

ADDITIONAL INFORMATION ON THE VALIDITY OF THE AGEING TECHNIQUE
FOR SABLEFISH DEVELOPED BY BEAMISH AND CHILTON (1982)

by

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INTRODUCTION

The ageing technique for sablefish developed by Beamish and Chilton (1982) was criticized because some biologists felt that the sizes of age 1 fish were too large and the ages produced were too old. While there was no evidence to support such criticism, the changes in the understanding of the biology of sablefish were so extreme that many people were skeptical of the validity of the ages. Despite validation studies (Beamish et al. 1983) that documented that the annuli were valid and that the adults grow very slowly, some biologist still felt that more evidence was required. Unfortunately the kind of evidence that people felt was needed required that tagged individuals be recaptured 10 to 30 years after release. Since large numbers of releases are required to obtain such recaptures and large numbers have only been released in recent years, (Beamish and McFarlane 1983) it will be another 10-20 years before "known old age" fish can be recovered. Thus any information relating to the validity of the technique is important.

This report describes two studies that provide some additional evidence. While both studies contain only a minimum of data, they are sufficiently important to the understanding of the biology of sablefish that they should be reported now.

The first study examines the growth of recently hatched sablefish. The second study reports on a sablefish that was recaptured after 21 years at liberty. In addition, we present some growth information from

tagging studies that demonstrates sablefish grow slowly. This growth information suggests that some sablefish, particularly males, may remain at a particular length.

MATERIALS AND METHODS

Larval sablefish, ranging in size from 15 to 33 mm were captured using Neuston nets. Catches were made off the entire west coast of Vancouver Island during April 1984. Most samples were preserved except for a small number transported alive to the Pacific Biological Station.

A sample of 5 fish ranging in length from 30 to 33 mm were placed in a 273 L tank with flowing saltwater of ambient temperature. Over the period of the experiment, temperatures ranged from 10.2 to 12.5°C and salinity was approximately 29 ppt. Fish were fed a ration equivalent to 20% of body weight once a day. The ration initially consisted of live brine shrimp and as fish grew changed to a combination of frozen brine shrimp, euphausiids, Oregon Moist pellets and frozen herring. Fish were measured for fork length every 10 days and after an average size of 120 mm weighed to the nearest gram. As of the end of September 1984 the experiment is still in progress.

From May 23 to June 11 1962, 575 sablefish were tagged with a

single barbed dart tag off the coast of Oregon. Fish were captured by bottom trawl, tagged and released in the area between 45°54'N and 46°06'N in 100 to 300 fathoms (183-549 m). No length measurements of tagged fish were recorded. The methods used in recent tagging and growth studies have been described in Beamish and McFarlane 1983 and McFarlane and Beamish 1983.

RESULTS

Of the 5 fish given full ration, one was sacrificed at 70 cm and one at 100 cm as part of another experiment. As of September 24, 1984, the 3 remaining fish were 26.5, 26.9 and 26.7 cm and 153.3, 166.9 and 139.1 gms. The average daily growth rate for 10 day periods indicated growth was extremely rapid (Table 1). Fish consumed all food provided and were capable of consuming increased rations.

On August 1, 1983, one of the fish tagged in 1962 off the coast of Oregon was recovered at 42°30'N, and 124°45'W in approximately 250 to 350 fathoms (457-640 m). When recaptured the fish measured 60 cm and weighed approximately 2.2 kg. No age structures were obtained nor was the sex identified.

Ages collected from sablefish sampled from the commercial fishery from 1978 to 1982 were tabulated for 60 cm fish (Table 2). Males

measuring 60 cm in length ranged in age from 4 to 50 years with a mean age of 14. Females measuring 60 cm ranged from 3 to 25 years with a mean age of 10. The lower mean age of females and the smaller number in the sample is a consequence of the continuing growth of adult females.

Using the results of the Canadian sablefish tagging studies (Beamish and McFarlane 1983), the number of fish that showed negative or no growth after being at liberty for 4 years was examined (Table 3). Fish were separated by sex and divided into length categories of ≤ 60 cm and >60 cm. To allow for measurement errors and shrinkage fish measuring 59.6 cm to 60.4 cm were considered to be 60 cm. Most recaptures (73%) of male fish showed no growth or negative growth over the 4 year period. Surprisingly, recoveries of female fish also showed a high percentage of no growth or negative growth.

