OVERVIEW OF THE FISHERY AND MANAGEMENT STRATEGY FOR SABLEFISH (Anoplopoma fimbria) OFF THE WEST COAST OF CANADA

by

Gordon A. McFarlane and Richard J. Beamish

Department of Fisheries and Oceans
Fisheries Research Branch
Pacific Biological Station
Nanaimo, B.C. V9R 5K6

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Abstract

Early and recent history of the sablefish fishery off Canada, trends in stock abundance as reflected by catch/effort data, and stock assessments and management rationale are reviewed.

Introduction

The importance of the sablefish fishery in the Canadian zone has increased steadily since the extension of Canada's fishery jurisdiction zone in 1977. It is the purpose of this report to present an overview of the fishery, fishery statistics, and management strategy for sablefish off Canada. This report summarizes the current management strategy, however, recent information on the biology, abundance, and stock delineation of sablefish may indicate that strategies should be re-evaluated.

Methods

Material for this report was summarized from Department of Fisheries and Oceans annual reports, International North Pacific Fisheries Commission statistical yearbooks, and groundfish stock assessment documents produced by staff at the Pacific Biological Station. Unpublished sources of data are cited in the text or text tables.

Discussion

History of the Sablefish Fishery in Canada

Early history (summarized from Ketchen and Forrester 1954). The first fishery for sablefish in British Columbia was carried out on a small scale by the Indians of the Queen Charlotte Islands. However, because sablefish inhabit deeper waters there was little incentive for the development of an extensive fishery.

The first commercial fishery for sablefish in Canadian waters occurred late in the nineteenth century and was carried out by specially equipped longline vessels. The establishment of a market was hampered, however, by abundant supplies of salmon. Between 1910 and 1915, salmon production decreased and the rising demand for salted sablefish gave incentive for development of the fishery. Landings of sablefish rose from close to 2000 t in 1913 to almost 6000 t in 1917 but declined in following years, reaching their lowest levels during the depression of the 1930s (Table 1). In the late 1930s and early 1940s there was an improvement in the fishery due to a shortening of the halibut season and an increased demand for fish liver products, particularly vitamin A. The fishery was also aided by an increased demand for food fish early in World War II. Landings hit a peak of 1895 t in 1949 but abruptly dropped in subsequent years with the development of synthetic vitamin A in 1950 (Table 1; Fig. 1).

Recent history. From 1951-1971 catches by Canadian fishermen in the Canadian zone were fairly stable, averaging about 400 t/year (Tables 2 and 3). It should be noted that fish landed at British Columbia ports may have been caught outside the Canadian zone. It was not until 1951 that the portion of the catch made in areas such as Alaska could be separated from the total landings. Prior to that time this was not possible due to the methods used in recording catch data.

Heavy exploitation of sablefish off the Pacific coast of North America did not start until the late 1960s when Japan increased the size of its distant water longline fleet. In 1968 the Japanese fleet began fishing sablefish as a target species on an experimental basis. They increased their effort substantially in 1969 and 1970 and the catch of 5142 t in 1970 was the largest made during their years in the Canadian zone (Table 4). The largest proportion of their catch was taken off the Queen Charlotte Islands. Total catch by the Japanese fleet fluctuated between 2900 t and 4700 t from 1971 to 1975 and tapered off in following years, due to self-imposed catch limits for the northeastern Pacific and the quotas created by the declaration of a 200-mile fishery zone by Canada in 1977.

The USSR and the Republic of Korea (R.O.K.) also fished off the Pacific coast of North America but to a lesser extent off British Columbia than did Japan. There is little information on catches made by the USSR prior to 1973 but it is known that they removed 6 and 65 t of sablefish incidental to their trawl catches in 1973 and 1974, respectively (Ketchen, 1977). The R.O.K. was engaged in a longline fishery targeting on sablefish from 1974 to 1977 and in 1975 and 1976 was a strong competitor with Japan (Table 4).

As of January 1, 1977, Canada declared a 200-mile fishery conservation zone. The total allowable catch (TAC) of sablefish for the Canadian zone was set at 5,000 t for 1977. It was estimated that Canada and the United States would not require more than 1500 t and as a result 3500 t of the 5000 t TAC was considered as surplus. Quotas of 3000 t and 500 t were allotted to Japan and the Republic of Korea, respectively. From 1978 to the present the TAC for the Canadian zone was reduced to 3500 t, with Japan being allotted 2200 t in 1978, 1000 t in 1979, and 200 t in 1980. Since 1980, Japan has not fished sablefish in the Canadian zone.

Table 1. Sablefish landings in the Canadian zone, 1913-1950 (round weight, tonnes).[a]

Year	Vancouver[b]	Charlotte[c]	Total
1913			1988
1914			3209
1915			2441
1916			4312
1917			5956
1918	1013	1026	2039
1919	446	270	716
1920	743	1011	1754
1921	774	609	1383
1922	843	450	1293
1923	727	408	1135
1924	786	452	1238
1925	406	611	1017
1926	343	362	705
1927	578	540	1118
1928	610	301	911
1929	729	313	1042
1930	746	378	1124
1931	337	60	397
1932	280	156	436
1933	208	205	413
1934	206	229	435
1935	348	311	659
1936	208	282	490
1937	396	516	912
1938	342	234	576
1939	403	214	617
1940	319	629	948
1941	348	840	1188
1942	277	558	835
1943	591	835	1426
1944	844	675	1519
1945	734	694	1428
1946	411	1208	1619
1947	346	559	891
1948	364	1119	1483
1949	691	1204	1895
1950	290	358	648

[a]Fishery Statistics of Canada. Converted from dressed weight to round weight by a factor of 1.5.

[b]Listed as District 1 or South Coast and District 3 or Fraser.

[c]Listed as District 2 or North Coast.

