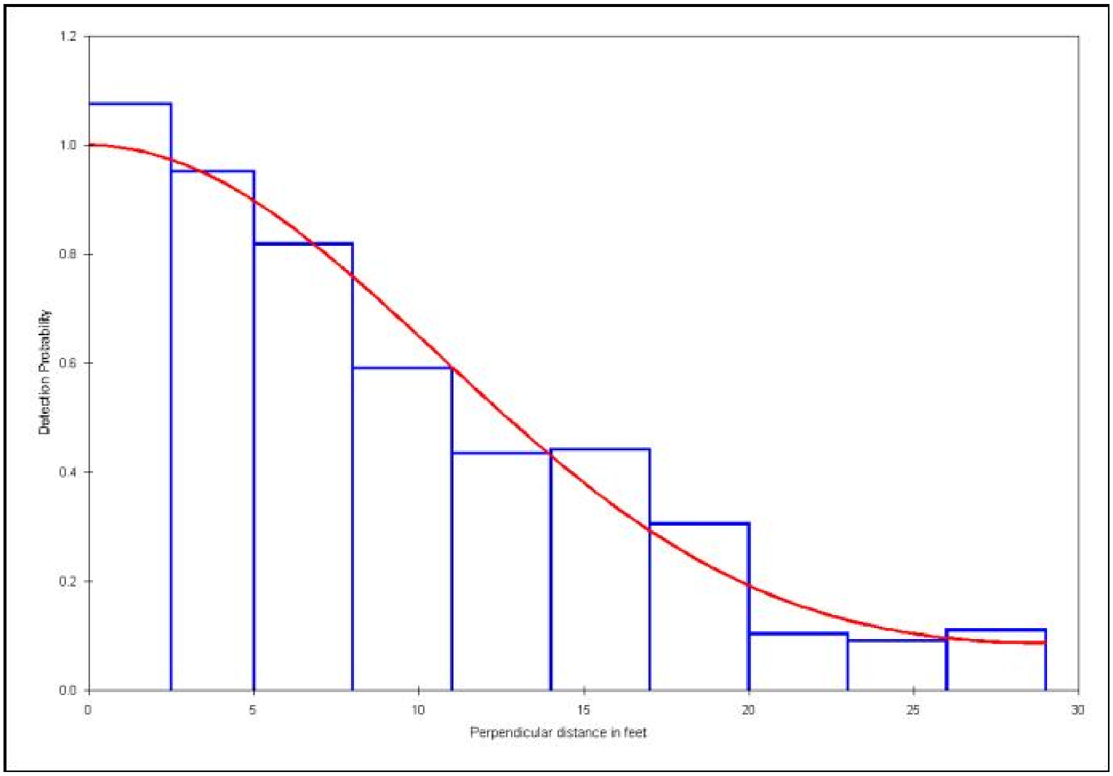
Appendix A1. 2003 EYKT Probability Detection Function, best fit.



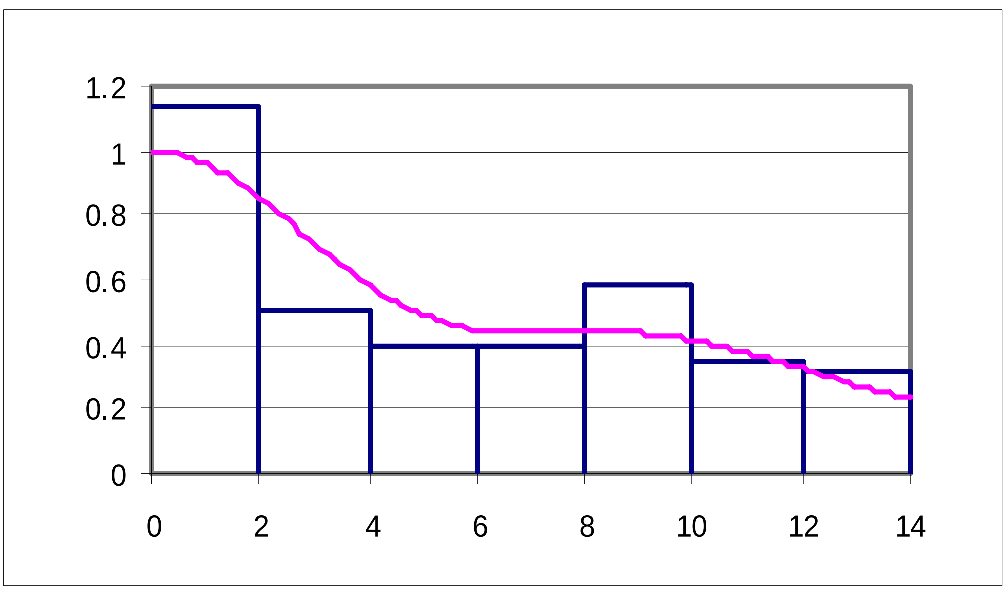
Appendix A2. 1999 EYKT Probability Detection Function.



