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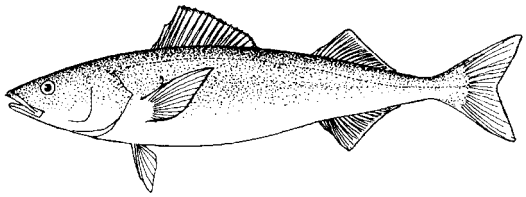
Pacific Region **Stock Status Report 2003/031**

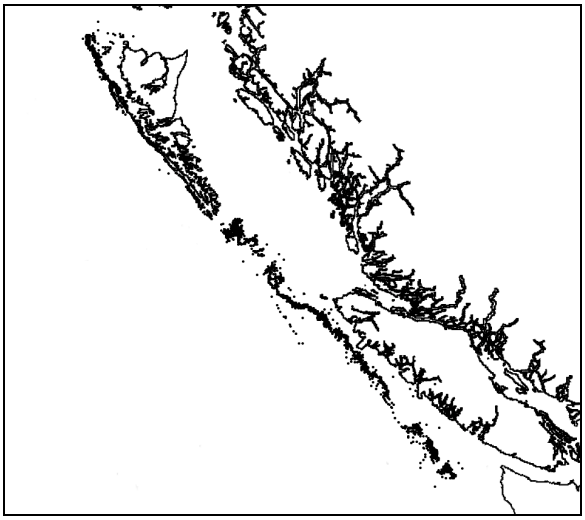


Sablefish

Background

Sablefish (Anoplopoma fimbria), often referred to as Blackcod, inhabit shelf and slope waters to depths greater than 1500 m, from central Baja California to Japan and the Bering Sea. Although genetic studies suggest a single population throughout their range, movement of adults is limited enough to allow assessment and management on a smaller scale. Differing patterns in recruitment and growth indicate the presence of northern and southern stocks in the British Columbia waters. The U.S. National Marine Fisheries Service carries out assessments of U.S. stocks.

Spawning occurs from January to March along the continental shelf at depths greater than 1000 m. Larval sablefish are found in surface waters over the shelf and slope in April and May. Juveniles migrate inshore over the following six months and rear in nearshore and shelf habitats until age 2-5, when they migrate offshore and recruit into the fishery. Juveniles are highly migratory, travelling from nursery areas in Hecate Strait to Alaska. Growth is rapid, with mature females reaching an average length of 55 cm, and a maximum of 80 cm, in 3 to 5 years. The oldest fish aged to date is 113 years. Age, growth and maturity parameters vary considerably among areas and depths. Recruitment rates also vary, with infrequent occurrences of very large year classes interspersed with moderate to low year classes.



Sablefish trap fishery catch locations.

Summary

- The assessment of stock status relies on the interpretation of trends in three primary stock indices: standardized commercial trap fishery catch rates, trap indexing survey catch rates, and estimates of (relative) trap vulnerable biomass from tag-recovery data.
  - *Standardized commercial trap CPUE* (North). Trap fishery catch rates for the north coastal area declined from 1991 to 1998, prior to the mandatory adoption of escape rings in the fishery. Subsequent to 1998 the four-year trend indicated a decline with a historical low in 2001 and improvement in 2002, in agreement with the indexing survey trend.
  - *Standardized commercial trap CPUE* (Central). Catch rates in the central coast increased in

Canada

the early 1990s, and then experienced a large decrease from 1994 to 1996. The trend subsequent to 1998 indicated a decline. The central B.C. coast did not show a historic low in 2001.

- *Standardized commercial trap CPUE* (South). The south coastal area catch rates initially increased and then declined from 1992 through 1998. Subsequent to 1998, the four-year trend indicated a decline. The index for the south decreased substantially between 2000 and 2001, as did the indexing survey in the south.
- *Indexing survey* (North). Results for 2002 indicated improvement in catch rates to a level comparable to the mid 1990s. This change was driven by the two most northern indexing localities. The highly reduced variance observed in 2001 was not evident in 2002.
- *Indexing survey* (South). Results for the south stock area in 2002 showed no improvement from levels in the mid 1990s.
- *Tag-recovery estimates of vulnerable biomass.* The trend in (relative) trap vulnerable biomass declined from 1993 through 1998, increased from 1998 to 1999, and declined through 2002.

