# Chapter 11

## Assessment of the Other flatfish stock complex in the Bering Sea and Aleutian Islands

by

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## Executive Summary

Changes in the input data

1) The 2011 catch (total and discarded) was updated, and catch through 15 October, 2011 were included in the assessment.

2) The 2011 Eastern Bering Sea trawl survey biomass estimates and standard errors of other flatfish species are included in the assessment.

| **Quantity** | As estimated or *specified last* year for: 2011 | 2012 | As estimated or *recommended this* year for: 2012 | 2013 |
|---|---|---|---|---|
| *M* (natural mortality rate) for rex sole | 0.17 | 0.17 | 0.17 | 0.17 |
| *M* (natural mortality rate) for Dover sole | 0.085 | 0.085 | 0.085 | 0.085 |
| *M* (natural mortality rate) for all others | 0.15 | 0.15 | 0.15 | 0.15 |
| Tier | 5 | 5 | 5 | 5 |
| Biomass (t) | 127,329 | 127,329 | **111,060** | 111,060 |
| $F_{OFL}$ (F=M)for rex sole | 0.17 | 0.17 | 0.17 | 0.17 |
| $F_{OFL}$ (F=M)for Dover sole | 0.085 | 0.085 | 0.085 | 0.085 |
| $F_{OFL}$ (F=M)for all other species | 0.15 | 0.15 | 0.15 | 0.15 |
| $maxF_{ABC}$ for rex sole | 0.13 | 0.13 | 0.13 | 0.13 |
| $maxF_{ABC}$ for Dover sole | 0.064 | 0.064 | 0.064 | 0.064 |
| $maxF_{ABC}$ for all other species | 0.113 | 0.113 | 0.113 | 0.113 |
| $F_{ABC}$ for rex sole | 0.13 | 0.13 | 0.13 | 0.13 |
| $F_{ABC}$ for Dover sole | 0.064 | 0.064 | 0.064 | 0.064 |
| $F_{ABC}$ for all other species | 0.113 | 0.113 | 0.113 | 0.113 |
| OFL (t) | 19,500 | 19,500 | **17,130** | 17,130 |
| maxABC (t) | 14,500 | 14,500 | **12,740** | 12,740 |
| ABC (t) | 14,500 | 14,500 | **12,740** | 12,740 |
| **Status** | As determined *last* year for: 2011 | 2012 | As determined *this* year for: 2012 | 2013 |
| Overfishing | n/a | n/a | n/a | n/a |

**No SSC comments from December 2011.**

## Introduction

The Bering Sea/Aleutian Islands "other flatfish" group have typically included those flatfish besides rock sole, yellowfin sole, arrowtooth flounder, Kamchatka flounder and Greenland turbot. Flathead sole (*Hippoglossoides elassodon*) were part of the other flatfish complex until they were removed in 1995, and Alaska plaice was removed from the complex in 2002, as sufficient biological data exists for these species to construct age-structured population models. In contrast, survey biomass estimates are the principal data source used to assess the remaining other flatfish. Although over a dozen species (Table 11.1) of flatfish are found in the BSAI area, the other flatfish biomass consists primarily of starry flounder, rex sole, longhead dab, Dover sole and butter sole.

## Catch History

The miscellaneous species of the other flatfish species category are listed in Table 11.1, and their catches from 1995-2011 are shown in Table 11.2 (with historical ABC and TAC). These species are not pursued as fishery targets but are captured in fisheries for other flatfish species and Pacific cod. Catch from 1995-2003 were obtained from the NMFS Regional Office "blend" data, and the catch for some species are reported by species and in an aggregate flatfish group. The catch estimates for these years were produced by applying the proportional catch, by species, from fishery observer data to the estimated total catch for the aggregate other flatfish group, and adding this total to the catch that was reported by species. In the newer catch accounting system (in use since 2003), catches of other flatfish are reported only in an aggregate group, and the catch estimates for these years were produced by applying the proportional catch, by species, from fishery observer data to the estimated total catch of the aggregate group. In recent years, starry flounder (*Platichthys stellatus*) and rex sole (*Glyptocephalus zachirus*) account for most of the harvest of other flatfish, contributing 95% of the harvest of other flatfish in 2011.

