

CHAPTER 9

OTHER FLATFISH

by

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EXECUTIVE SUMMARY

The other flatfish species complex had previously included Alaska plaice, which are assessed with an age-structured population model. Because the 2002 harvest specifications separated Alaska plaice from the other flatfish complex, the assessment of Alaska plaice has been presented as a separate chapter in this SAFE document. The assessment of the remaining other flatfish, excluding Alaska plaice, is presented in this chapter.

The following changes have been made to this assessment relative to the November 2001 SAFE:

Changes in the input data

- 1) The 2001 catch (total and discarded) was updated, and catch through 28 September, 2002 were included in the assessment.
- 2) 2002 trawl survey biomass estimates and standard errors of other flatfish species were included in the assessment.

Changes in assessment methodology

- 1) The tier 4 approach in previous assessments of applying the flathead sole F_{40} and F_{35} fishing rates is examined with respect to the available data for the other flatfish complex, and it is recommended that this complex be assessed under tier 5. A natural mortality rate of 0.20 was used for the tier 5 calculations, based upon values used in age-structured analyses of BSAI flatfish. A summary of the harvest recommendations for 2003 (under tier 5) is compared to the tier 4 recommendations used in the 2002 assessment.

	2001 Assessment recommendations (Tier 4)	2002 Assessment recommendations (Tier 5)
Exploitable biomass	78,293 t	106,739 t
ABC	18,065 t	14,691 t
Overfishing	21,832 t	19,588 t
F_{ABC}	$F_{0.40} = 0.30$	0.15
$F_{overfishing}$	$F_{0.35} = 0.38$	0.20

INTRODUCTION

Prior to 2001, the “other flatfish” species complex included Alaska plaice (*Pleuronectes quadrituberculatus*). Flathead sole (*Hippoglossoides elassodon*) were part of the other flatfish complex until they were removed in 1995, and in recent years Alaska plaice was the dominant species of the complex and comprised 87% of both the 2000 catch and the estimated 2001 trawl survey biomass. Because more biological information exists for Alaska plaice than for the remaining species of other flatfish, an age-structured population model was used to assess this stock. In contrast, survey biomass estimates are the principal data source used to assess the remaining other flatfish. In 2002, Alaska plaice were and removed from the other species complex and managed separately. Given the differences in biological information, assessment techniques, and management, it is appropriate to separate the assessment of Alaska plaice from the remaining other flatfish. This chapter considers the assessment of other flatfish excluding Alaska plaice.

Catch History

The miscellaneous species found in the other flatfish species category are listed in Table 1, and their catches from 1995-2002 are shown in Table 2. These catch estimates were produced by applying the proportional catch, by species, from fishery observer data to estimates of total catch for the other flatfish complex. In recent years, starry flounder (*Platichthys stellatus*) and rex sole (*Glyptocephalus zachirus*) account for most of the harvest of other flatfish, and contributed 89% of the harvest of other flatfish in 2002.

Other flatfish are grouped with Alaska plaice, rock sole, and flathead sole and other flatfish fisheries in a single prohibited species class (PSC) classification, with seasonal and total annual allowances of prohibited bycatch applied to the classification. In recent years, this group of fisheries has been closed prior to attainment of the TAC due to the bycatch of halibut (Table 3), and portion of the eastern Bering Sea has been closed to these fisheries in 2002 for exceeding the red king crab bycatch allowance.

DATA

Absolute Abundance and Exploitation Rates

The biomass of the other flatfish complex on the eastern Bering Sea shelf has been relatively stable from 1983-1995, averaging 52,000 t, and has slightly increased from 1996 to 2002, averaging 75,000 t (Table 4). The 2002 biomass estimate of other flatfish on the EBS shelf is 97,938 t. Increases in biomass have also been seen in the Aleutian Islands trawl survey; the 2002 estimate is 8800 t. Individual species biomass estimates from 1997-2002 are shown in Table 5. Exploitation rates for starry flounder and rex sole have been low, not exceeding 0.10 from 1997 to 2001 (Table 9). The exploitation rates for butter sole have been slightly higher, exceeding 0.15 in 1997, 2000, and 2001, but the biomass estimates for butter sole have large sampling variances, with coefficients of variation ranging from 0.5 to 0.64 in recent EBS trawl surveys.

