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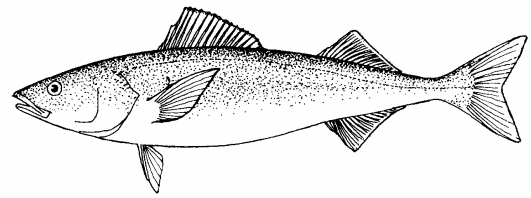
Pacific Region **Stock Status Report 2004/025**



Sablefish

Background

Sablefish (Anoplopoma fimbria), also referred to as Blackcod, inhabit shelf and slope waters to depths greater than 1500 m, from central Baja California to the Bering Sea and Japan. Although genetic studies suggest a single population throughout the range, fishery management is conducted on stocks defined in the Gulf of Alaska, British Columbia, and the continental United States. Patterns in sablefish recruitment, growth and the movement of tagged fish indicate the presence of northern and southern stocks in British Columbia waters that mix in a zone off north western Vancouver Island.

Spawning occurs from January to March along the continental shelf at depths greater than 300 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 near shore and shelf habitats until age 2-5 when they migrate offshore and recruit to deeper waters. Fish become vulnerable to the offshore longline trap and hook fisheries at this time. Juveniles can be highly migratory, traveling from nursery areas in Hecate Strait and mainland inlets 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 was 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.

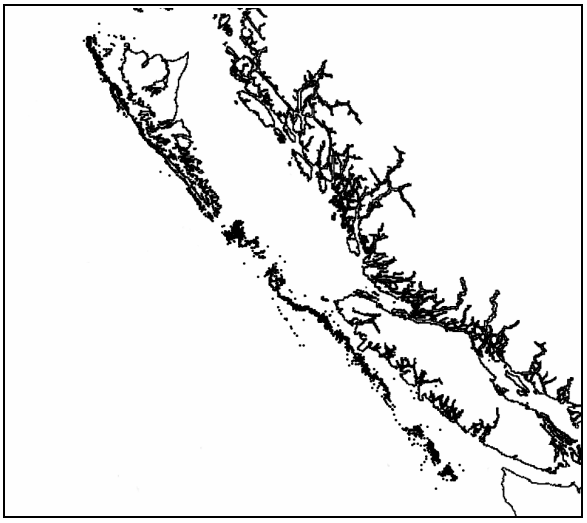


Figure 1: Sablefish trap fishery catch locations.

Summary

- The assessment of stock status relies on the interpretation of trends in four stock indices that relate to the trap vulnerable component of the British Columbia (B.C.) sablefish population. Three indices are in terms of catch per unit effort (CPUE) and one index is expressed in biomass units:

  – *Standardized commercial trap CPUE (1990-2003)*. Trap fishery catch rates (kg/trap) for the north coastal area declined from 1991 to 1998, prior to the mandatory adoption of escape rings. Subsequent to 1998 the four-year trend indicated a decline, with a historical low in 2001 and improvement in 2002 in agreement with the standardized survey trend. Catch rates increased substantially (63%) in 2003. The south coastal area catch rates initially increased and then declined from 1992 through 1998. Subsequent to 1998, the four-

Canada

year trend was relatively flat. No south coastal estimate was available for 2003 due to the lack of trap fishing in the first half of that year.

- *Nominal commercial trap CPUE (1979-2002)*. Recent coast wide CPUE (kg/trap) is near levels experienced in the early 1980s. The peak of nominal trap CPUE during the early 1990s was consistent with a similar pattern observed for the Gulf of Alaska, though slightly lagged. Catch rate estimates for 2003 were not available due to very limited trap fishing early in the year. This time series is not standardized and coincides with a period of change in fishery management practice.
- *Standardized survey CPUE (1990-2003).* Coast wide results for 2003 show substantially increased catch rates (numbers per trap) in both the north and south coastal areas. The historical trend shows a general decline in CPUE from highs in the early 1990s. Beginning in the mid 1990s the rate of decline in the north slowed and entered a period of relative stability through to 2000. The 2001 survey resulted in the lowest CPUE estimates in the time series. The northern catch rate improved in 2002 relative to 2001 and was comparable to those observed in the mid 1990s. The 2003 CPUE estimate was the highest in the time series. Catch rates in the south exhibited a continuous decline from the mid-1990s to 2002, but showed significant improvement in 2003 largely due to improved catches in the three shallow depth strata.
- *Tag-recovery estimates of vulnerable biomass (1991-2002).* Estimates of trap vulnerable biomass derived from trap fishery tag recoveries declined from a high in 1993 through to 1998. Estimated biomass remained at low levels from 1998 through 2002, with a historical low in 2001 in agreement with the commercial and standardized survey time series. Trap vulnerable 2003 biomass was not estimated due to the lack of commercial trap effort after February of 2003.

- A Bayesian production model was used to integrate stock indices and to evaluate the consequences of future catch levels on projected stock biomass. Annual production terms were estimated where production represented the net changes in biomass resulting from fish growth, recruitment, immigration, emigration, and changes in trap vulnerability. Performance measures related to (1) stock increase from the estimated 2002 biomass, and (2) a surrogate for a conservation limit, were summarized as decision tables for fishery managers.
- A review of indicators related to stock increase through recruitment or immigration suggested future production of sablefish should be greater than the low levels experienced in the 1990s. Indicators included the Gulf of Alaska stock assessment results, shelf and slope trawl surveys off the west coast of the continental U.S., and shrimp survey data from B.C. where young sablefish were recorded as a bycatch species.

The Fishery

Average Canadian Landings (metric tons)

1960-1969	1970-1979	1980-1989	1990-1999	2000-2003
1320	5130	4380	4620	3205

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 economic exclusion zone in 1977.