Other flatfish fisheries are grouped with Alaska plaice, rock sole, and flathead sole in a single prohibited species group (PSC) classification, with seasonal and total annual allowances of prohibited bycatch applied to the group. In past years, this group of fisheries was closed due to the bycatch of halibut (Table 11.3). In 2007 the other flatfish harvest was subject to 3 closures. The first and second seasonal closures were imposed to prohibit further halibut retention, and the annual halibut cap closure as detailed in Table 11.3. There have been no closures since 2007.

# DATA

### Absolute Abundance and Exploitation Rates

The biomass of the other flatfish complex on the eastern Bering Sea shelf was relatively stable from 1983-1995, averaging 54,274 t, and then increased from 1996 to 2003, averaging 84,137 t (Table 11.4). Since 2003 the biomass estimates have been at a higher level averaging 115,000 t. The 2011 shelf survey estimate of 94,217 t, although lower than most years since 2002, is still at a high level relative to the time-series of observations since 1982. The estimated increases from the past five years are primarily due to the higher estimates of starry flounder on the Eastern Bering Sea shelf. In years when an AI survey was not conducted (2011) total BSAI biomasss was calculated by fitting a linear trend to the observed survey data (1991-2010 for this assessment), and then adding the predicted AI biomass estimate to the observed EBS estimate. For this assessment, the linear model estimates were incorporated to account for the Aleutian Islands biomass in the absence of any Aleutian Islands survey. Individual species biomass estimates for the EBS and AI areas from 1997-2011 are shown in Table 11.5. Estimates of total BSAI biomass (Table 11.6) were then used to compute species-specific exploitation rates (catch/biomass).

Exploitation rates for starry flounder and rex sole have been low, not exceeding 0.05 from 1997 to 2011 (Table 11.6). The exploitation rates for butter sole have been higher, exceeding 0.14 in 1997, 2000, 2001, and 2003-2009 and 2011. In 2008 the butter sole catch exceeded the trawl survey biomass estimate. However these biomass estimates calculated for butter sole have large sampling variances, with coefficients of variation ranging from 0.44 to 0.86 in recent EBS trawl surveys dating back to 1999. The 2011 exploitation rate is 0.18.

Closer inspection of the butter sole biomass variability suggests that occasional high exploitation rates may be an artifact of survey sampling. The 2003 and 2008 biomass estimates of butter sole were 429 t and 541 t, respectively, unusually low relative to biomass estimates from the past 20 years. These estimates are less than one-fourth the 2002 estimate of 2382, and result in estimated exploitation rate of nearly 70% in 2003 and 1.14 in 2008. However, butter sole were only captured in four hauls in the 2003 EBS trawl survey and in six hauls in the 2008 survey, causing a large coefficient of variation of 0.61 for the estimated biomass. Thus, it is likely that the population of butter sole is larger than that indicated from the survey, and the comparison of survey biomass to harvest should be interpreted accordingly. Biomass estimates since 2003 have been much higher, and variable. The 2011 biomass estimate of 437 for butter sole was twice as large as the 2003 estimate, with a high CV from the shelf survey (0.69).

The timing of the butter sole fishery catches do not overlap with survey sampling and came primarily from waters less than 50 m in January and February, a depth and time not covered by the trawl survey. Butter sole are mostly caught by non-pelagic trawl catcher-processors in the rock sole and Pacific cod target fisheries in areas 509 and 516. The center of abundance for butter sole in Alaska is in the Gulf of Alaska whereas the survey and fishery catches on the north side of the Alaska Peninsula represent butter sole captured at the periphery of their distribution, where they are relatively rare.