- A simple biomass dynamics model was used to integrate stock indices and described the consequences of assumed levels of future production on projected stock biomass. Performance measures related to stock increase were summarized as decision tables for fishery managers.
- A review of stock indicators related to increases through recruitment or immigration suggested future production of sablefish should improve over low levels experienced in the 1990s. Indicators included the Gulf of Alaska stock status; shelf and slope trawl surveys off the west coast of the lower 48 United States; and survey data from B.C. where sablefish were recorded as a bycatch species.

The Fishery

Average Canadian Landings (metric tons)

1960-69	1970-79	1980-89	1990-99	2000-02
1320	5130	4380	4620	3240

Sablefish have a long history of exploitation with the first recorded landings in 1913. Foreign fishing was conducted from 1961 to 1981, but was phased out after the declaration of the 200-mile fishery conservation zone in 1977.

The directed sablefish fishery is regulated under a “K” tab license that permits longline traps or hooks to be deployed. The fishery has operated under an Individual Transferable Quota (ITQ) system since 1990. Approximately 8% of the total allowable catch (TAC) is allocated to the trawl fishery. Sablefish are primarily caught using longline Korean traps, with about 17% of the total catch fished using longline hooks during the 1999 to 2002 period. Most trap fishing effort occurs between about 450 m and 825 m.

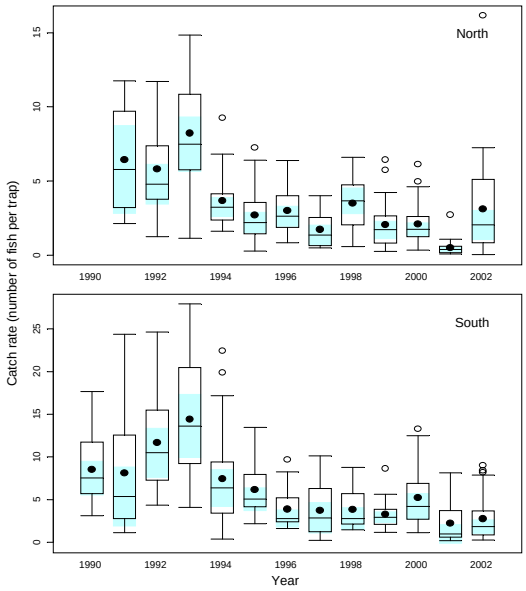
The sablefish fishery continues to be one of the most important in B.C. with an estimated value of CAN $29 million from a TAC of 4,000 t in 2000. The majority of the product is headed, gutted

and frozen at sea for export to Japanese markets. A collaborative agreement between Fisheries and Oceans Canada and the Canadian Sablefish Association provides for joint research, stock assessment, management and enforcement.

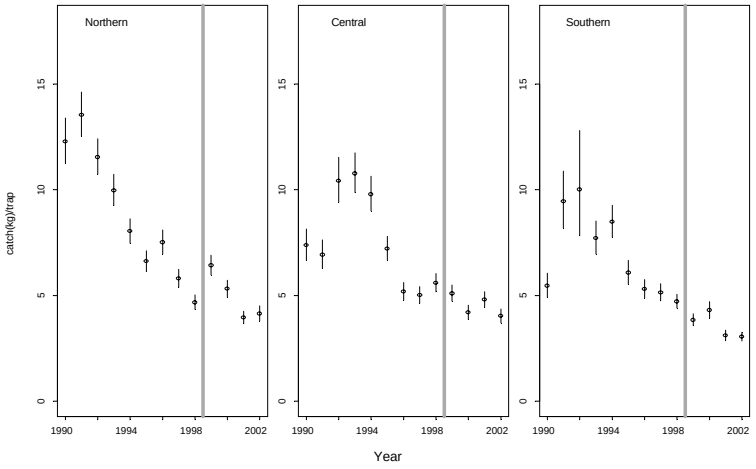
Resource Status

Data sources include catch from longline, trap, and trawl fisheries, release and recovery data from sablefish tagging programs conducted in 1991 to 2002 and survey index data from 1990 to 2002. Stock indices are derived from commercial trap catch rates, trap survey catch rates, and estimates of biomass vulnerable to trap gear determined from tag-recovery data. The assessment in 2003 included results from a new standardized commercial catch rate analysis and a revised tag-recovery model.

