Pacific Whiting, *Merluccius productus*, Stocks off the West Coast of Vancouver Island, Canada

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Introduction

Pacific whiting, *Merluccius productus*, in Canadian waters form two distinct populations. One population is found in the Strait of Georgia and the other, known as "offshore whiting" is found primarily off the west coast of Vancouver Island. The offshore population can be distinguished from the inshore or Strait of Georgia population by its larger size and otolith growth pattern (Beamish et al., 1982; McFarlane and Beamish, 1985) and the presence of a parasite not found in Pacific whiting in the Strait of Georgia (Kabata and Whitaker, 1981).

The offshore Pacific whiting are mostly migratory fish that enter the Canadian zone in late spring and leave in the fall. There are some local spawning populations but they are small relative to the biomass of the migratory fish (G. A. McFarlane, unpubl. data).

This paper reviews the biology and fishery of the offshore Pacific whiting in the Canadian zone. This fishery is the most rapidly developing fishery on Canada's Pacific Coast, and it is timely to consider how the fishery in the Canadian zone should be developed in relation to the fishery off the United States. To do this, it is important to understand the timing of the migration in and out of the Canadian zone and the age, size, and sex composition of the fish.

Material used in this report was assembled from a number of sources, including Beamish (1981), and Beamish et al. (1982). Samples were collected from research vessels and foreign and domestic fishing vessels. Sampling methods varied, but in most cases subsamples of about 100 fish were collected without selection from the catch and, if possible, these samples were combined to make a total sample of about 300 fish per time/area. Pacific whiting were measured for fork length, sex was determined, and in some cases the state of maturity was noted. Otoliths were collected in pairs, stored in a 50 percent glycerin solution, and processed according to the procedures of Beamish (1979) and Chilton and Beamish (1982). Catches were estimated by prorating product quantities to round weight using conversion factors (Table 1).[1]

Table 1.—Conversion rates.

Year	Nation	Primary product	Conversion factor (dressed to round)
1977	Poland	Skinless fillets	unknown
1978	Poland	Skinless fillets	3.071
	U.S.S.R.	Skinless fillets	3.571
1979	Poland	Skinless fillets	3.125
		Skin-on fillets	2.326
		Boneless fillets	3.704
		Head off gutted	1.786
		Meal	5.555
1982	Poland	Skinless fillets	3.125
		Skin-on fillets	N/A
		Boneless fillets	3.704
		Head off gutted	1.786
		Meal from round	5.555
		Meal from offal	5.555

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ABSTRACT—*Concentrations of Pacific whiting,* Merluccius productus, *have been found in the Canadian zone as early as February and as late as November. A review of the commercial fishery suggests that a whiting fishery could be sustained for 4-6 months annually. Length frequency analysis and egg and larval surveys indicate the presence of resident spawning stocks off the west coast of Vancouver Island.*

The population consisted of about 70 percent females. The mean size of males and females increased each year from 1977 to 1981 and decreased substantially in 1982 as a result of the strong influx of 5-year-olds into the fishery. Whiting ranged in age from 2 to 20 years; however, the majority were in the 5- to 12-year range.

Catches are dominated by strong year classes. During 1982, the 1970, 1973, and 1977 year classes were dominant and accounted for 77 percent of all fish sampled. The fishery off Canada is dependent on older, larger, primarily female fish. These fish should be harvested conservatively until more is known about their role in sustaining recruitment.

Timing of Migration in and out of the Canadian Zone

Commercial catches by the U.S.S.R. off Canada from 1967 to 1975 (Table 2) indicate that Pacific whiting have been in commercial concentrations as early as February and as late as December. In 1979, a series

[1] B. Leaman, Department of Fisheries and Oceans, Pacific Biological Station, Nanaimo, B.C., Canada V9R 5K6. Unpubl. data, Nov. 1982.

Table 2.—U.S.S.R. catches (t) of Pacific whiting in the PMFC and/or INPFC area—Charlotte and Vancouver—by month, 1967-76.