Several other species in this management category are relatively rare on the EBS shelf, including Dover sole, Sakhalin sole, and English sole, and it is useful to identify whether the EBS represents the edge of the distribution for these species. The distribution of English sole has been identified as Baja California to Unimak Island, and the distribution of Dover sole has been identified as from Baja California to the Bering Sea (Hart 1973). Thus, the eastern Bering Sea can be considered the periphery of the range for these species. They are much more abundant in the Gulf of Alaska. For example, the abundance of Dover sole in the 1984-2009 GOA surveys has fluctuated between 63,000 t and 99,000 t, the abundance of butter sole has fluctuated between 17,000 t and 31,000 t, and the abundance of English sole has fluctuated between 3,000 t and 18,600 t (Turnock et al. 2009). Dover sole and English sole were most common in the eastern portion of the GOA, consistent with their reported distribution along the west coast of North America. In the case of Sakhalin sole, which prefer colder water and are caught at the northern extent of the survey, their perceived abundance from survey biomass estimates may be related to annual mean bottom water temperature as they tended to be more abundant in colder years during the 1980s and 1990s. The recent trend from trawl surveys estimates Sakhalin sole at low abundance, however, sampling of the northern Bering Sea in 2010 indicated that their primary distribution is located to the north of the standard survey area (Fig. 11.1). The northern Bering Sea biomass estimate of Sakhalin sole is 2,180 t compared to the 78 t estimated for the standard survey area.

## PROJECTIONS AND HARVEST ALTERNATIVES

### Reference Fishing Mortality Rates and Yields

Other flatfish are assessed under Tier 5 of Amendment 56 to the BSAI groundfish management plan, and thus have harvest recommendations which are directly calculated from estimates of biomass and natural mortality. The natural mortality rates used in age-structured BSAI flatfish assessments can be used as guidance and are presented below:

| Species | Natural mortality rate used for stock assessment |
|---|---|
| BSAI yellowfin sole | 0.12 |
| BSAI northern rock sole | 0.15 |
| BSAI flathead sole | 0.20 |
| BSAI Alaska plaice | 0.13 |
| GOA rex sole | 0.17 |
| GOA Dover sole | 0.085 |

Natural mortlity values for rex and Dover sole are available from age-structured assessments in the Gulf of Alaska SAFE document (Turnock and A'mar 2005 and Stockhausen et al. 2005) and those published values are used for rex and Dover sole in this stock assessment. For the remaining flatfish species, where less information is available, an assumption of M = 0.15 appears reasonable given the range of values shown above. For the case of starry flounder where estimates are available from a west coast stock assessment (Ralston 2005), the high estimates of M (male = 0.45, female = 0.3) are not used here due to the uncertainty of the estimates and the large spatial difference between the two management areas.

The estimates of $F_{abc}$ and $F_{ofl}$ under tier 5 are 0.75 x *M* and *M*, respectively, and the ABC and OFL levels are the product of the fishing mortality rate and the biomass estimate. Given the $F_{abc}$ and $F_{ofl}$ levels of 0.11 and 0.15, and the biomass estimate of 111,060 t, the resulting ABC and OFL levels are 12,740 and 17,130 t.

| | $F_{ABC}$ | $F_{OFL}$ | ABC | OFL |
|---|---|---|---|---|
| Rex sole | 0.13 | 0.17 | 4,231 | 5,532 |
| Dover sole | 0.064 | 0.085 | 178 | 237 |
| Others | 0.1125 | 0.15 | 8,330 | 11,360 |
| **Total Other flatfish** | | | **12,740** | **17,130** |

## Summary

In summary, several quantities pertinent to the management of the other flatfish are listed below.

| Quantity | Value |
|---|---|
| Tier | 5 |
| Year 2011 Total Biomass | 111,060 t |
| OFL | 17,130 t |
| Maximum allowable ABC | 12,740 t |
| Recommended ABC | 12,740 t |

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Turnock, B.J. , Z. T. A'mar and T. Wilderbuer. 2009. Gulf of Alaska rex sole stock assessment. In Stock Assessment and Fishery Evaluation Document for Groundfish Resources in the Gulf of Alaska Region as Projected for 2006. North Pacific Fishery Management Council, P.O. Box 103136, Anchorage Alaska 99510.