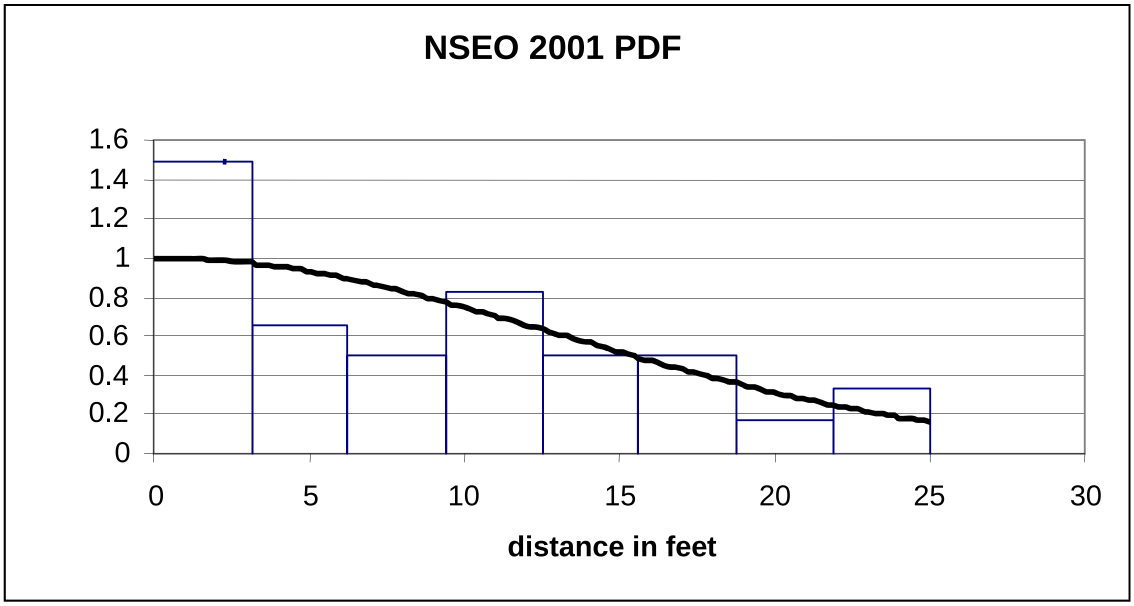
Appendix A3. 2003 CSEO Probability Detection Function, best fit.