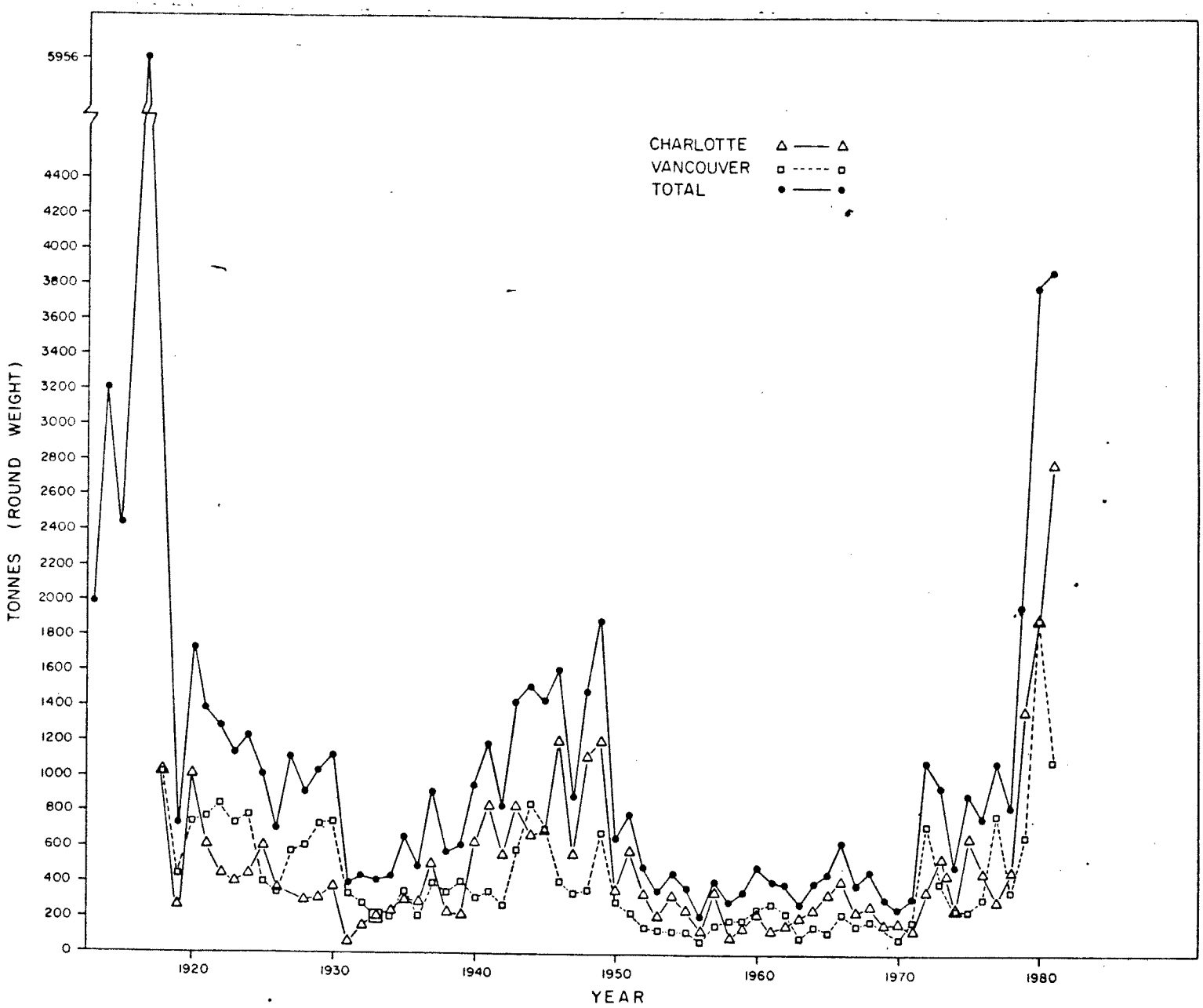

Fig. 1. Canadian landings of sablefish, 1913-1981 (landings prior to 1951 include fish caught in Alaska).

Table 2. Canadian sablefish catches, by gear, in the "Vancouver" zone, 1951-1981 (round wt., metric tons).[a]

	Gear type								
	Longline		Trawl		Trap		Other[b]		
Year	Wt.	%	Wt.	%	Wt.	%	Wt.	%	Total
1951	196.1	(89.8)	21.8	(9.9)			0.5	(0.2)	218.4
1952	115.1	(78.3)	31.3	(21.3)			0.6	(0.4)	147.0
1953	129.4	(94.6)	6.3	(4.6)			1.1	(0.8)	136.8
1954	103.7	(80.8)	24.3	(18.9)	0.3	(0.2)			128.3
1955	115.5	(89.3)	13.9	(10.7)					129.4
1956	48.3	(60.8)	31.1	(39.2)					79.4
1957	123.6	(74.8)	41.2	(25.0)	0.3	(0.2)			165.1
1958	78.6	(41.2)	111.4	(58.4)	0.6	(0.3)			190.6
1959	143.8	(72.5)	54.6	(27.5)					198.4
1960	208.9	(80.9)	49.2	(19.1)					258.1
1961	198.1	(69.4)	87.4	(30.6)					285.5
1962	152.5	(64.4)	83.2	(35.1)			1.1	(0.5)	236.8
1963	64.5	(76.0)	20.4	(24.0)					84.9
1964	108.4	(71.6)	42.9	(28.4)					151.3
1965	54.0	(44.1)	68.5	(55.9)					122.5
1966	127.2	(55.9)	100.3	(44.1)					227.5
1967	55.7	(34.4)	106.3	(65.6)					162.0
1968	68.4	(35.9)	122.3	(64.1)					190.7
1969	18.2	(12.5)	126.8	(87.3)			0.3	(0.2)	145.3
1970	12.0	(14.8)	69.3	(85.2)					81.3
1971	14.6	(8.1)	166.7	(91.9)					181.3
1972	100.3[c]	(13.7)	632.7	(86.3)					733.0
1973	3.2	(0.8)	50.9	(12.5)	353.4	(86.7)	Tr		407.5
1974	2.3	(0.9)	83.7	(33.6)	161.5	(64.8)	1.8	(0.7)	249.3
1975	2.3	(0.9)	200.3	(81.8)	41.5	(16.9)	0.9	(0.4)	245.0
1976	41.7	(13.3)	224.8	(71.5)	47.6	(15.1)	0.1	(0.1)	314.2
1977	27.3	(3.5)	688.4	(87.1)	68.9	(8.7)	5.9	(0.7)	790.5
1978	18.2	(5.1)	89.9	(25.4)	239.5	(67.7)	6.4	(1.8)	354.0
1979	118.3	(17.5)	143.4	(21.2)	409.8	(60.5)	6.0	(0.9)	677.5
1980	69.1	(3.6)	106.8	(5.6)	1722.5	(90.6)	3.0	(0.2)	1901.4
1981	94.8	(8.6)	140.2	(12.8)	862.4	(78.6)			1097.4

[a]Can. Dept. Fish., British Columbia Catch Statistics, 1951-1971 (converted from dressed weight to round weight by a factor of 1.5). Fish. Res. Board Can. Catch and effort statistics of the Canadian groundfish fishery of the Pacific coast, 1972-1981.

[b]Includes troll and handline.

[c]Includes longline, handline, and others.

Table 3. Canadian sablefish catches, by gear, in the "Charlotte" zone, 1951-1981 (round wt., metric tons).[a]

	Gear type								
	Longline		Trawl		Trap		Other[b]		
Year	Wt.	%	Wt.	%	Wt.	%	Wt.	%	Total
1951	576.7	(99.8)	1.3	(0.2)					578.0
1952	338.1	(99.2)	2.7	(0.8)					340.8
1953	206.2	(99.2)	1.7	(0.8)					207.9
1954	328.6	(99.4)	2.1	(0.6)					330.7
1955	243.5	(99.8)	0.6	(0.2)					244.1
1956	124.5	(95.4)	6.0	(4.6)					130.5
1957	342.0	(98.3)	5.9	(1.7)					347.9
1958	88.5	(93.5)	6.2	(6.5)					94.7
1959	154.5	(98.3)	2.7	(1.7)					157.2
1960	214.4	(93.2)	15.7	(6.8)					230.1
1961	123.2	(92.1)	10.6	(7.9)					133.8
1962	125.2	(80.4)	30.5	(19.6)					155.7
1963	157.8	(77.9)	44.5	(22.0)			0.2	(0.1)	202.5
1964	166.1	(66.9)	82.2	(33.1)			0.1	-	248.4
1965	139.2	(41.8)	193.4	(58.1)			0.3	(0.1)	332.9
1966	198.5	(48.6)	209.4	(51.3)			0.2	(0.1)	408.1
1967	197.2	(85.8)	32.6	(14.2)			0.1	(0.1)	229.9
1968	223.9	(82.1)	33.7	(12.4)			15.1	(5.5)	272.7
1969	144.1	(86.9)	21.4	(12.9)			0.3	(0.2)	165.8
1970	130.1	(73.2)	47.2	(26.5)			0.5	(0.3)	177.8
1971	108.4	(82.7)	22.7	(17.3)					131.1
1972	299.4	(84.3)	55.8	(15.7)					355.2
1973	116.6	(21.6)	31.7	(5.9)	392.4	(72.6)			540.7
1974	39.0	(16.1)	38.1	(15.7)	165.6	(68.2)			242.7
1975	149.9	(22.7)	82.0	(12.4)	427.9	(64.9)			659.8
1976	47.7	(10.4)	154.2	(33.7)	255.8	(55.9)			457.7
1977	49.8	(16.9)	98.3	(33.4)	145.7	(49.4)	0.9	(0.3)	294.7
1978	39.0	(8.2)	40.4	(8.5)	395.1	(83.0)	1.4	(0.3)	475.9
1979	158.7	(11.7)	133.1	(9.8)	1067.6	(78.5)			1359.4
1980	179.7	(9.5)	226.7	(12.0)	1488.3	(78.6)			1894.7
1981	284.8	(10.2)	92.9	(3.3)	2412.6	(86.5)			2790.3

[a]Can. Dept. Fish. British Columbia Catch Statistics, 1951-1971 (converted from dressed weight to round weight by a factor of 1.5). Fisheries Research Board of Canada Catch and effort statistics of the Canadian groundfish fishery of the Pacific coast, 1972-1981.