Table 11.1. Flatfish species of the Bering Sea/Aleutian Islands "other flatfish" management complex.

| Common Name | Scientific Name |
|---|---|
| Arctic flounder | *Liopsetta glacialis* |
| butter sole | *Isopsetta isolepis* |
| curlfin sole | *Pleuronectes decurrens* |
| deepsea sole | *Embassichths bathybius* |
| Dover sole | *Microstomus pacificus* |
| English sole | *Parophrys vetulus* |
| longhead dab | *Limanda proboscidea* |
| Pacific sanddab | *Citharichthys sordidus* |
| petrale sole | *Eopsetta jordani* |
| rex sole | *Glyptocephalus zachirus* |
| roughscale sole | *Clidodoerma asperrimum* |
| sand sole | *Psettichthys melanostictus* |
| slender sole | *Lyopsetta exilis* |
| starry flounder | *Platichthys stellatus* |
| Sakhalin sole | *Pleuronectes sakhalinensis* |

Table 11.2. Harvest (t) of other flatfish from 1995-2010. 2010 catch is through October 16, 2010.

| Year | Starry Founder | Rex Sole | Butter Sole | longhead dab | Dover sole | English sole | deep sea sole | Sakhalin sole | Total | ABC | TAC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1995 | 398 | 673 | 157 | 7 | 59 | 26 | 4 | 0 | 1324 | 117000 | 19540 |
| 1996 | 1171 | 1148 | 218 | 175 | 6 | 0 | 0 | 30 | 2748 | 102000 | 35000 |
| 1997 | 1043 | 687 | 448 | 211 | 53 | 0 | 29 | 6 | 2490 | 97500 | 50750 |
| 1998 | 402 | 998 | 229 | 93 | 41 | 0 | 0 | 0 | 1765 | 164000 | 89434 |
| 1999 | 725 | 998 | 230 | 56 | 81 | 27 | 0 | 0 | 2117 | 154000 | 154000 |
| 2000 | 1151 | 1069 | 458 | 277 | 66 | 4 | 0 | 0 | 3027 | 117000 | 83813 |
| 2001 | 755 | 869 | 244 | 62 | 70 | 4 | 6 | 0 | 2028 | 122000 | 28000 |
| 2002 | 1075 | 1192 | 222 | 107 | 34 | 0 | 1 | 0 | 2631 | 18100 | 3000 |
| 2003 | 887 | 1399 | 296 | 125 | 39 | 2 | 0 | 0 | 2749 | 16000 | 3000 |
| 2004 | 2062 | 1858 | 514 | 146 | 82 | 6 | 0 | 0 | 4669 | 13500 | 3000 |
| 2005 | 2069 | 2001 | 487 | 25 | 16 | 1 | 0 | 0 | 4599 | 21400 | 3500 |
| 2006 | 1663 | 1266 | 261 | 33 | 10 | 0 | 0 | 0 | 3233 | 18100 | 3500 |
| 2007 | 4356 | 812 | 579 | 87 | 4 | 2 | <1 | <1 | 5840 | 21400 | 10000 |
| 2008 | 1978 | 968 | 618 | 47 | 10 | 2 | <1 | <1 | 3623 | 21600 | 21600 |
| 2009 | 806 | 1143 | 198 | 7 | 7 | 2 | 0 | <1 | 2163 | 17,400 | 17,400 |
| 2010 | 1506 | 510 | 162 | 9 | 5 | <1 | <1 | <1 | 2194 | 17,300 | 17,300 |
| 2011 | 2082 | 826 | 103 | 17 | 9 | 12 | 0 | <1 | 3051 | 14,500 | 3,000 |

Table11.3. Restrictions on the "other flatfish" fishery from 1995 to 2007 in the Bering Sea – Aleutian Islands management area. Note that in 1994, the other flatfish category included flathead sole. Unless otherwise indicated, the closures were applied to the entire BSAI management area. Zone 1 consists of areas 508, 509, 512, and 516, whereas zone 2 consists of areas 513, 517, and 521.