PROJECTIONS AND HARVEST ALTERNATIVES

Reference Fishing Mortality Rates and Yields

The other flatfish complex are currently managed under Tier 4 of Amendment 56 to the BSAI groundfish management plan, and thus rely upon knowledge of maturity ogives, growth rates, and fishery selectivity in order to produce a $F_{40\%}$ estimate. In previous assessments, the $F_{40\%}$ estimate from flathead sole was used as a proxy for this complex. This practice originated before Alaska plaice were assessed with an age-structured model, as flathead sole were viewed as a reasonable proxy for Alaska plaice. Starry flounder are currently the dominant component of the other flatfish complex, it is useful to reexamine the appropriateness using flathead sole as a proxy species. Although relatively little information exists on starry flounder life-history characteristics in Alaska, the information available suggest potentially considerable differences from flathead sole in growth and maturity. Hart (1973), citing California studies, indicates that females mature at age 3 at around 350 mm; in contrast, female flathead sole in Alaska grow to about 160 mm at age 3 and have a 50% maturity at approximately age 8 (although the size at maturity is similar). Despite the lack of information about starry flounder in Alaska waters, use of an $F_{40\%}$ proxy could be justified if there was little variation in growth and maturity patterns in flatfish for which we have more information. However, $F_{40\%}$ levels in relatively small flatfish (yellowfin sole, rock sole, Alaska plaice, and flathead sole) differ by a factor of three, ranging from 0.11 for yellowfin sole to 0.30 for flathead sole. The yellowfin sole $F_{40\%}$ estimate is lower than other flatfish species because of slower growth and delayed maturity schedules, thus making them more vulnerable to overfishing in mixed-species trawl fisheries (Spencer et al. 2002). In conclusion, it appears that the use of a flathead sole $F_{40\%}$ proxy for other flatfish is not supported by the available data, and it is recommended that this complex be assessed with tier 5 methods.

The information requirements for tier 5 assessments are 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:

<u>Species</u>	<u>Natural mortality rate used for stock assessment</u>
Yellowfin sole	0.12
Rock sole	0.18
Flathead sole	0.20
Alaska plaice	0.25

Given this range of values, an assumption of 0.20 appears reasonable. The estimates of F_{abc} and F_{ofl} under tier 5 are $0.75M$ 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 0.15 and 0.20, and the biomass estimate of 106,739 t, the resulting ABC and OFL levels are 14,691 and 19,588 t. These values are more conservative than those obtained from the tier 4 approach of applying (using the catch equation) the $F_{40\%}$ and $F_{35\%}$ levels estimated from this years (2002) flathead sole assessment to the 2002 BSAI survey biomass of miscellaneous flatfish. The 2002 estimates of $F_{40\%}$ and $F_{35\%}$ for flathead sole are 0.286 and 0.355, respectively, and the tier 4 ABC and OFL levels are 23,649 t and 28,440 t. A comparison of the tier 4 and tier 5 estimates is shown below:

<u>F level (value)</u>	<u>Projected yield for year 2003</u>
Tier 4 F_{ABC} (0.286)	23,649 t
Tier 4 F_{OFL} (0.355)	28,440 t
Tier 5 F_{ABC} (0.15)	14,691 t
Tier 5 F_{OFL} (0.20)	19,588 t

5. In conclusion, it is recommended that the other flatfish complex be assessed under tier

REFERENCES

- Hart, J.L. 1973. Pacific fishes of Canada. Fisheries Research Board of Canada, Bulletin 180, Ottawa. 740 pp.
- Spencer, P.D., T.K. Wilderbuer, and C.I. Zhang. 2002. A mixed-species yield per recruit model for eastern Bering Sea flatfish fisheries. *Can J. Fish. Aquat. Sci.* 59:291-302.

Table 1. Flatfish species of the Bering Sea/Aleutian Islands “other flatfish” management complex.

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

Table 2. Harvest (t) of other flatfish from 1995-2002.

Year	Starry Founder	Rex Sole	Butter Sole	Remaining Species	Total
1995	337	512	163	15	1027
1996	1194	984	219	98	2495
1997	1193	588	492	179	2451
1998	330	775	214	41	1359
1999	756	655	213	16	1640
2000	1012	748	349	20	2129
2001	644	682	198	18	1542
2002*	1120	1053	205	32	2441

*NMFS Regional Office Report through Sept 28, 2002

Table 3. Restrictions on the “other flatfish” fishery from 1994 to 2001 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.

<u>Year</u>	<u>Dates</u>	<u>Bycatch Closure</u>
1994	2/28 – 12/31	Red King crab cap (Zone 1 closed)
	5/7 – 12/31	Bairdi Tanner crab (Zone 2 closed)
	7/5 – 12/31	Annual halibut allowance
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	3/4 – 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

Table 4. Estimated biomass (t) of other flatfish from the eastern Bering Sea and Aleutian Islands trawl survey.

Year	Area		AI percent of total	Total
	EBS	AI		
1975		22,200		
1979		50,900		
1980		56,500		
1981		88,000		
1982		104,700		
1983		53,000		
1984		51,500		
1985		32,900		
1986		38,800		
1987		47,700		
1988		48,000		
1989		49,400		
1990		46,600		
1991		73,900	2.8	76,044
1992		50,100		
1993		87,200		
1994		54,100	9.2	59,566
1995		37,787		
1996		60,200		
1997		70,300	9.7	77,880
1998		73,947		
1999		69,730		
2000		70,539	10.4	78,688
2001		78,293		
2002		97,938	8.2	106,739

Table 5 --Estimated biomass (t) and coefficient of variation (in parentheses) for the miscellaneous species of the "other flatfish" management complex in the Aleutian Islands and Bering Sea trawl surveys.