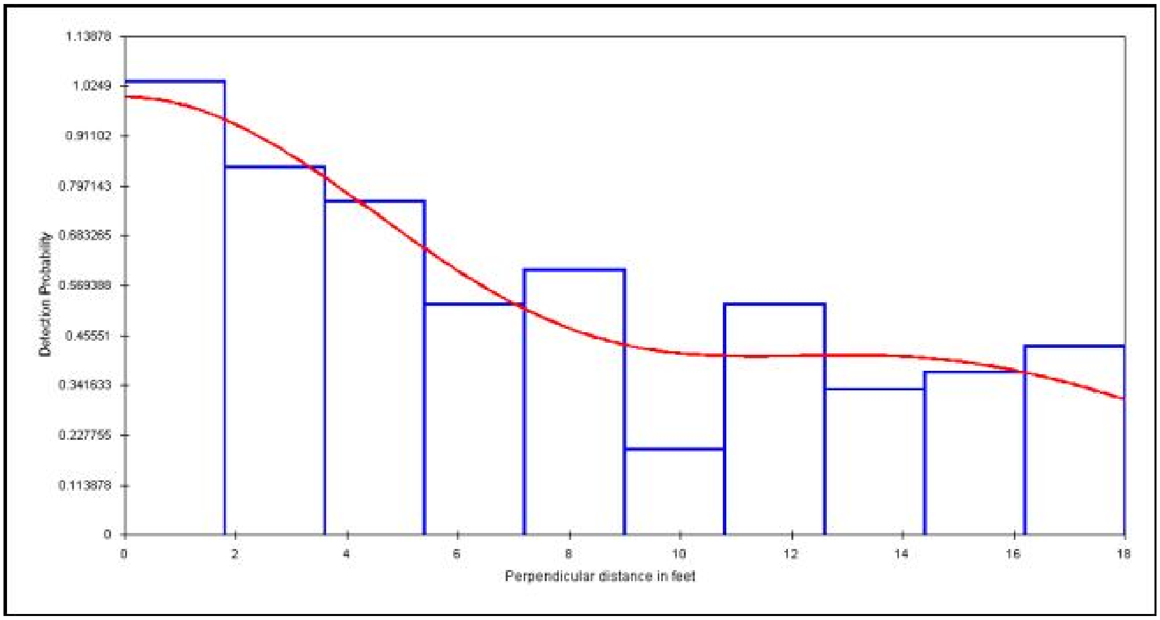
Appendix A4. 1997 CSEO Probability Detection Function.



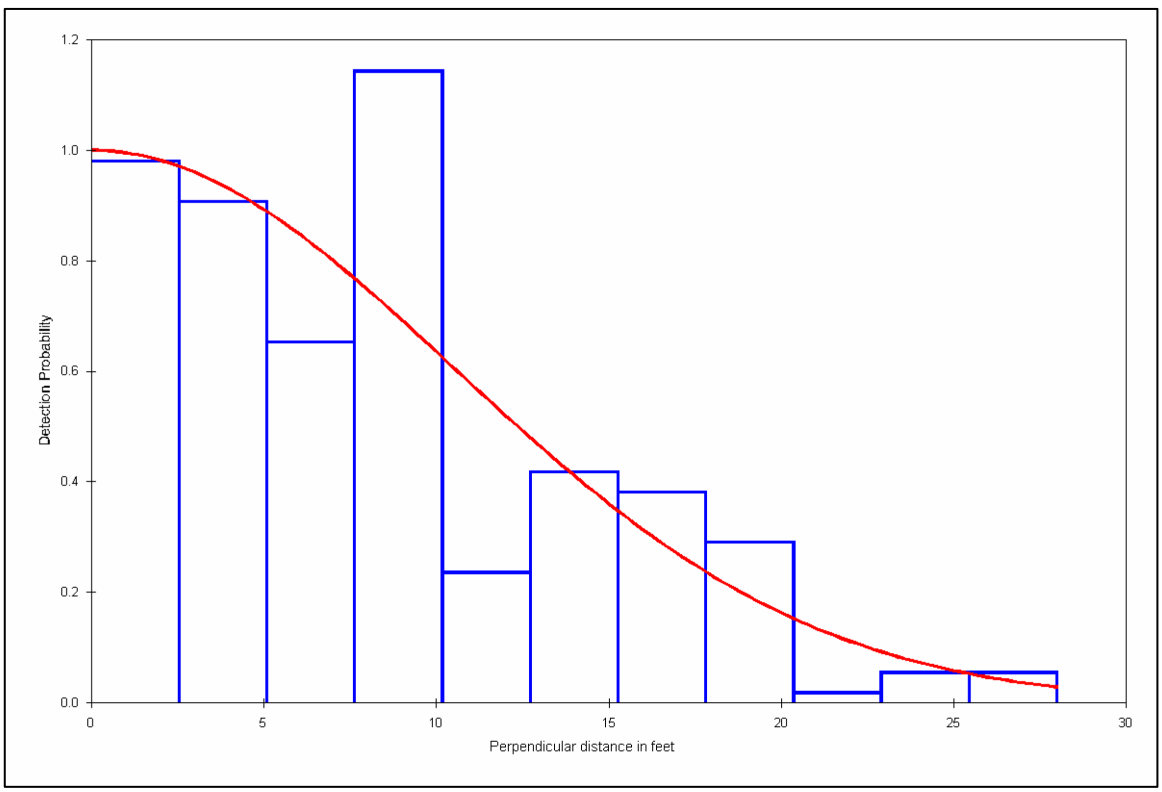
Appendix A5. 2001 NSEO Probability Detection Function.