| Year | Dates | Bycatch Closure |
|---|---|---|
| 1995 | 2/21 – 3/30 | First Seasonal halibut cap |
| | 4/17 – 7/1 | Second seasonal halibut cap |
| | 8/1 – 12/31 | Annual halibut allowance |
| 1996 | 2/26 – 4/1 | First Seasonal halibut cap |
| | 4/13 – 7/1 | Second seasonal halibut cap |
| | 7/31 – 12/31 | Annual halibut allowance |
| 1997 | 2/20 – 4/1 | First Seasonal halibut cap |
| | 4/12 – 7/1 | Second seasonal halibut cap |
| | 7/25 – 12/31 | Annual halibut allowance |
| 1998 | 3/5 – 3/30 | First Seasonal halibut cap |
| | 4/21 – 7/1 | Second seasonal halibut cap |
| | 8/16 – 12/31 | Annual halibut allowance |
| 1999 | 2/26 – 3/30 | First Seasonal halibut cap |
| | 4/27 – 7/04 | Second seasonal halibut cap |
| | 8/31 – 12/31 | Annual halibut allowance |
| 2000 | ¾ – 3/31 | First Seasonal halibut cap |
| | 4/30 – 7/03 | Second seasonal halibut cap |
| | 8/25 – 12/31 | Annual halibut allowance |
| 2001 | 3/20 – 3/31 | First Seasonal halibut cap |
| | 4/27 – 7/01 | Second seasonal halibut cap |
| | 8/24 – 12/31 | Annual halibut allowance |
| 2002 | 2/22 – 12/31 | Red King crab cap (Zone 1 closed) |
| | 3/1 – 3/31 | First Seasonal halibut cap |
| | 4/20 – 6/29 | Second seasonal halibut cap |
| | 7/29 – 12/31 | Annual halibut allowance |
| 2003 | 2/18 – 3/31 | First Seasonal halibut cap |
| | 4/1 – 6/21 | Second seasonal halibut cap |
| | 7/31 – 12/31 | Annual halibut allowance |
| 2004 | 2/24 – 3/31 | First Seasonal halibut cap |
| | 4/10 – 12/31 | Bycatch status |
| 2005 | 3/1 - 3/31 | First Seasonal halibut cap |
| | 4/22-6/30 | Second Seasonal halibut cap |
| | 5/9-12/31 | Bycatch status, TAC attained |
| 2006 | 2/21 - 3/31 | First Seasonal halibut cap |
| | 4/5 – 12/31 | Red King crab cap (Zone 1 closed) |
| | 4/12 – 5/31 | Second seasonal halibut cap |
| | 5/26 | TAC attained, 7,000 t reserve released |
| | 8/7 – 12/31 | Annual halibut allowance |
| 2007 | 2/17 – 3/31 | First Seasonal halibut cap |
| | 4/9 – 5/31 | Second seasonal halibut cap |
| | 8/6 – 12/31 | Annual halibut allowance |

Table 11.4. Estimated biomass (t) of other flatfish from the eastern Bering Sea and Aleutian Islands trawl surveys. Species included are Dover sole, longhead dab, rex sole, Sakhalin sole, starry flounder, and butter sole. A linear regression between EBS and AI survey abundance was used to predict AI abundance in years in which an AI survey did not occur.

| | Area | | |
|---|---|---|---|
| Year | EBS | AI | total |
| 1982 | 117,763 | | 129,518 |
| 1983 | 66,131 | 2,700 | 68,831 |
| 1984 | 59,647 | | 64,956 |
| 1985 | 34,572 | | 37,101 |
| 1986 | 39,517 | 6,100 | 45,617 |
| 1987 | 49,764 | | 53,977 |
| 1988 | 44,559 | | 48,195 |
| 1989 | 49,663 | | 53,865 |
| 1990 | 47,126 | | 51,047 |
| 1991 | 72,453 | 2,144 | 74,597 |
| 1992 | 53,954 | | 58,632 |
| 1993 | 44,500 | | 48,130 |
| 1994 | 54,368 | 5,464 | 59,832 |
| 1995 | 37,891 | | 40,788 |
| 1996 | 60,376 | | 65,766 |
| 1997 | 71,545 | 7,580 | 79,125 |
| 1998 | 74,672 | | 81,648 |
| 1999 | 68,557 | | 74,855 |
| 2000 | 70,866 | 8,149 | 79,015 |
| 2001 | 78,930 | | 86,378 |
| 2002 | 98,218 | 8,801 | 107,019 |
| 2003 | 90,552 | | 99,289 |
| 2004 | 128,740 | 14,980 | 143,720 |
| 2005 | 43,970 | | 120,900 |
| 2006 | 132,925 | 16,367 | 149,292 |
| 2007 | 133,502 | | 149,507 |
| 2008 | 104,608 | | 121,494 |
| 2009 | 103,575 | | 121,342 |
| 2010 | 114,253 | 13,076 | 127,329 |
| 2011 | 94,217 | | 111,060 |

Table 11.5 --Estimated biomass (t) and coefficient of variation (in parentheses) for the miscellaneous species of the "other flatfish" management complex in the Bering Sea trawl and Aleutian Islands surveys.