The directed sablefish fishery is regulated under a “K” tab license that permits the use of longline traps or hooks. The fishery has operated under an Individual Transferable

Quota (ITQ) system since 1990. The allocation to the trawl fishery is 8.75% of the total allowable catch (TAC). Sablefish are primarily caught using longline Korean traps, with about 21% of the total catch fished using longline hooks during the 1999 to 2003 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 activities.

Resource Status

Data sources include annual catch from longline, trap, and trawl fisheries, release and recovery data from a sablefish tagging program conducted from 1991 to 2002, and standardized survey data from 1990 to 2003. Stock indices are derived from commercial trap catch rates, trap survey catch rates, and estimates of trap vulnerable biomass determined from tag-recovery data. The 2003 assessment included a time series of estimated trap vulnerable biomass from a new tag recovery model that utilized tag returns regardless of years at large, allowed new untagged fish to enter the trap vulnerable biomass via recruitment or immigration, and allowed both tagged and untagged fish to leave the trap vulnerable biomass.

There was general agreement among the trends in stock indices that sablefish vulnerable to trap gear experienced a decrease in abundance from (relatively) high levels in the early 1990s to low levels in the mid 1990s (Figure 2). 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 standardized survey. Standardized survey catch rates for the north improved in 2002, and were comparable to those observed in the mid 1990s. There was substantial improvement in 2003 survey catch rates to a level similar to highs observed in the early 1990s. The pattern of tagging model estimates of vulnerable biomass was generally consistent with the trends indicated by the commercial catch rate and standardized survey series.

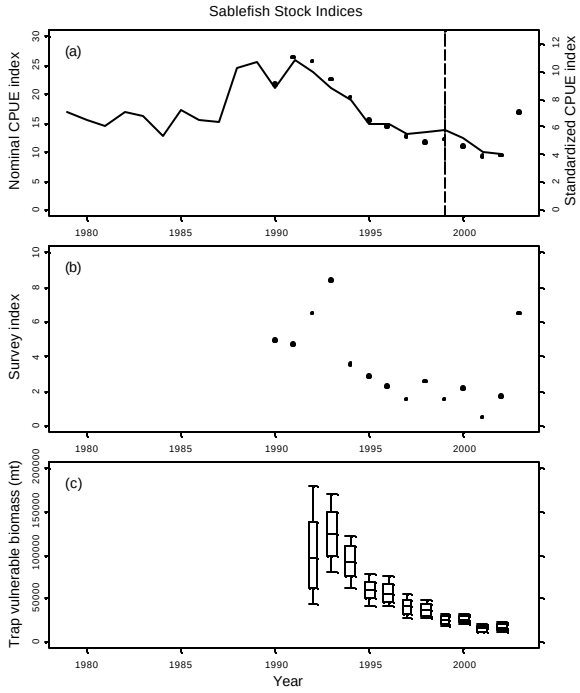


Figure 2 Coast wide stock indices: (a) nominal trap fishery catch rates (solid line) and standardized trap fishery index (filled circles), (b) standardized survey index abundance, and (c) tagging model marginal posterior distributions of trap vulnerable biomass. The dashed vertical line in panel (a) indicates the inception of trap escape rings.

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 reconstructions.

Research to resolve difficulties in the ageing of sablefish is ongoing.

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. Analyses of sablefish indicators from various sources in B.C. and the U.S. suggested that future production of sablefish should improve over low levels experienced in the 1990s. Exploitable biomass for the Gulf of Alaska stock is 10 percent higher than in 2000, due primarily to the 1997 year class which is projected to comprise about 40% of unfished biomass in 2004. Relatively strong 1999 and 2000 year classes have been detected by the 2001 shelf and slope surveys off the continental U.S. 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 to the B.C. stock will not be evident until recruitment to the fishery beginning in 2004 or 2005.

Performance measures evaluated for the assessment were relative to the trap vulnerable biomass in 2002 and to the 5th percentile of the distribution of unfished trap vulnerable biomass, $B^{0.05}$=19,000 t:

1. The probability that vulnerable stock biomass is above $B^{0.05}$=19,000 t at the end of the projection period, $P\left(B_{2009} > B^{0.05}\right)$;
2. The probability that vulnerable stock biomass is above B_{2002} at the end of the projection period, $P\left(B_{2009} > B_{2002}\right)$;
3. The expected ratio of vulnerable biomass to unfished vulnerable biomass $B^{0.05}$=19,000 t over the projection period, $E\left(B_{2009} / B^{0.05}\right)$, and
4. The expected ratio of vulnerable biomass to 2002 vulnerable biomass over the projection period, $E\left(B_{2009} / B_{2002}\right)$.

Based on the stock indices, the model outputs suggest there is little risk that the TAC levels investigated with the biomass dynamics model will lead to a short-term conservation concern (eg., Table 1). However, the model projection outputs are strongly influenced by the substantial increase observed in the 2003 standardized survey and northern trap fishery indices relative to results in 2002. Support for sustained TACs at high levels requires the accumulation of stock index values that continue to provide evidence of high abundance.

Total Annual Catch (t) 2004-2008	$P\left(B_{2009} > B_{2002}\right)$ Current Biomass			
	Low	Average	High	Expectation
0	0.97	0.94	0.87	0.93
3000	0.93	0.91	0.82	0.89
4000	0.92	0.89	0.79	0.87
5000	0.90	0.87	0.77	0.85
6000	0.87	0.82	0.74	0.82

Table 1: Decision table showing the expected outcome of $P\left(B_{2009} > B_{2002}\right)$ at 2004 to 2008 catch levels from 0 to 6,000 t. The "Expectation" column integrates the effects of B_{2003} being at the low to high end of the range of estimated values.

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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