DISCUSSION

It is apparent from the laboratory experiment that young-of-the-year cultured sablefish grow rapidly. Samples of young-of-the-year wild sablefish captured in 1977 in Queen Charlotte Sound averaged 11 cm in August and 23 cm in September (McFarlane and Beamish 1983). The average lengths of fish in the laboratory were larger, for a comparable time period (Table 1). Wild fish captured in late October 1977 averaged 29 cm (McFarlane and Beamish 1983). In

January when wild fish are considered to be age 1, there had been little increase in length from late October. While it is clear that the laboratory growth is slightly greater than for wild fish, it is also clear that young sablefish can grow rapidly. Thus the lengths observed in January (age 1) could easily be obtained in the first year of growth.

The tagging study indicated that sablefish can be at least 21 years old. Using the ageing technique of Beamish and Chilton (1982) sablefish have been found to be as old as 70 yrs (Fig. 1) and depending on the composition of the catch, average age in the fishery has ranged from 13 to 21 years. Males and females grow rapidly to age 3 and a length of 45 cm (Fig. 2). Males then reduce growth in length and maintain an average size of approximately 60 cm. Females will continue to increase in length. While the sex of the recaptured fish was not determined the length of 60 cm after at least 21 years confirms that the prolonged period of little or no growth exists. McFarlane and Beamish (1983) have shown that total mortality of males and females is not different indicating that males are not smaller because they are younger. Ages from the Canadian commercial fishery ranging from 4 to 50 years for males and 4 to 52 years for females have been observed (McFarlane and Beamish 1983) showing that similar sized fish exhibit extreme variation in age.

The slow growth, wide range in ages for similar sized fish and average size of 60 cm for males and 70 cm for females indicates fish undergo long periods during which little or no growth occurs. While it may not be possible to say that determinate growth exists, it is clear that if growth does continue it is insignificant in proportion to total length.

When comparing lengths at release and recapture for fish at liberty for 4 years for releases in 1977, 78 and 79 most fish showed either no growth or a reduced length. It is possible that the reduced length is a result of shrinkage. However, whether or not the shrinkage is real, there is little doubt from these tagging studies; from the ageing studies and from the recaptured fish reported in this study that sablefish can live for many years without increases in length.

The data presented in this report provides additional evidence that the ageing technique of Beamish and Chilton (1982) is valid. Adult sablefish in the commercial fishery can be quite old and the importance of their longevity remains to be determined.

ACKNOWLEDGMENTS

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Table 1. Growth of larval sablefish reared in captivity from April, 1984 to September, 1984.

Date measured	Time interval (# days)	Mean length (mm)	Mean weight (g)	Length increase mm (%)	Weight increase g (%)	Daily length increase mm (%)	Daily weight increase g (%)
22 Apr	-	30	-	-	-	-	-
12 May	21	45	-	15(50.0)	-	0.7(2.4)	-
24 May	12	59	-	14(31.1)	-	1.2(2.6)	-
04 June	11	70	-	11(18.6)	-	1.0(1.7)	-
13 June	9	81	-	11(15.7)	-	1.2(1.7)	-
23 June	10	93	-	12(14.8)	-	1.2(1.5)	-
03 July	10	107	-	14(15.0)	-	1.4(1.5)	-
13 July	10	123	16.9	16(15.0)	-	1.6(1.5)	-
24 July	9	145	27.2	22(17.9)	10.3(61.0)	2.4(2.0)	1.1(6.8)
03 Aug	10	169	42.6	24(16.6)	15.4(56.7)	2.4(1.7)	1.5(5.7)
13 Aug	10	194	59.5	25(14.8)	16.9(37.7)	2.5(1.5)	1.7(4.0)
23 Aug	10	217	74.4	23(11.9)	14.9(25.0)	2.3(1.2)	1.5(2.5)
04 Sept	12	236	106.5	19 (8.8)	32.1(43.1)	1.6(0.7)	2.7(3.6)
14 Sept	10	251	133.6	15 (6.3)	27.1(25.4)	1.5(0.6)	2.7(2.5)
24 Sept	10	267	153.1	16 (6.4)	19.5(14.6)	1.6(0.6)	2.0(1.5)

Table 2. Age frequency of 60 cm sablefish, by sex.