**Eastern Bering Sea Shelf survey**

| Year | Dover Sole | Rex Sole | longhead dab | Sakhalin sole | starry flounder | butter sole | slender sole | sand sole |
|---|---|---|---|---|---|---|---|---|
| 1982 | -- | 5994 (0.16) | 103806 (0.16) | -- | 7781 (0.32) | 182 (0.82) | -- | -- |
| 1983 | -- | 7272 (0.18) | 51386 (0.38) | -- | 7436 (0.25) | 37 (0.45) | -- | 1559(0.94) |
| 1984 | -- | 13058 (0.28) | 35308 (0.16) | 137 (0.43) | 8913 (0.36) | 2231 (0.64) | -- | -- |
| 1985 | 10 (1.04) | 10751 (0.20) | 9107 (0.13) | 102 (0.37) | 12181 (0.24) | 2421 (0.83) | -- | -- |
| 1986 | 15 (1.00) | 12886 (0.22) | 10889 (0.14) | 274 (0.48) | 9112 (0.33) | 6341 (0.58) | -- | -- |
| 1987 | 81 (0.91) | 12931 (0.19) | 11897 (0.19) | 110 (0.58) | 22702 (0.63) | 2043 (0.38) | -- | -- |
| 1988 | 38 (0.59) | 15445 (0.15) | 16710 (0.19) | 1061 (0.40) | 9222 (0.30) | 2083 (0.47) | -- | 1128(1.0) |
| 1989 | -- | 12939 (0.15) | 13086 (0.16) | 129 (0.57) | 22205 (0.35) | 1304 (0.54) | -- | -- |
| 1990 | 47 (0.58) | 11857 (0.21) | 18601 (0.15) | 587 (0.36) | 15048 (0.26) | 986 (0.60) | -- | -- |
| 1991 | 55 (0.70) | 16014 (0.28) | 18680 (0.14) | 345 (0.68) | 34303 (0.23) | 3056 (0.50) | -- | -- |
| 1992 | 137 (0.58) | 14001 (0.24) | 10827 (0.17) | 212 (0.48) | 27544 (0.22) | 1233 (0.70) | -- | -- |
| 1993 | 37 (0.75) | 14567 (0.32) | 11690 (0.21) | 179 (0.31) | 16510 (0.22) | 1517 (0.75) | -- | -- |
| 1994 | 73 (0.72) | 15943 (0.38) | 18533 (0.26) | 506 (0.52) | 18218 (0.22) | 1095 (0.97) | -- | -- |
| 1995 | -- | 10420 (0.28) | 8402 (0.15) | 214 (0.27) | 17652 (0.29) | 1203 (0.54) | -- | -- |
| 1996 | -- | 10532 (0.40) | 8567 (0.20) | 185 (0.56) | 40409 (0.45) | 683 (0.53) | -- | -- |
| 1997 | -- | 8233 (0.27) | 18003 (0.21) | 1407 (0.84) | 41018 (0.21) | 2884 (0.43) | -- | -- |
| 1998 | 41 (0.44) | 7588 (0.22) | 14737 (0.19) | 770 (0.86) | 49605 (0.30) | 1942 (0.38) | -- | -- |
| 1999 | 16 (0.65) | 8020 (0.28) | 12087 (0.21) | 907 (0.63) | 43375 (0.25) | 4152 (0.62) | -- | -- |
| 2000 | 11 (1.02) | 9348 (0.19) | 13511 (0.30) | 473 (0.43) | 45810 (0.19) | 1713 (0.56) | -- | -- |
| 2001 | 16 (0.84) | 21660 (0.23) | 12764 (0.26) | 117 (0.32) | 43026 (0.25) | 796 (0.50) | -- | -- |
| 2002 | 7 (0.80) | 26053 (0.20) | 9740 (0.22) | 173 (0.90) | 59877 (0.23) | 2254 (0.64) | -- | -- |
| 2003 | 350 (0.66) | 28023 (0.15) | 8827(0.22) | 280 (0.75) | 52893 (0.17) | 179 (0.61) | 3 | |
| 2004 | 31(0.51) | 28762 (0.19) | 11290 (0.23) | 1118 (0.98) | 86698 (0.38) | 841 (0.86) | -- | -- |
| 2005 | 157(0.19) | 23171(0.19) | 11556 (0.21) | 961(0.97) | 71673(0.26) | 958(0.81) | -- | -- |
| 2006 | 90(0.53) | 21515(0.28) | 13204(0.25) | 125(0.58) | 96900(0.37) | 1091(0.53) | -- | -- |
| 2007 | 73(0.53) | 17025(0.25) | 16733(0.24) | 30(0.34) | 98623(0.17) | 1018(0.44) | -- | -- |
| 2008 | 364(0.90) | 18788(0.31) | 10884(0.22) | 77(0.36) | 74077(0.21) | 418(0.44) | -- | -- |
| 2009 | 469(0.95) | 18142(0.39) | 5,011(0.23) | 55(0.44) | 79366(0.19) | 532(0.60) | -- | -- |
| 2010 | 201(0.54) | 20320(0.32) | 11557(0.47) | 78(0.49) | 80351(0.25) | 1746(0.82) | -- | -- |
| 2011 | 408(0.96) | 18525(0.32) | 10348(0.59) | 513(0.72) | 63,986(0.23) | 437(0.69) | | |