Appendix A6. 1999 SSEO Probability Detection Function.



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



Appendix B1.

November 2005 SAFE

From Program DISTANCE 4.1

Area	Detection Function Description	Density [D] (no./km2)	s.e. [D]	CV(D)	AIC	Chi-square	k	L
CSEO 2003 LT with 2002/3 wt update	uniform cosine	1864.7	209.21	0.1122	2950.5	0.048015	102	90275
EYKT 2003 lt habitat updated from 2002 mb	half normal cosine	3557.2	611.84	0.172	1378.5	0.15468	20	18503
NSEO 2001 LT		1420	446.4	0.3144	188.59	0.69	6	4474
SSEO Run 14	hazard rate	2196.3	376.93	0.1716	955.76	0.35801	33	29907

Detection functions were investigated with differeing truncations, models etc. the function judged to provide the best fit was used in estimating biomass.

Area	n/L	s.e. n/L	f(0)	n	var(n)	cv[f(0)]	cv(n)	df
CSEO 2003 LT with 2002/3 wt update	0.0078205	0.00082914	0.072675	706	5602.614341	0.0367	0.1060207	126.4
EYKT 2003 lt habitat updated from 2002 mb	0.017456	0.002863	0.062111	323	2806.254105	0.0461	0.16400647	23
NSEO 2001 LT	0.0067054	0.0018	0.0645	30	65.79419	0.1604	0.2704	9
SSEO Run 14	0.0094292	0.0016089	0.070996	282	2315.281517	0.0184	0.17062898	32.7

Area	95% Lower	95% Upper	90% Lower	90% Upper	Area	Weight	·or Mean Wt.	CV[w]
CSEO 2003 LT with 2002/3 wt update	1494.458157	2326.666741	1549.248806	2244.381972	CSEO	2.9589	0.05922	0.020014194
EYKT 2003 lt habitat updated from 2002 mb	2498.65952	5064.184112	2654.704373	4766.508833	EYKT (All)	4.046	0.062595	0.015470835
NSEO 2001 LT	709.0695131	2843.726832	808.8923166	2492.791634	NSEO	2.98	0.09533	0.031989933
SSEO Run 14	1552.286211	3107.502764	1645.715633	2931.085779	SSEO	3.16	0.072898	0.023068987

Area	Area of Rocky Habitat (km2) [A] (2003 estimate)	Biomass (kg) for Area [bk]	Biomass (mt) for Area [bm]	Var(biomass) for Area [Var(bk)]	CV(bk)	Lower 90% CL (kg) [l90]		Upper 90% CL (kg) [u90]
CSEO 2003 LT with 2002/3 wt update	1414	7801689.614	7801.689614	7.90618E+11	0.113971084	6471853.019	CSEO	9404781.081
EYKT 2003 lt habitat updated from 2002 mb	742	10679183.95	10679.18395	3.4012E+12	0.172694374	8055045.806	EYKT (All)	14158202.52
NSEO 2001 LT	472	1997315.2	1997.3152	3.98411E+11	0.316023284	1202336.822	NSEO	3317928.834
SSEO Run 14	732	5080305.456	5080.305456	7.73736E+11	0.173143692	3829180.004	SSEO	6740216.834

Area	Lower 90% CL (mt)	Upper 90% CL (mt)	yelloweye F=.02, mt	DSR TAC (ye/.96), mt	
CSEO 2003 LT with 2002/3 wt update	6471.85	9404.78	129.44	134.83	
EYKT 2003 lt habitat updated from 2002 mb	8055.05	14158.20	161.10	167.81	
NSEO 2001 LT	1202.34	3317.93	24.05	25.05	
SSEO Run 14	3829.18	6740.22	76.58	79.77	407.47

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