Male		Female	
Age	Frequency	Age	Frequency
-	-	3	7
4	11	4	39
5	17	5	20
6	12	6	10
7	13	7	4
8	14	8	1
9	15	9	3
10	10	10	4
11	8	11	2
12	13	12	4
13	14	13	2
14	12	14	2
15	14	15	3
16	9	16	7
17	9	17	7
18	4	18	5
19	6	19	2
20	8	20	1
21	9	21	6
22	4	22	5
23	3	23	2
24	6	24	2
25	2	25	6
26	3	-	-
27	2	-	-
30	3	-	-
31	2	-	-
32	2	-	-
34	2	-	-
36	1	-	-
40	1	-	-
41	2	-	-
50	1	-	-
Total no.:	232		144
Mean age.:	14		10

Table 3. Growth of tagged sablefish by sex and at large for four years for fish ≤ 60 cm and >60 cm at release.

Rel. year Rec. year	77 81				78 82				79 83			
	≤ 60 (%)		>60 (%)		≤ 60 (%)		>60 (%)		≤ 60 (%)		>60 (%)	
	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
No growth	3(21.4)	3(50.0)	4(22.2)	7(12.5)	-	-	3(30.0)	4(20.0)	6(31.6)	1(33.3)	5(16.1)	6(16.7)
-ve growth	10(71.4)	2(33.3)	10(55.6)	31(55.4)	1(33.3)	-	4(40.0)	6(30.0)	6(31.6)	-	17(54.8)	10(27.8)
+ve growth	1(7.1)	1(16.7)	4(22.2)	18(32.1)	2(66.7)	-	3(30.0)	10(50.0)	7(36.8)	2(66.7)	9(29.1)	20(55.5)