**Aleutian Islands Surveys**

| | Species | | | | | | |
|---|---|---|---|---|---|---|---|
| Year | Dover Sole | Rex Sole | longhead dab | Sakhalin sole | starry flounder | butter sole | English sole |
| 1991 | 174 (0.45) | 1694 (0.18) | -- | -- | 142 (0.85) | 86 (0.73) | 47 (0.80) |
| 1994 | 438 (0.41) | 4306 (0.15) | -- | -- | 134 (0.69) | 505 (0.98) | 83 (0.81) |
| 1997 | 386 (0.34) | 6378 (0.16) | -- | -- | 459 (0.90) | 346 (0.98) | 12 (0.72) |
| 2000 | 630 (0.38) | 6526 (0.18) | -- | -- | 590 (0.71) | 310 (0.99) | 95 (0.97) |
| 2002 | 575 (0.28) | 7381 (0.15) | -- | -- | 671 (0.72) | 127 (0.83) | 47 (0.94) |
| 2004 | 870 (0.28) | 13717 (0.18) | -- | -- | 123 (0.72) | 235 (0.93) | 35(1.00) |
| 2006 | 2155 (0.57) | 14230 (0.19) | --- | -- | 17 (0.97) | 13(0.98) | 25(0.84) |
| 2010 | 2853(0.43) | 9762(0.14) | -- | -- | 127(0.14) | 180(0.69) | 154(0.67) |

Table 11.6. Estimated exploitation rates of rex sole, starry flounder and butter sole from 1997 to 2011.

| | Rex sole | | | Starry Flounder | | | Butter sole | | |
|---|---|---|---|---|---|---|---|---|---|
| Year | Biomass (t) | Harvest (t) | Exp. Rate | Biomass (t) | Harvest (t) | Exp. Rate | Biomass (t) | Harvest (t) | Exp. Rate |
| 1997 | 14611 | 401 | 0.03 | 41477 | 814 | 0.02 | 3230 | 336 | 0.10 |
| 1998 | 14250 | 569 | 0.04 | 49950 | 242 | 0.00 | 2210 | 157 | 0.07 |
| 1999 | 15415 | 516 | 0.03 | 43750 | 597 | 0.01 | 4416 | 167 | 0.04 |
| 2000 | 15874 | 569 | 0.04 | 46400 | 770 | 0.02 | 2023 | 266 | 0.13 |
| 2001 | 30524 | 507 | 0.02 | 43829 | 479 | 0.01 | 1059 | 147 | 0.14 |
| 2002 | 33411 | 1227 | 0.04 | 60633 | 1023 | 0.02 | 2382 | 187 | 0.08 |
| 2003 | 38349 | 1399 | 0.04 | 53353 | 887 | 0.02 | 429 | 296 | 0.69 |
| 2004 | 42479 | 1858 | 0.04 | 86821 | 2062 | 0.02 | 1076 | 514 | 0.48 |
| 2005 | 34963 | 1830 | 0.05 | 72176 | 1892 | 0.03 | 1201 | 445 | 0.37 |
| 2006 | 35745 | 1266 | 0.04 | 96917 | 1663 | 0.02 | 1104 | 261 | 0.24 |
| 2007 | 31,052 | 812 | 0.03 | 98941 | 4,356 | 0.04 | 1153 | 579 | 0.50 |
| 2008 | 33,613 | 961 | 0.03 | 74,397 | 1,964 | 0.03 | 541 | 614 | 1.14 |
| 2009 | 33,766 | 1,132 | 0.03 | 79,688 | 797 | 0.01 | 642 | 196 | 0.31 |
| 2010 | 30,082 | 491 | 0.02 | 80,478 | 1,148 | 0.02 | 1,926 | 156 | 0.08 |
| 2011 | 32,544 | 826 | 0.03 | 64,218 | 2,082 | 0.03 | 562 | 103 | 0.18 |