[b]Includes troll, handline, and sunken gillnet (1968 only).

Table 4. Sablefish catch (t) by nation (all fishing gears) in INPFC areas "Vancouver" and "Charlotte", 1964-1981.

Calendar year	Canada[a]			U.S.A.[b]			Japan[c]		
	Charl.	Vanc.	Total	Charl.	Vanc.	Total	Charl.	Vanc.	Total
1964	248	151	399	40	43	83			
1965	333	123	456	40	52	92			
1966	408	228	636	39	56	95	164	10	174
1967	230	162	392	49	16	65	381	808	1189
1968	273	191	464	29	36	65	1870	520	2390
1969	166	145	311	26	17	43	2533	2187	4720
1970	178	81	259	21	83	104	3980	1162	5142
1971	131	181	312	11	150	161	2180	870	3050
1972	355	733	1088	19	563	582	2784	1452	4236
1973	541	408	949	20	62	82	2143	807	2950
1974	243	249	492	33	194	227	2084	1782	3866
1975	660	245	905	12	529	541	3286	1416	4702
1976	458	314	772	25	448	473	2628	866	3494
1977	295	791	1086	42	529	571	1818	1143	2961
1978	476	354	830	Tr	948	948	1339	764	2103
1979	1359	678	2037	17	1219	1236			1112[d]
1980	1895	1901	3796	10	307	407			199
1981	2790	1097	3887						

Calendar year	U.S.S.R.[e]			R.O.K.[e]			TOTAL
	Charl.	Vanc.	Total	Charl.	Vanc.	Total	
1964							482
1965							548
1966							905
1967							1646
1968							2919
1969							5074
1970							5505
1971							3523
1972							5906
1973		6	6				3981
1974		65	65		129	129	4779
1975				207	1056	1263	7411
1976						2335	7074
1977						186[d]	4804
1978							3881
1979							4385
1980							4402
1981							3887

[a]Canada Dept. Fisheries, B.C. Catch Statistics, 1965-1971, and Fish. Res. Board Can. Catch and effort statistics of the Canadian groundfish fishery of the Pacific coast (1972-1981).

[b]Ketchen (1977) until 1973; from INPFC Statistical Yearbooks, 1974-1979 (1979 preliminary); and from PMFC data series, 1980.

Table 4 (cont'd).

[c]INPFC Statistical Yearbooks, 1964-1978, and from fishing log books for 1979-1980.

[d]Best estimate of catch using fishing log books plus observer information. These figures differ from previously published estimates (Ketchen 1980) as a result of a change in conversion rates.

[e]Ketchen (1977).

In Canada, the sablefish fishery has traditionally been carried out by longlining and trawling. The effort expended by the longline fleet has been closely linked to the fluctuations of the halibut fishery. Most longline vessels targeted on sablefish only after the halibut season closed. As the halibut season was shortened over the years more boats turned to sablefish, particularly when they were allowed to retain incidental catches of halibut after that season had closed. From 1951 to 1972 longliners accounted for the largest portion of domestic sablefish landings, especially in the "Charlotte" area (Table 3; Fig. 2). In the "Vancouver" area trawl landings surpassed landings by other gear types from the mid-sixties until 1977 (Table 2).

In 1973, longline landings dropped sharply with the introduction of traps to the fishery (Tables 2 and 3; Fig. 2). The trap fishery has been most successful off the west coast of the Queen Charlotte Islands, accounting for about 70% of the sablefish landings from that area from 1973 to 1981. In 1980 there were restrictions put on Canadian participation in the halibut fishery in U.S. waters and this resulted in an increased number of vessels landing sablefish and also some changes in gear from longline to trap. Since 1980, trap-caught sablefisn have accounted for approximately 80 to 90% of landings from both areas.

The increase in trawl landings in the "Vancouver" area may be partly attributed to a reduction in the minimum size limit. In 1945, a minimum size limit of 5 lb. (2.3 kg) dressed, head-on (approximately 63 cm FL) was imposed for economic reasons and in 1948 it was amended to 4.5 lb. (2.0 kg) dressed, head-off (Ketchen and Forrester, 1954). In 1965 the minimum size was reduced to 2.5 lb. (1.1 kg) dressed, head-off (approximately 54 cm FL). This regulation remained in effect until November 1970 when a large number of undersized sablefish were landed by special permit to test a specialty market for small sablefish. In July 1972 the minimum size regulation was waived for three months, on an experimental basis, and there was a corresponding sharp increase in trawl landings of sablefish (Table 2). A downward shift in the sizes of fish landed was evident, as fish that would normally have been discarded were kept (unpub. data). In October 1972 the size limit was reinstated and has remained in effect since that time. In 1977 it was redefined as the equivalent size of 4 lb. (1.8 kg) round weight (approximately 55 cm FL).

In 1981, license limitation was implemented in an attempt to control effort directed towards sablefish. There are currently 49 sablefisn or "K" licenses in the fishery of which 16 are longline and 31 are trap vessels. Two licenses have not been identified by gear.