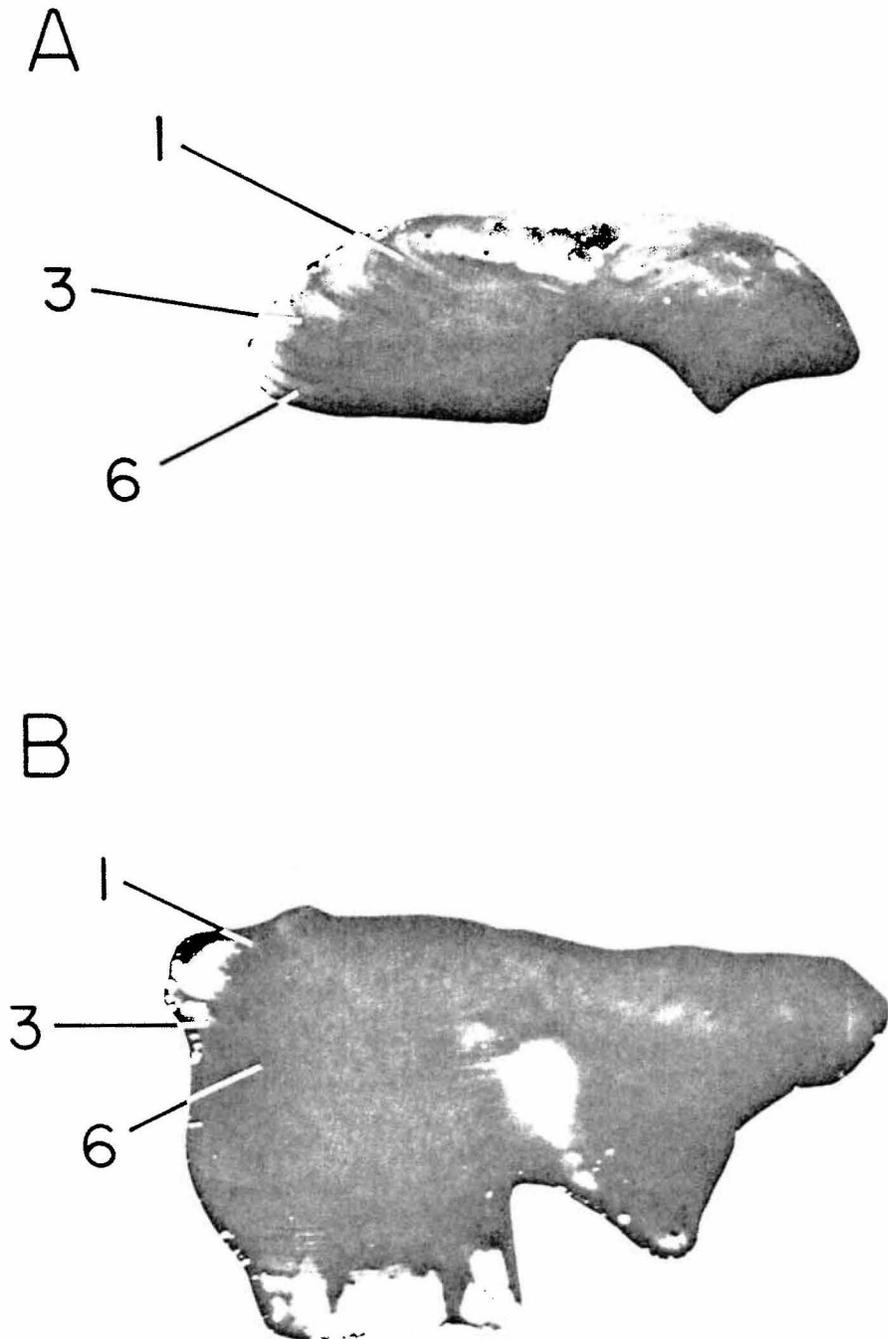


Fig. 1. Sections of broken and burnt sablefish otoliths. A. Section of otolith from a 6-year-old, 69 cm female. B. Section of otolith from a 70-year-old, 56 cm female captured off California. The position of the 6th annulus is identified for comparison with Fig. 1A.

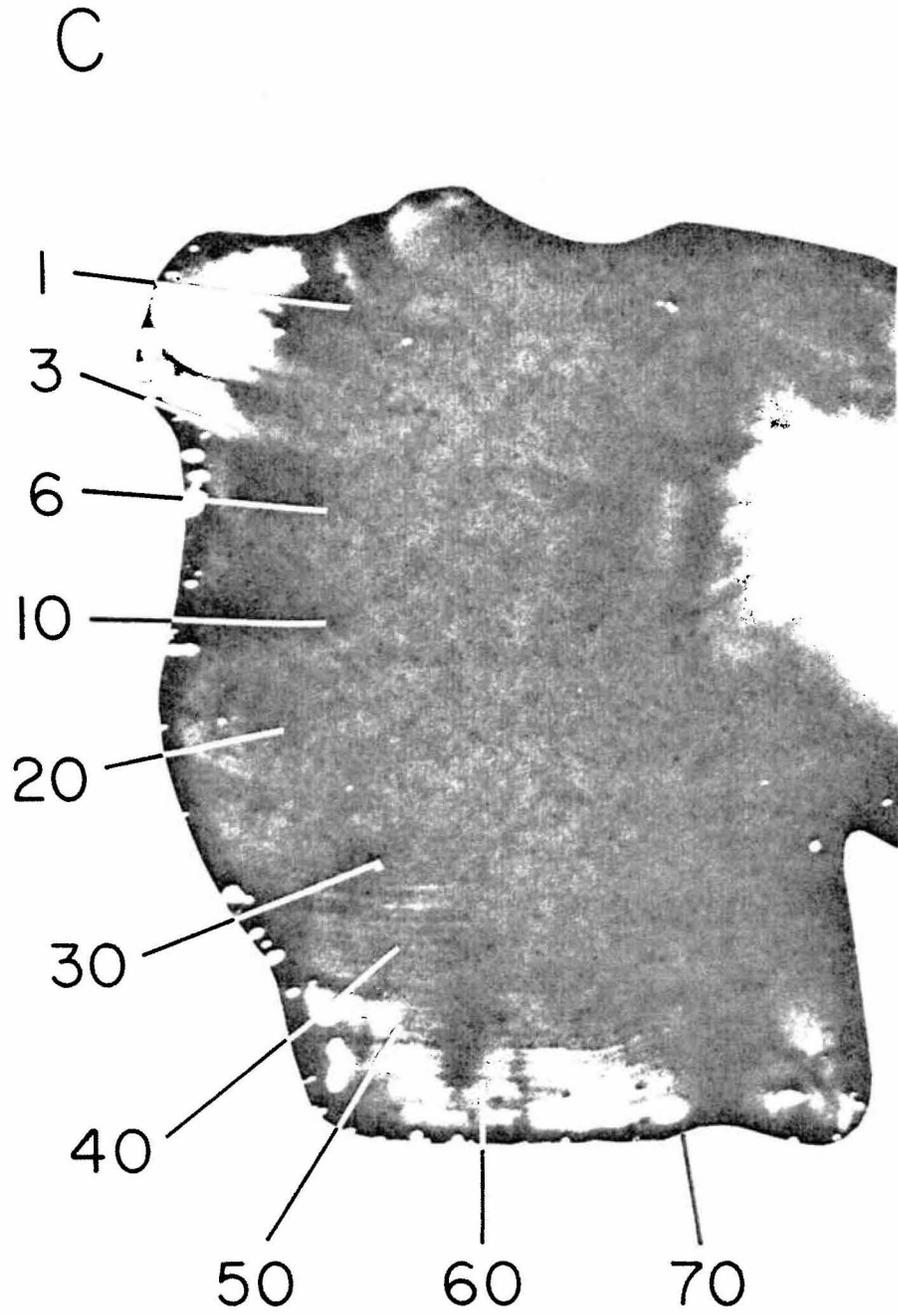


Fig. 1C. Enlargement of Fig. 1B, showing 70 annuli.