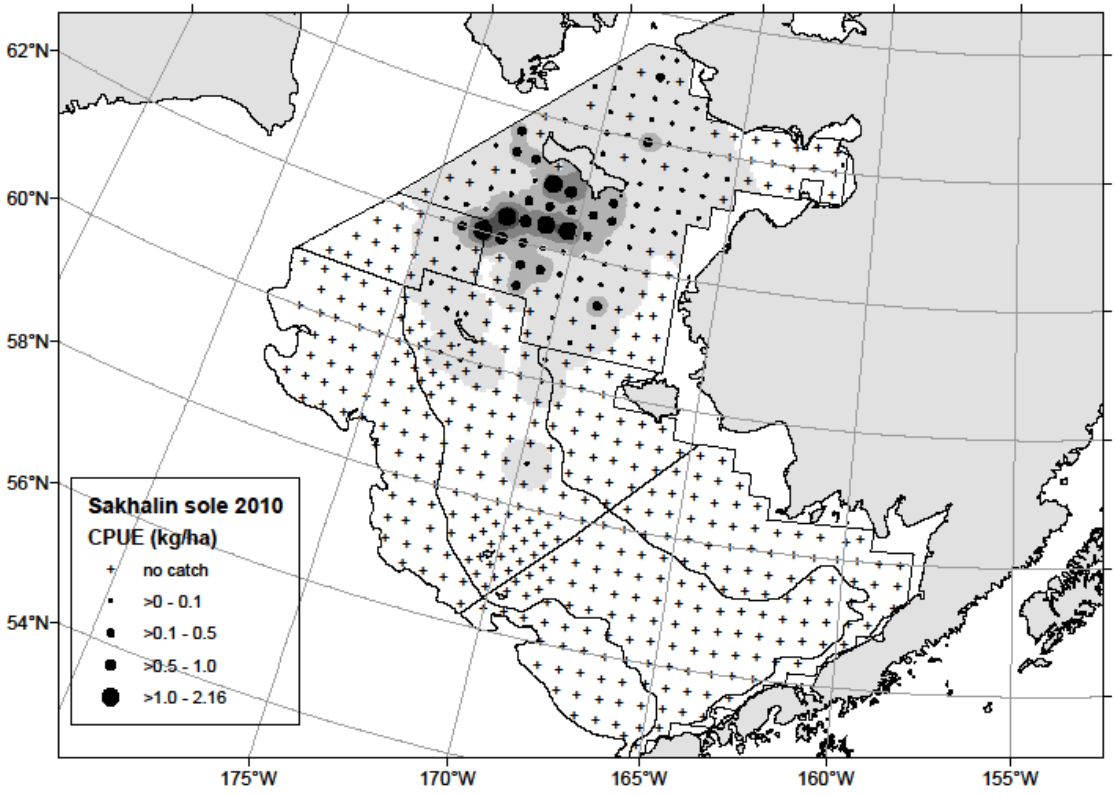


Figure 11-1. Distribution and relative abundance of Sakhalin sole from the AFSC sampling of the Bering Sea in the summer of 2010.