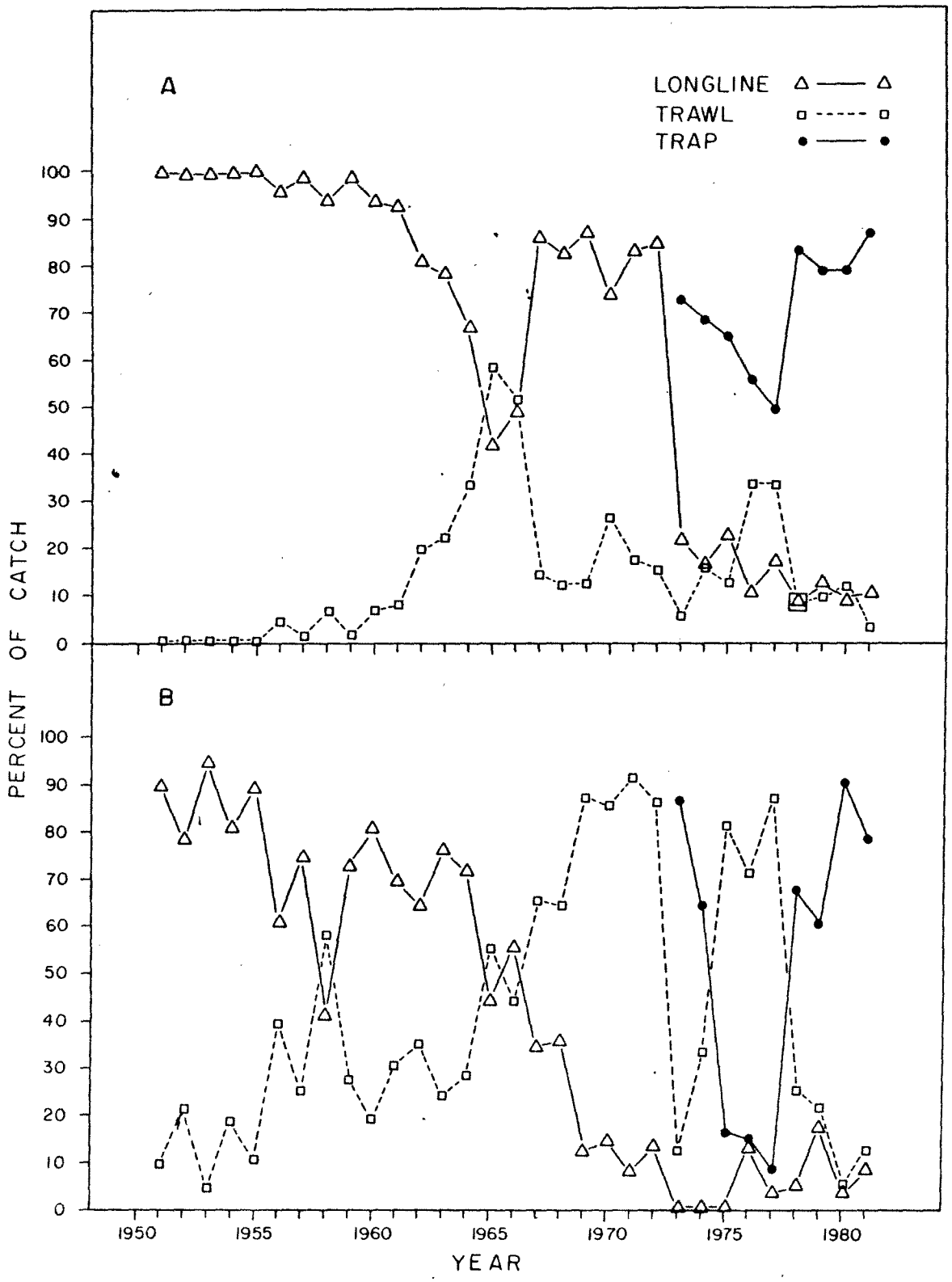

Fig. 2. Percent catch of sablefish by major gear type in the Canadian fishery (1951-1981) A. Charlotte zone and B. Vancouver zone.

Trends in CPUE

Japan. Catch-per-unit-effort for the Japanese longline fishery is defined as catch in metric tons per 10 hachi (t/10 hachi). One hachi of longline gear is approximately 100 m long and contains an average of 40 hooks but the number of hooks may vary between 33 and 53 (information from observers aboard longliners in 1977, 1978, and 1979). Since the Japanese freeze a dressed product, their estimate of total catch was obtained by multiplying the dressed product weight by 1.333, a recovery rate of 75%. However, calculations made by Canadian observers indicated that the recovery rate is closer to 65%; that is the dressed, head-off weight should be multiplied by 1.538. Reported total catches would therefore be lower than actual total catches by approximately 15%. Of course, if these conversion factors have not changed since the beginning of the fishery, CPUE data will not be affected.

The use of 10-hachi units to measure fishing effort could misrepresent effort if longer "soak-time" times are used. Soak-time is the period of time, usually in hours, that the gear is left in the water and is actually fishing. The use of boat-days, the number of calendar days spent fishing, might reduce the dependence on soak-time, however, a boat-day unit ignores the problem of increased efficiency by setting more hachi per day or more hooks per hachi. Since the possibility of setting

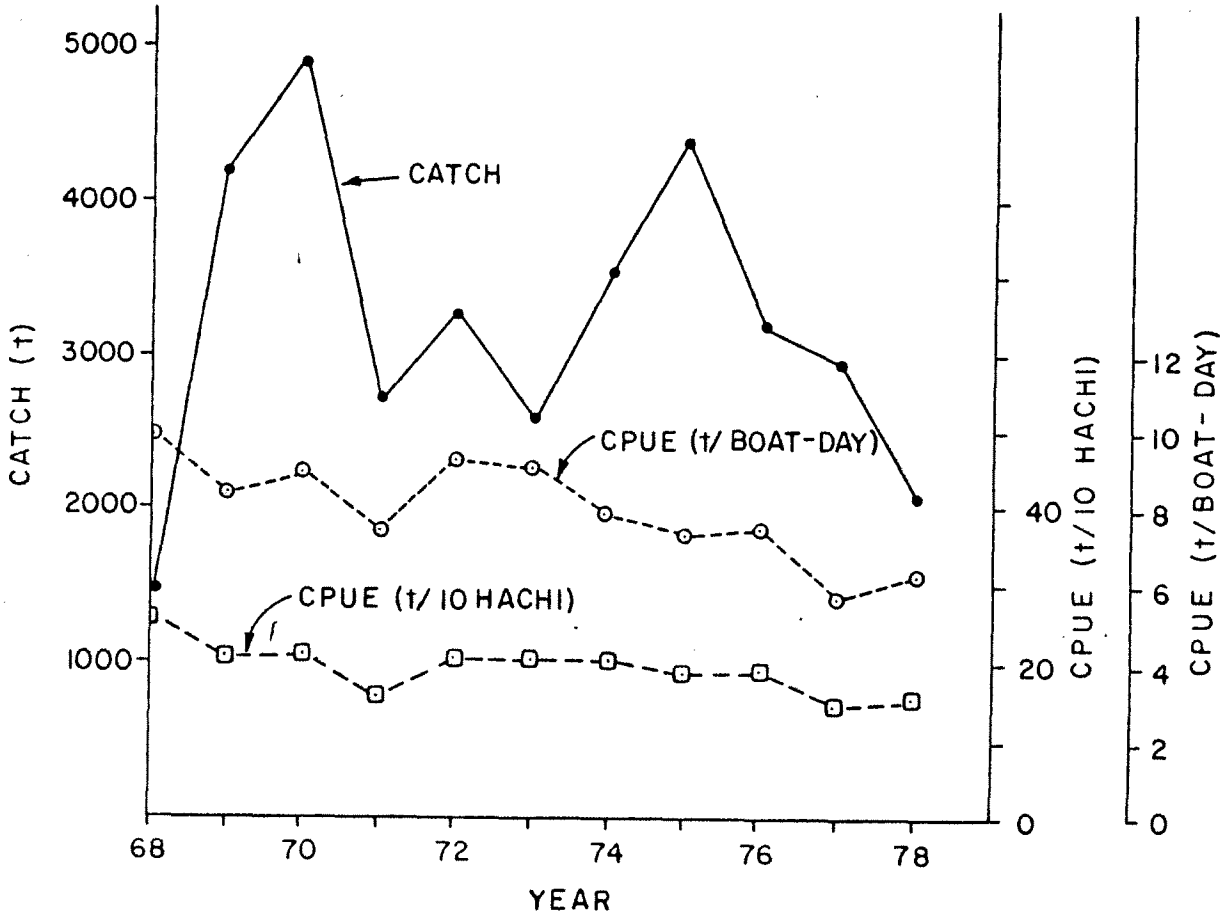

Fig. 3. Trends in catch and CUPE for the Janpanese longline fishery for sablefish in Canadian waters (48°00' - 54°39') 1968-1978).

more hachi per day is thought to have a greater effect than longer "soak-time", effort calculated as 10-hachi units is thought to be more accurate. The CPUE using boat-days has been calculated for the whole coast for comparison (Fig. 3).