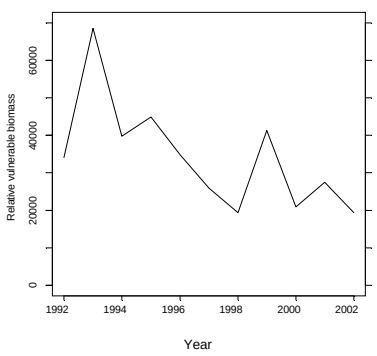
There was general agreement among the trends in stock indices that sablefish vulnerable to trap gear experienced a decrease in abundance from high levels in the early 1990s to low levels in the mid 1990s. The rate of decline slowed markedly in the mid-1990s for both stock areas. For the north stock area, a period of relative stability occurred in the mid 1990s until 2001 when historically low catch rates were observed for the commercial trap fishery and the indexing survey. Survey catch rates for the north improved in 2002, and were comparable to those observed in the mid 1990s. In contrast, the decline in commercial trap and survey indices for the south stock area was more gradual through the mid 1990s, but has continued through 2002. The pattern of tagging model estimates of vulnerable biomass was generally consistent with the trends indicated by the commercial catch rate and index survey series, though it is variable through the late 1990s.



Distribution of sablefish survey catch rates (number of fish per trap) for each set by year and stock. Boxplots show the distribution of catch rates observed on each set. The filled circles show the mean annual catch rate. The lightly shaded rectangle indicates an approximate 95% confidence interval on the median annual catch rate.



Year and region effects from the standardized trap fishery model (kg/trap). Vertical lines indicate +/- two standard errors. The gray vertical lines indicate the introduction of mandatory escape rings on trap gear.



Trap vulnerable biomass (t) from tag-recovery model.

Unresolved problems in the reliability of sablefish ageing have postponed the accumulation of catch at age information since 1996. The lack of recent ageing data, and unsuitability of length-based methods for sablefish, precludes age-structured or size-structured population dynamics models and associated stock projections. A research project designed to resolve difficulties in the ageing of sablefish is being conducted in 2003/2004.

Outlook

Sablefish recruitment during the 1990s was regarded as below average in B.C. and for U.S. stocks in the eastern Gulf of Alaska and off the southern U.S. coast north of Point Conception. Recent analyses of sablefish recruitment indicators from various sources in B.C. and the United States suggested that future production of sablefish should improve over low levels experienced in the 1990s. Exploitable biomass is expected to increase about 6% for the Gulf of Alaska stock in 2003, due primarily to an above average 1997 year class. Relatively strong 1999 and 2000 year classes have been detected by the 2001 shelf and slope surveys off Washington, Oregon and California. Similarly, bycatch of sablefish in a west coast Vancouver Island shrimp survey increased markedly in 2001 and 2002, due to the 1999 and 2000 year classes. However, the relative contribution of these year classes will not be evident until recruitment to the fishery at about 2004 or 2005.

The assessment recommended pursuing fishery objectives that will increase abundance from current levels. A simple biomass dynamics model was used to combine stock indices and examine the consequences of assumed levels of future production on projected stock biomass. Production, $\bar{P}$, was defined to be the combined effects of recruitment, immigration, emigration and growth. Mean production in the 1996 to 2002 reference period was estimated, and biomass was projected over the 2003 to 2008 period under various assumptions regarding annual catch and future production. A decision-making procedure based on output from the simple biomass dynamics model depended explicitly on two considerations external to available data:

1. the degree of optimism regarding future production during the 2003 to 2008 projection period, e.g. $1\bar{P}$ to $1.5\bar{P}$, relative to the 1996 to 2002 reference period;

2. the desired trade-off between fishery yield and the objective to increase stock biomass, *B*, in 2008 relative to 2003, e.g. the probability $P(B_{2008} > B_{2003})$ and the expectation $E(B_{2008}/B_{2003})$.

Advice to managers was cast in the form of decision tables, and the $1.25\bar{P}$ level was supported based on the expectation of increased production

over the 2003 to 2008 period relative to the 1996 to 2002 reference period.

Decision table showing the expected outcome of $P(B_{2008} > B_{2003})$ at 2003 to 2008 catch levels from 0 to 3,500 t for three levels of future stock production.

Total Annual Catch 2003-2008	$P(B_{2008} > B_{2003})$ Productivity Assumption		
	$1 \bullet \bar{P}$	$1.25 \bullet \bar{P}$	$1.5 \bullet \bar{P}$
0	0.91	0.92	0.93
2000	0.70	0.83	0.88
2500	0.54	0.78	0.85
3000	0.30	0.68	0.81
3500	0.07	0.53	0.75

Long-term harvest strategies for sablefish are difficult to evaluate in the absence of a population dynamics model that integrates age structure and tagging information. In the interim, the current schedule of annual assessments permits adjustment of yield advice in response to changing stock trends.

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