Survey	Species						
	Dover Sole	Rex Sole	longhead dab	Sakhalin sole	starry flounder	butter sole	English sole
1982 BS	--	5994 (0.16)	103806 (0.16)	--	7781 (0.32)	182 (0.82)	--
1983 BS	--	7272 (0.18)	51386 (0.38)	--	7436 (0.25)	37 (0.45)	--
1984 BS	--	13058 (0.28)	35308 (0.16)	137 (0.43)	8913 (0.36)	2231 (0.64)	--
1985 BS	10 (1.04)	10751 (0.20)	9107 (0.13)	102 (0.37)	12181 (0.24)	2421 (0.83)	--
1986 BS	15 (1.00)	12886 (0.22)	10889 (0.14)	274 (0.48)	9112 (0.33)	6341 (0.58)	--
1987 BS	81 (0.91)	12931 (0.19)	11897 (0.19)	110 (0.59)	22702 (0.63)	2043 (0.38)	--
1988 BS	38 (0.59)	15445 (0.15)	16710 (0.19)	253 (0.63)	9222 (0.30)	2083 (0.47)	--
1989 BS	--	12939 (0.15)	13086 (0.16)	58 (0.57)	22205 (0.35)	1304 (0.54)	--
1990 BS	47 (0.58)	11857 (0.21)	18601 (0.15)	110 (0.51)	15048 (0.26)	986 (0.60)	--
1991 BS	55 (0.70)	16014 (0.28)	18680 (0.14)	291 (0.79)	34303 (0.23)	3056 (0.50)	--
1991 AI	174 (0.45)	1694 (0.18)	--	--	142 (0.85)	86 (0.73)	47 (0.80)
1992 BS	137 (0.58)	14001 (0.24)	10827 (0.17)	75 (0.48)	27544 (0.22)	1233 (0.70)	--
1993 BS	37 (0.75)	14567 (0.32)	11690 (0.21)	78 (0.34)	16510 (0.22)	1517 (0.75)	--
1994 BS	73 (0.72)	15943 (0.38)	18533 (0.26)	183 (0.41)	18218 (0.22)	1095 (0.97)	--
1994 AI	438 (0.41)	4306 (0.15)	--	--	134 (0.69)	505 (0.98)	83 (0.81)
1995 BS	--	10420 (0.28)	8402 (0.15)	109 (0.32)	17652 (0.29)	1203 (0.54)	--
1996 BS	--	10532 (0.40)	8567 (0.20)	34 (0.34)	40409 (0.45)	683 (0.53)	--
1997 BS	--	8233 (0.27)	18003 (0.21)	87 (0.49)	41018 (0.21)	2884 (0.43)	--
1997 AI	386 (0.34)	6378 (0.16)	--	--	459 (0.90)	346 (0.98)	12 (0.72)
1998 BS	41 (0.44)	7588 (0.22)	14737 (0.19)	34 (0.49)	49605 (0.30)	1942 (0.38)	--
1999 BS	16 (0.65)	8020 (0.28)	12087 (0.21)	63 (0.29)	43375 (0.25)	4152 (0.62)	--
2000 BS	11 (1.02)	9348 (0.19)	13511 (0.30)	145 (0.88)	45810 (0.19)	1713 (0.56)	--
2000 AI	630 (0.38)	6526 (0.18)	--	--	590 (0.71)	310 (0.99)	95 (0.97)
2001 BS	16 (0.84)	21660 (0.23)	12764 (0.26)	31 (0.43)	43026 (0.25)	796 (0.50)	--
2002 BS	7 (0.80)	26053 (0.20)	9740 (0.22)	7 (0.69)	59877 (0.23)	2254 (0.64)	--
2002 AI	575 (0.28)	7381 (0.15)	--	--	671 (0.72)	127 (0.83)	47 (0.94)

Table 6. Estimated exploitation rates of rex sole, starry flounder and butter sole from 1997 to 2002.

Year	Rex sole			Starry Flounder			Butter sole		
	Biomass (t)	Harvest (t)	Exp. Rate	Biomass (t)	Harvest (t)	Exp. Rate	Biomass (t)	Harvest (t)	Exp. Rate
1997	14611	590	0.04	41477	1196	0.03	3230	494	0.15
1998	7588	776	0.10	49605	330	0.01	1942	213	0.11
1999	8020	655	0.08	43375	757	0.02	4152	212	0.05
2000	15874	749	0.05	46400	1013	0.02	2023	350	0.17
2001	21660	685	0.03	43026	602	0.01	796	199	0.25
2002	33434	1042	0.03	60548	1148	0.02	2381	210	0.09