The Japanese catches (Table 5; Fig. 3) show an initial decline from 1968 to 1971 in CPUE from 0.261 t per 10-hachi to 0.162 t per 10-hachi. CPUE then remained relatively steady from 1972 to 1976 ranging from 0.194 to 0.210 t per 10-hachi. During 1977, CPUE dropped by 24% to 0.147 t per 10-hachi and 1978 CPUE was only slightly higher at 0.162 t per 10-hachi. (If a correction for the 1977 and 1978 catches for the discrepancy in recovery rates is made, the drop in CPUE in 1977 is only 13% to 0.170 t per 10-hachi.)

Table 5. Sablefish catch (t) and effort (10-hachi) statistics for Japanese longline fishery in Canadian waters (48°00'-54°30'N lat.), 1968-78.

Calendar year	Catch (t)	Effort (10-hachi)	CPUE (t/10-hachi)
1968[a]	1,454	5,573	0.261
1969	4,224	22,412	0.207
1970	4,919	22,886	0.215
1971	2,721	16,774	0.162
1972	3,491	16,831	0.207
1973	2,585	12,367	0.209
1974	3,527	16,765	0.210
1975	4,433	22,807	0.194
1976	3,209	16,519	0.194
1977[b]	2,982(3,440)[c]	20,260	0.147(0.170)[c]
1978	2,091(2,405)[c]	13,396	0.162(0.180)[c]
1968-78 average	3,240	16,781	0.197

[a]1968-76 statistics from U.S. National Marine Fisheries Service computer printouts.

[b]1977 and 1978 statistics from fishing log books.

[c]Catch and CPUE corrected for change in recovery rates reported by observers on board vessels.

A similar pattern of change in CPUE is seen in the Queen Charlotte Islands-Dixon Entrance area, Sub-zone 5-5, (Table 6; Fig. 4), where CPUE declined from 1968 to 1971 from 0.289 t per 10-hachi to 0.180 t per 10-hachi. During 1972-75, CPUE was relatively consistent, varying between 0.194 t per 10-hachi and 0.202 t per 10-hachi. A drop in CPUE in 1976 to 0.184 t per 10-hachi precedes the drop in 1977 to 0.140 t per 10-hachi. However, there was an increase in CPUE in 1978 to 0.162 t per 10-hachi.

Table 6. Sablefish catch (t) and effort (10-hachi) statistics for Japanese longline fishery in the Queen Charlotte Islands-Dixon Entrance area, Sub-zone 5-5 (52°00'-54°30'N lat.), 1968-78.

	Total for Sub-zone 5-5			Block with the largest catch (033540)		
Year[a]	Catch (t)	Effort (10-hachi)	CPUE (t/10-hachi)	Catch (t)	Effort (10-hachi)	CPUE (t/10-hachi)
1968[b]	1,142	3,954	.289	478	1,532	.312
1969	1,490	6,650	.224	580	2,128	.273
1970	1,549	7,229	.214	708	2,971	.238
1971	1,472	8,164	.180	786	4,484	.175
1972	2,080	10,284	.202	1,221	5,996	.204
1973	1,327	6,589	.201	752	3,731	.202
1974	1,151	5,875	.196	694	3,559	.195
1975	1,610	8,284	.194	935	4,759	.196
1976	1,259	6,850	.184	717	4,098	.175
1977[c]	737	5,246	.140	377	2,743	.138
1978	555	3,424[d]	.162	219[e]	1,363[e]	.161

[a]Calendar year.

[b]1968-76 data from U.S. Nat. Marine Fish. Serv. computer printouts.

[c]1977 and 1978 data from Japanese log books.

[d]One log book unavailable, therefore, effort estimated.

[e]Catch and effort in this block probably higher -- missing information from one log book.

The pattern of catch and effort in Queen Charlotte Sound, Sub-zone 5-4, and off Vancouver Island, Sub-zones 5-1, 5-2, and 5-3 was different from Sub-zone 5-5 (Table 7, 8; Fig. 4). In the former areas CPUE is almost as high between the years 1972 and 1976 as the initial high CPUEs in 1969 and 1970. However, there were low CPUEs in 1971 and in 1977. The increase in CPUE in 1978 from the low of 1977 is less pronounced in these areas than in the Queen Charlotte Islands-Dixon Entrance area.

Canada. Accurate catch and effort statistics for the Canadian trap fishery were unavailable until 1977 when a concerted attempt was made to collect this information. The change from Canadian rectangular traps to Korean conical traps around 1978 further complicated the situation in that the change-over was so complete that we have very little information to standardize the two types of traps.

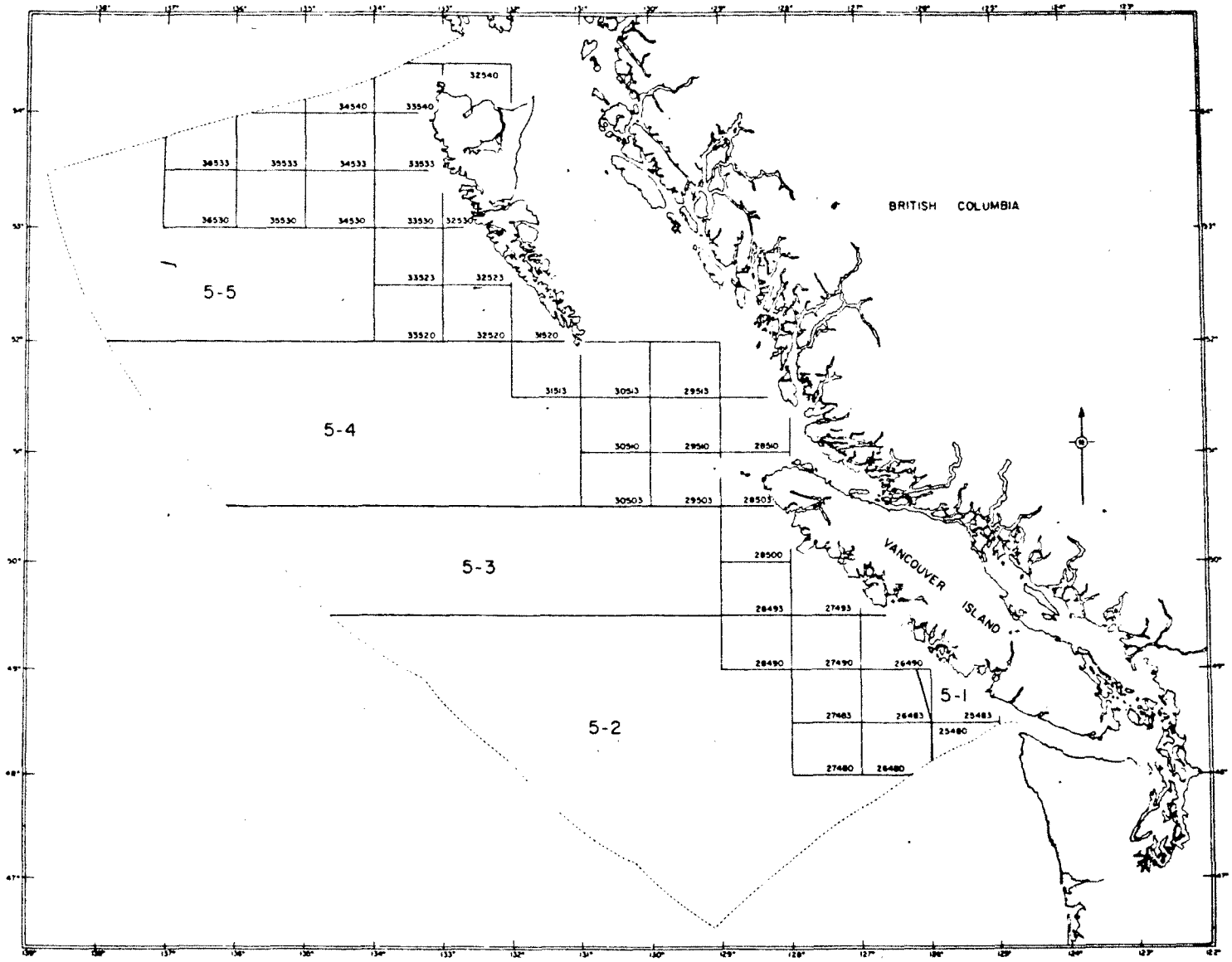

Fig. 4. Locations of blocks referred to in Japanese catch and effort records. Numbers refer to the longitude and latitude of the southeast corner of each block.