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1967													[1]11,000
1968		423			14,455			25,825			614		[2]41,317
1969					266			61,741			2,922		[2]64,929
1970					19,119			6,372					25,491
1971					4,741	1,355	3,844	4,321	1,474	6,844	3,410	72	[3]26,061
1972					1,879	6,888	5,018	11,574	9,643	4,195	4,102		[3]43,299
1973							2,148	3,442	2,546	5,703			13,839
1974							—[4]	1,867	15,144				[3]17,011
1975								3,493					3,493
1976							280	3,638					3,918

[1]This is an instance where catches were estimated or inferred from broader groupings, from Ketchen (1977).
[2]Landings in 1968 and 1969 are higher than previously reported by Ketchen (1977) and in unpublished documents from the International North Pacific Fisheries Commission (INPFC). These landings include a percentage of whiting which were reported as "other fish" but identified as whiting.
[3]Majority of these catches from U.S. portion of INPFC Vancouver Area.
[4]Unreported, but probably some catch at this time.

Table 3.—Monthly (Mar.-Aug.) mean sea surface temperatures (°C) at Amphitrite Point, west coast of Vancouver I. (lat. 48°55′N, long. 125°32′W).

Year	March	April	May	June	July	August
1960	9.7	11.0	10.8	11.2	13.3	13.4
1961	9.0	9.5	11.2	11.8	14.1	13.7
1962	7.6	9.4	10.6	11.1	11.2	13.1
1963	8.6	10.1	11.9	11.3	13.5	14.2
1964	8.7	8.9	9.2	11.3	12.7	13.2
1965	8.2	8.7	9.9	11.1	11.7	12.9
1966	8.1	9.6	10.0	11.7	12.3	12.2
1967	7.9	9.1	10.1	11.9	12.7	13.2
1968	8.7	9.1	10.6	11.7	12.4	12.9
1969	7.9	9.3	11.4	12.8	12.3	12.9
1970	9.1	9.5	10.2	11.2	12.4	12.5
1971	7.0	8.6	9.8	11.8	12.8	13.6
1972	7.9	8.4	10.3	11.4	13.0	13.8
1973	8.5	9.4	10.4	11.6	12.4	12.8
1974	7.7	9.0	10.0	10.7	13.0	14.0
1975	7.6	8.8	10.4	10.8	12.0	12.6
1976	7.1	8.8	9.9	10.8	12.9	12.5
1977	8.6	9.7	10.7	11.9	11.9	14.4
1978	9.1	10.1	11.1	13.7	13.3	13.1
1979	8.1	9.3	11.5	11.6	13.6	14.0
1980	8.7	10.1	11.3	12.1	12.7	13.4
1981	9.7	10.0	11.4	12.5	13.4	13.8
1982	8.2	9.2	10.2	11.5	12.4	13.4

of cruises demonstrated that commercially exploitable quantities of Pacific whiting were not present in mid-May but were by mid-June. Fishable concentrations remained until November. During 1979, the Canadian and foreign fishery started on 6 August and continued until 1 October. During this period there was no indication that the size of the stocks had declined to levels that would not support a commercial fishery.

In 1980, 1981, and 1982 the fishery started on 6 August, 11 July, and 1 July respectively, and terminated on 15 October, 19 October, and 31 October respectively. In 1982, fishermen reported fishable stocks as early as April.

It appears that movement in and out of the Canadian zone is variable. Large quantities appear to be present from mid-June until October and fishable quantities appear to be present for a slightly longer period, enabling commercial fishing for a minimum of 4-5 months and a maximum of 5-6 months.

The factors that control recruitment of Pacific whiting into the Canadian zone are unknown, but it is possible that adults may utilize the deeper California undercurrent to migrate north and that the strength of this current affects the extent of northerly movement. Since 1976, total catches have steadily increased (Fig. 1). Ketchen (1977) reported that Soviet scientists believed that migration into the Canadian zone in 1971 and 1973 was reduced because of the particularly cold water during these years. A review of surface temperatures in Canadian waters (Table 3) indicates no correlation between catches (Table 2) and temperature. Fluctuations in catches are probably a consequence of Soviet fleet management.