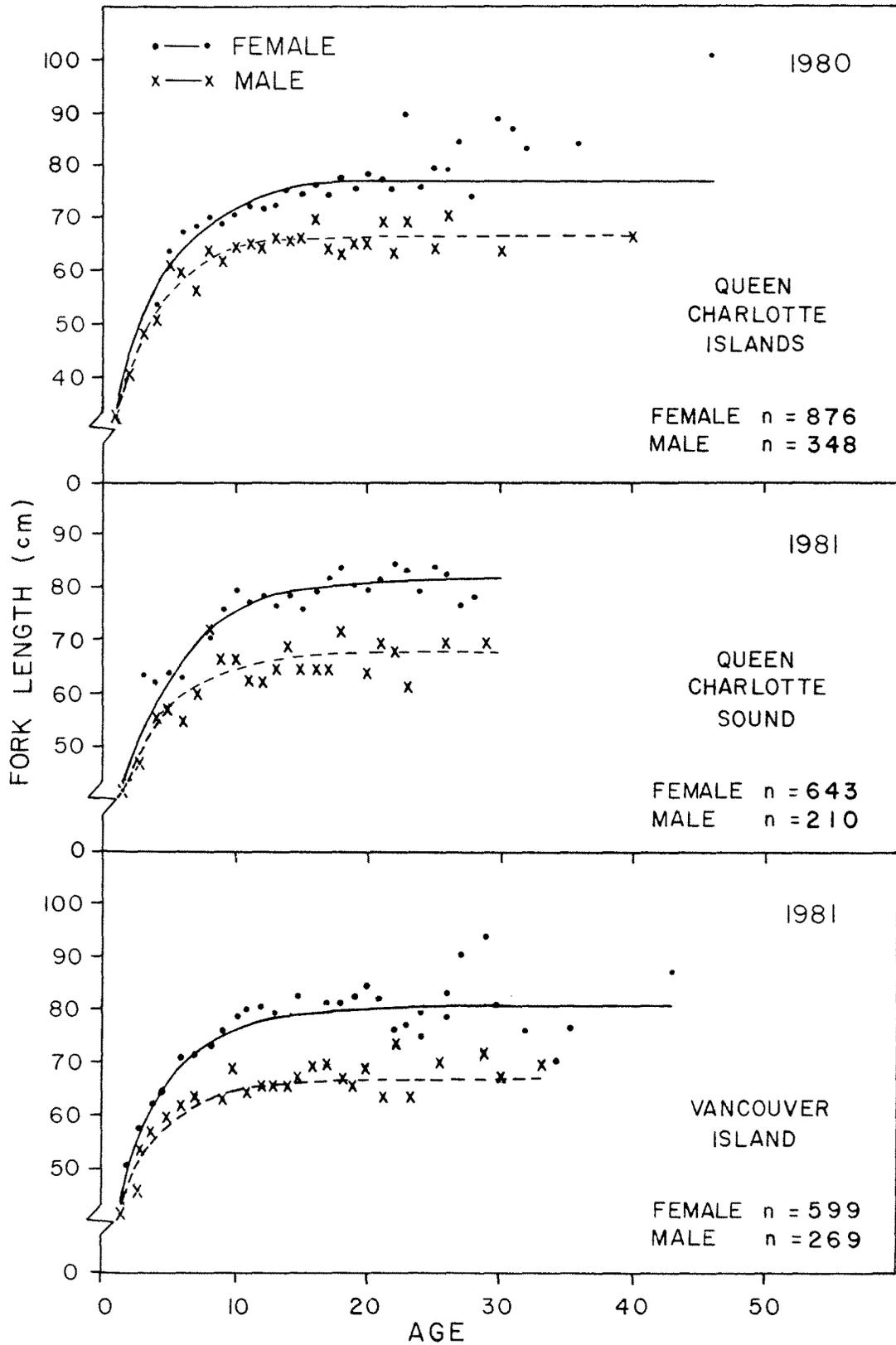


Fig. 2. Growth curves of sablefish stocks off the west coast of British Columbia in 1980 and 1981.