Table 7. Sablefish catch (t) and effort (10-hachi) statistics for Japanese longline fishery adjacent to Queen Charlotte Sound, Sub-zone 5-4 (50°30'-52°00'N lat.), 1968-78.

Year[a]	Total for Sub-zone 5-4			Block with the largest catch					
				Catch (t)					
	Catch (t)	Effort (10-hachi)	CPUE (t/10-hachi)	029510	029503	030510	030513	Effort (10-hachi)	CPUE (t/10-hachi)
1968[b]	73	466	.157	22	-	-	-	189	.116
1969	765	3,700	.207	-	-	246	-	1,051	.234
1970	2,310	10,756	.215	-	-	886	-	3,988	.222
1971	655	4,458	.147	-	-	-	338	1,843	.183
1972	585	2,503	.234	-	-	-	295	1,140	.259
1973	460	2,156	.213	-	178	-	-	872	.204
1974	820	3,755	.218	-	-	-	268	1,172	.229
1975	1,444	7,397	.195	-	-	-	405	2,051	.197
1976	1,126	5,327	.211	-	-	-	741	3,382	.219
1977[c]	1,081	7,342	.147	-	-	-	423	2,761	.153
1978	765	4,924	.155	-	-	-	304	1,954	.155

[a]Calendar year.

[b]1968-76 data from U.S. Nat. Marine Fish. Serv. computer printouts.

[c]1977 and 1978 data from Japanese log books.

Table 8. Sablefish catch (t) and effort (10-hachi) statistics for Japanese longline fishery in the Vancouver Island Area, Sub-zones 5-1, 5-2 and 5-3 (48°00'-50°30'N. lat.), 1968-78.

Year[a]	Total for Sub-zones 5-1,2,3			Block with the largest catch						
				Catch (t)						
	Catch (t)	Effort (10-hachi)	CPUE	028500	027493	027490	026483	025480	Effort (10-hachi)	CPUE
1968[b]	239	1,153	.207	-	102	-	-	-	466	.219
1969	1,969	10,062	.196	-	796	-	-	-	4,367	.182
1970	1,060	4,901	.216	455	-	-	-	-	1,858	.245
1971	594	4,152	.143	-	-	-	200	-	1,264	.158
1972	826	4,044	.204	-	191	-	-	-	826	.231
1973	798	3,622	.220	-	-	-	211	-	943	.224
1974	1,556	7,135	.218	-	-	-	-	411	1,893	.217
1975	1,379	7,126	.194	-	-	371	-	-	1,903	.195
1976	824	4,342	.190	267	-	-	-	-	1,295	.206
1977[c]	1,164	7,672	.152	-	-	-	308	-	1,942	.158
1978	771	5,048[d]	.162	-	238[e]	-	-	-	1,445[e]	.165

[a]Calendar year.

[b]1968-76 data from U.S. Nat. Marine Fish. Serv. computer printouts.

[c]1977 and 1978 data from Japanese log books.

[d]One log book unavailable, therefore, effort estimated.

[e]Catch and effort in this block probably higher--missing information from one log book.

The CUPE data for 1978 are incomplete and probably not representative of the annual catch and CPUE for Korean traps. The coast-wide CPUE from 1979 to 1982 is similar and has varied from 14.8 to 17.4 kg/trap (Table 9, Fig. 5). There has been considerable variation between and within areas (Table 9). The first quarter (January to April) landing statistics have been included for comparison (Table 10, Fig. 5) showing the substantial increases in catch made in this quarter since 1980. In the Vancouver area both catch and CPUE declined by 50 and 30% in 1981 and 1982 respectively, from 1980 levels. At this time, the decline in CPUE in this area is attributed to new participants entering the fishery and is not a reflection of declining abundance. In the Charlotte area CPUE has remained relatively stable with substantial increases in both catch and effort (Table 9), in 1981 and 1982.