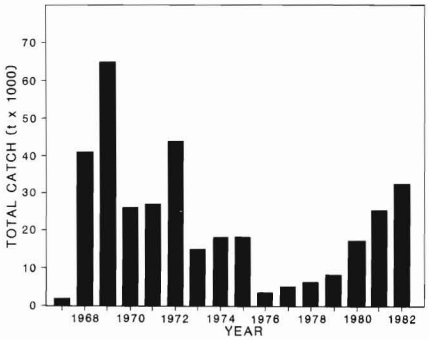

Figure 1.—Pacific whiting catch off the west coast of Canada and the State of Washington to lat. 47°30′N, 1967-76, and off the west coast of Canada, 1977-82.

Most Pacific whiting are concentrated southwest of Barkley Sound (Fig. 2). Some whiting are found in the Strait of Juan de Fuca, and their size and otolith growth pattern indicate that these whiting are from the offshore population (Beamish et al. 1982). Large Pacific whiting have been observed as far north as southern Hecate Strait (Fig. 3) (Thompson and Beamish, 1979). Pacific whiting in these northern waters are not abundant and it is unknown if they are part of the migratory "offshore" stock.

There are resident "offshore" stocks in Barkley Sound and Sydney Inlet as indicated by the samples of age 1 and age 2 fish (Fig. 4). These young whiting were first sampled in 1978, although fishermen had reported their presence previously. The 1983 sample shows the occurrence of the 1981 and 1982 year classes. Eggs and larvae have been collected from January to April off these areas,[2] clearly indicating the presence of resident spawning stocks.

Size and Sex Composition

The size and sex composition of fish has been monitored since 1977 (Fig. 5). The mean size of males over this 6-year period has ranged from 48.5 to 53.6 cm, and females from 50.7 to 56.9 cm. The mean size of both sexes increased each year from 1977 to 1981, then decreased substantially in 1982 (Fig. 6). This decrease

[2]J. C. Mason, Department of Fisheries and Oceans, Pacific Biological Station, Nanaimo, B.C., Canada V9R 5K6. Unpubl. data, Oct. 1982.

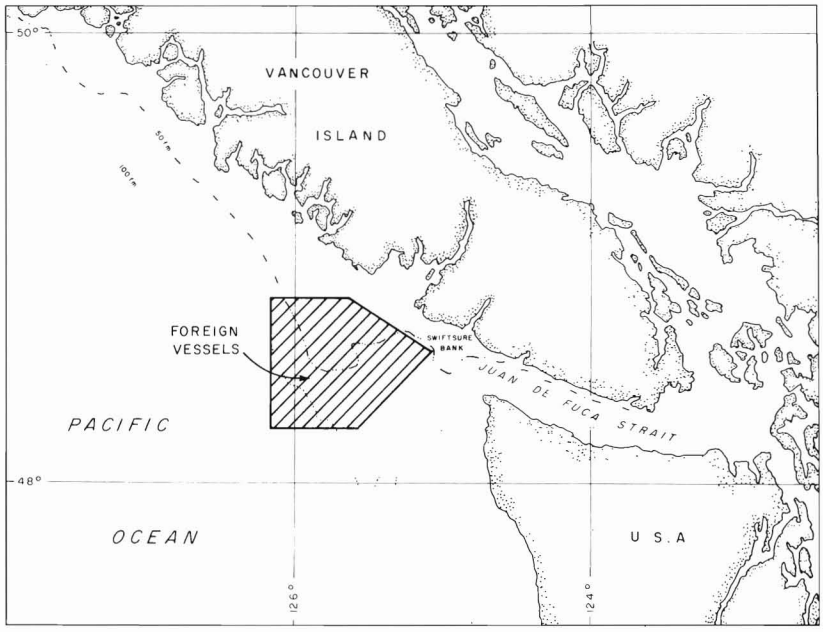

Figure 2.—Main concentration of Pacific whiting as reflected by the fishery.