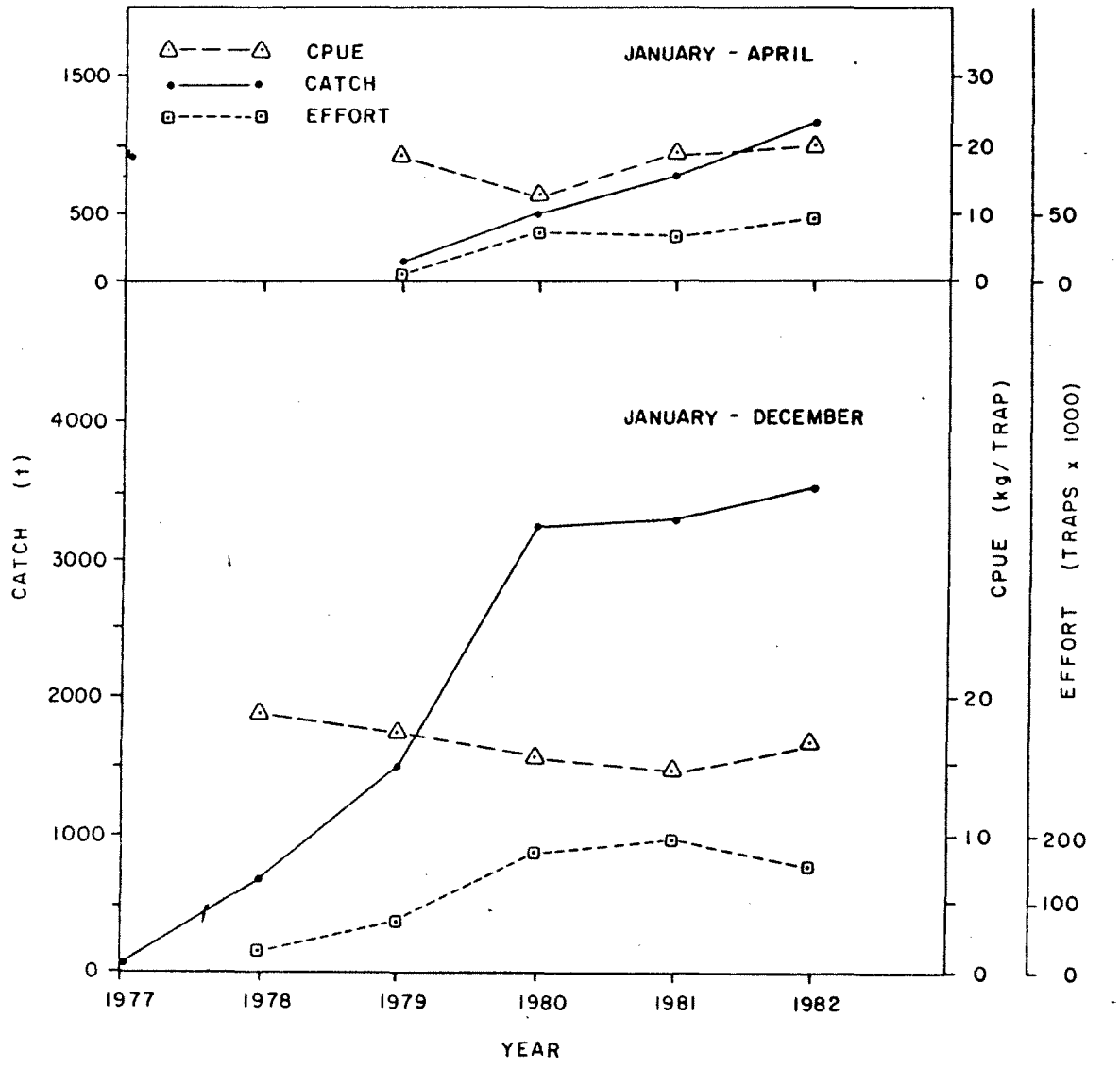

Fig. 5. Trends in catch and CPUE for the Canadian trap fishery for sablefish in Canadian waters, 1977-1982.

Table 9. Reported sablefish catch (round weight) and effort statistics for the Canadian trap fishery by INPFC Areas - Vancouver and Charlotte, 1978-1982.

	Vancouver			Charlotte			Total		
Year	Catch (tonnes)	Effort (traps)	CPUE (kg/trap)	Catch (tonnes)	Effort (traps)	CPUE (kg/trap)	Catch (tonnes)	Effort (traps)	CPUE (kg/trap)
1978	141.3	5,603	15.3	404.8	23,127	17.5	545.3	28,730	18.9
1979	409.8	18,687	13.9	1067.6	52,531	18.1	1477.4	71,218	17.4
1980	1722.5	80,312	15.0	1488.3	91,873	15.7	3210.8	172,185	15.4
1981	862.5	72,947	10.3	2412.6	125,885	17.4	3275.1	198,827	14.8
1982	947.2	43,560	11.8	2559.8	111,085	18.7	3507.0	154,645	16.8

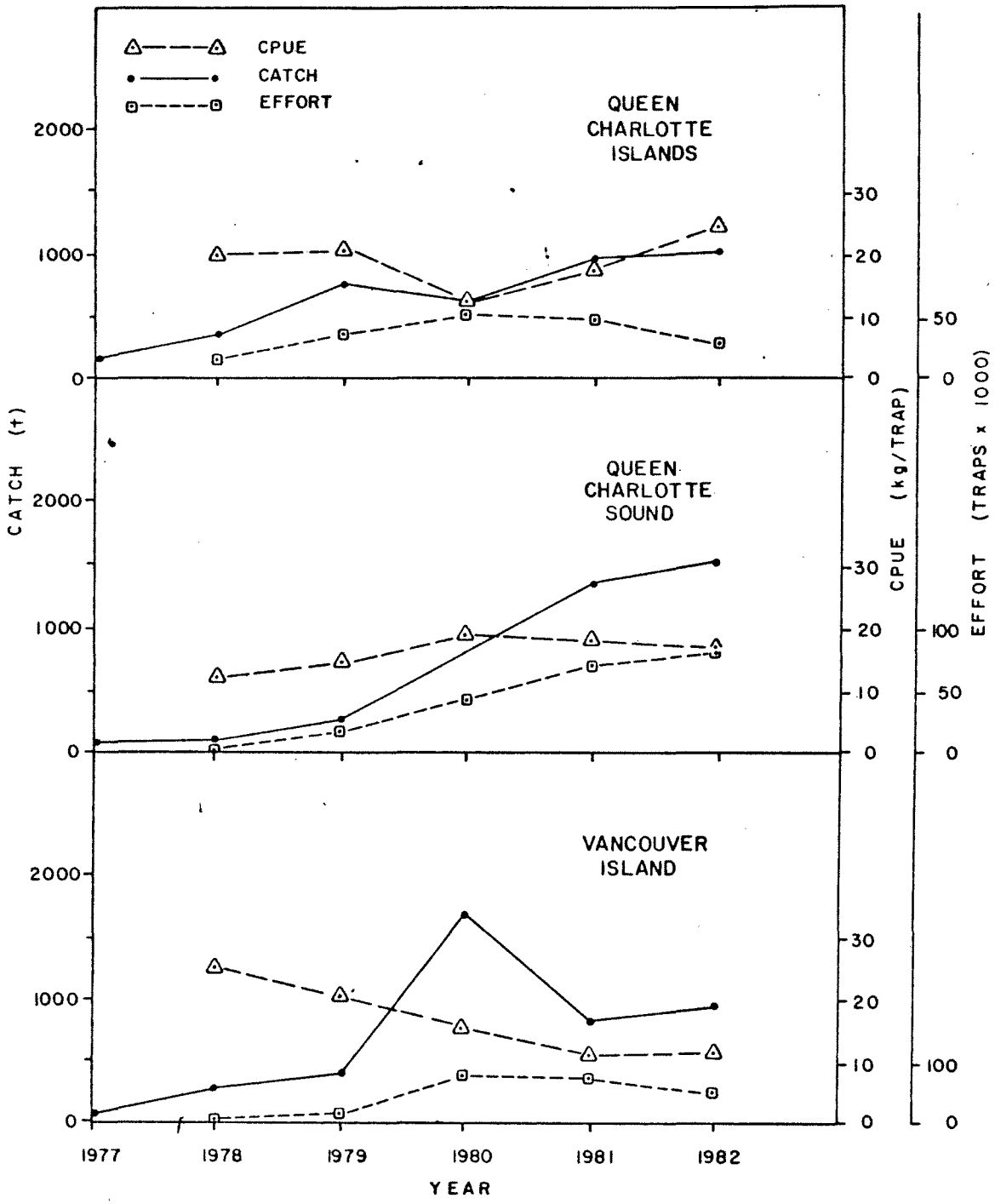

Fig. 6. Trends in catch and CPUE for the Canadian trap fishery for sablefish in the major fising areas, 1977-1982.

Table 10. Sablefish total trap catch and CPUE estimates for January 1-April 10 and for all months combined for the three major fishing areas[a] during 1977-1982.

	Vancouver Island				Queen Charlotte Sound				Queen Charlotte Islands			
	1st Qtr.		All Qtrs.		1st Qtr.		All Qtrs.		1st Qtr.		All Qtrs.	
Year	T.L.[b] (t)	CPUE kg/trap	T.L. (t)	CPUE kg/trap	T.L. (t)	CPUE kg/trap	T.L. (t)	CPUE kg/trap	T.L. (t)	CPUE kg/trap	T.L. (t)	CPUE kg/trap
1977	-	-	53.6		-	-	17.3	-	-	-	128.6	-
1978	-	-	141.3	25.2	-	-	77.6	11.6	-	-	326.4	20.1
1979	15.1	-	392.0	14.1	-	-	281.3	14.0	163.4	18.3	759.7	20.9
1980	275.7	16.9	1714.1	15.0	31.3	8.6	797.2	18.5	193.1	9.9	682.8	13.5
1981	240.3	12.5	860.6	10.3	198.7	22.4	1359.1	17.9	342.3	24.2	991.9	18.5
1982	222.0	13.0	942.2	11.8	369.1	16.8	1511.2	16.8	586.6	30.9	1033.7	25.0

[a]Vancouver Island = Statistical Areas 3C and 3D
Queen Charlotte Sound = Statistical Areas 5A, 5B, and 5C
Queen Charlotte Islands = Statistical Areas 5E

[b]T.L. = Total Landing

In the Charlotte area, two major fishing grounds are monitored (Table 10). In Queen Charlotte Sound (Table 10, Fig. 6) landings increased by approximately 71% in 1981 and 90% in 1982 from 1980 levels as a result of an 85% increase in effort during these years. CPUE in this area has remained relatively constant (Table 10), ranging from 14.0 to 18.5 kg/trap from 1977 to 1982. Off the west coast of the Queen Charlotte Islands (Table 10, Fig. 6) landings increased by approximately 47% in 1981 and 1982 over the 1980 level, despite declining effort (Table 9, Fig. 6). It is unknown at this time if the dramatic increase in CPUE in 1982 is an error in reporting or due to the particular vessels involved in the fishery in that area.

Review of Stock Assessments

American scientists in 1979 used two methods to fit the sablefish catch and effort data from the Japanese longline fishery to a general production model. They indicate from tagging observations that there may be a number of biological stock units. However, defining these stocks was considered to be difficult so an analysis by geographical regions was used. Their results for the longline fishery off Canada produced a MSY of 5,155 t/yr using the method of Fox (1970) and a MSY of 5,800 t/yr using the method of Rivard and Bledsoe (1973, personal communication) (Table 11).

Initially, Canadian scientists used two methods to estimate MSY (Westrheim, 1980). The first method is the same as that used by U.S. and Japanese scientists. It involves a regression of CPUE on the average fishing effort over a number of preceding years (K), which ideally should be equal to the average length of time an individual of a year-class is vulnerable to the fishery (Gulland, 1961); the second is a dynamic, stochastic version of the Schaefer model (Schnute, 1977).

Using Gulland's (1961) linear regression model, estimates of MSY using catch-per-10-hachi and catch-per-boat-day range between 3,200 and 4,100 t/yr (Table 11). Results generated by the modified Schaefer model produced estimates ranging from 5,200 to 6,200 t/yr.

An estimated total effort for all-nation catches for the whole coast was calculated by applying the Japanese longline CPUE to all other catches of sablefish (i.e., catches by different gear types). The results of Gulland's linear regression model using this estimated total effort in both 10-hachi and boat-day units ranged from 4,600 to 4,800 t/yr.

Recent analysis using new age estimates indicated that the range in MSY may be greatly reduced (Table 11). Deriso's (1980) model produced an estimate of 2,200 t/yr while preliminary analysis incorporting age and fecundity data (unpub.) gave a range of MSY of 3,200 to 4,000 t/yr.

In summary, stock assessments prior to 1981 were based on analysis of the Japanese longline fishery from 1968-1978. Estimates of MSY ranged from 3,400 to 6,100 t/yr. Recent analysis using new age composition data indicate previous estimates may have been too high.

Table 11. Summary of estimated ranges of predicted MSY.

	MODEL TYPE	MSY (t/yr)
American	-Exponential surplus yield (assuming Gompertz Growth function)	5155
	-Pella Tomlinson stock production model	5800
Canadian	-Gulland's Linear Regression (Japanese Catch)	3200-4100
	-Gulland's Linear Regression (All-nation Catch)	4600-4800
	-Schaeffer	5200-6200
	-Deriso	2200
	-Sablefish Dynamic Pool	3200-4000

Management

When Canada extended its fishery jurisdiction zone in 1977 and assumed responsibility for management in its zone, little was known about the biology or fishery for sablefish. Initially, a quota of 5,000 t was established for 1977. This was reduced to a more conservative quota of 3,500 t in 1978, based upon analysis of Japanese longline catch and effort data from 1968-1978.

Biological information collected from 1977-1982 indicates that the 3500 t quota may not be conservative and may be close to the sustainable yield. In addition, there is the concern that management to a fixed quota generally results in an overrun of the quota. For example, during 1980, 1981, and 1982 the quota was exceeded by approximately 500 t (14%) annually. Also, fish captured by lost gear cannot be accounted for. At present, we do not have an estimate of the number of traps lost annually, however, reports from fishermen suggest that it is substantial. Non-reporting is not considered to be serious, however, there may be a small amount of sablefish caught which is not reported or which is not included in the landings until after the quota has been reached. In view of these concerns, it may be necessary to re-examine our management strategies. In other words, although the quota may be sustainable, it may be necessary to recommend lower quotas because of the lack of rigid control over the actual landings.

Effective management of sablefish has been limited by a general lack of biological information. As mentioned, recent evidence indicates the quota may not be conservative. New ageing information has shown that sablefish are much older than previously thought (Beamish and Chilton, 1982), with the majority ranging from 4-35 years of age. This represents a substantial decrease in mortality rates and a corresponding increase in the length of time a cohort is available to the fishery. It is also evident that strong year-classes are an important component of the stock and that the fishery is supported by these strong year-classes (McFarlane and Beamish a, this symposium). It has been estimated that the biomass of the strong 1977 year-class may be equal to the adult component of the stock (McFarlane and Beamish 1983b). The strategy for

exploiting strong year-classes has not been developed, however, the desirability of increased fishery pressure on these year-classes, coupled with the concurrent increase in mortality of older year-classes, is questionable. The presence of older fish in the population and hence the longer reproductive life span may be necessary for maintaining the stock, particularly in times of poor environmental conditions.

Tagging studies have shown that juvenile fish rearing in the inside waters (Queen Charlotte Sound, Hecate Strait, and mainland inlets) move northward into the United States zone off Alaska (Beamish and McFarlane, 1983). If this northward movement is a coastwide phenomenon in the northeast Pacific Ocean, as evidenced by Bracken (1982) and Sasaki (1982), then a Canadian fishery for juveniles in these inside waters would impact on the U.S. fishery off Alaska. However, the intensive fishery for juveniles being conducted off the coasts of Washington, Oregon, and California clearly indicates that the management strategy in these areas is to exploit strong year-classes when they occur. This fishery may be seriously affecting recruitment to the Canadian zone, making it difficult to justify conservation of migratory juveniles rearing in the Canadian zone but recruiting to the U.S. fishery.

These tagging studies (Beamish and McFarlane, 1983) have identified discrete stocks of adult sablefish off areas such as the northwest coast of Vancouver Island, Queen Charlotte Sound, the west coast of the Queen Charlotte Islands, as well as major inlets. The major recruitment to these stocks is from outside the particular area (Beamish and McFarlane, 1983) and excessive effort in these areas without compensating recruitment may result in a localized depletion. If monitoring programs indicate excessive effort and reduction in CPUE in an area, it will be necessary to set quotas by discrete areas as a precautionary measure.

In addition, stocks present off the west coast of the Queen Charlotte Islands and in the Southeastern area of Alaska have a higher percentage of interchange than other areas (Beamish and McFarlane, 1983). The greater southward movement of adult fish from the Southeastern area may partially compensate for the northward movement of juveniles.

In summary, new age information indicates that the time series of catch and effort data is not sufficient to allow the use of general production modelling. Biological characteristics such as longevity, strong year-classes, and stock boundaries have been identified and must be considered when evaluating exploitation strategies. It appears that at present we do not have the required assessment tools for adequate management of this species. For this reason, we recommend a very conservative management strategy until the implications of the new biological information have been assessed and the responses of the stocks to the fishery are more clearly understood.

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