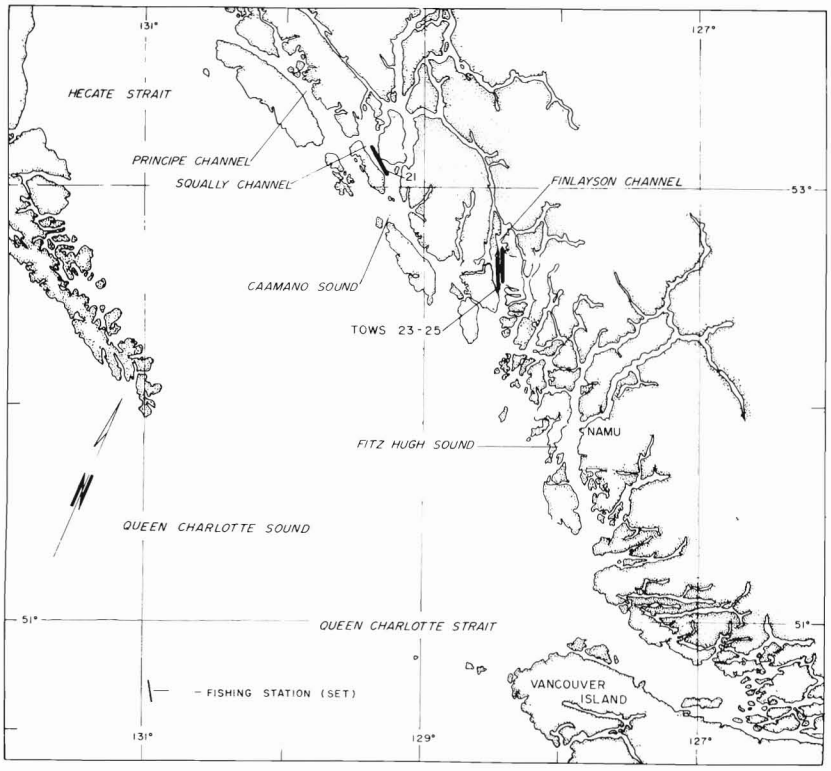

Figure 3.—Areas of capture of Pacific whiting in mainland inlets off Queen Charlotte Sound in southern Hecate Strait.

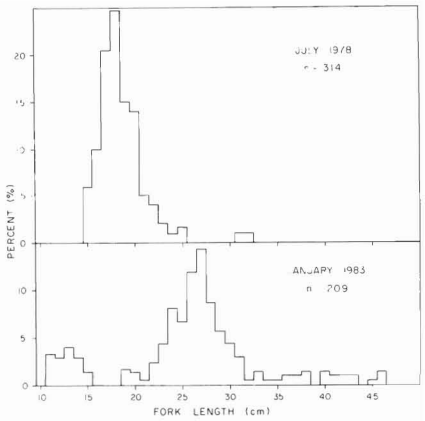

Figure 4.—Length frequency of Pacific whiting sampled off Sidney Inlet, 1978, and in Barkley Sound, 1983.

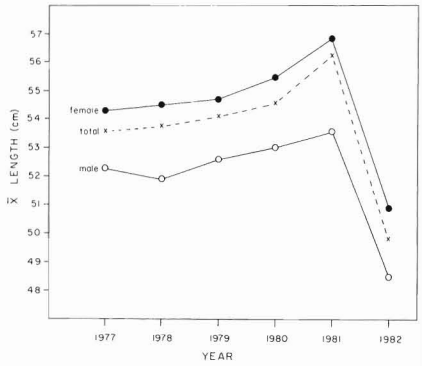

Figure 5.—Mean Length of Pacific whiting sampled from commercial catches 1977-82.

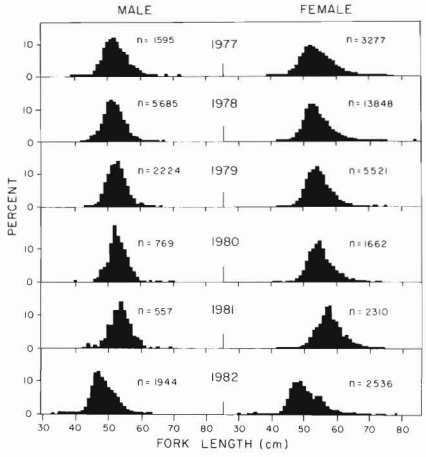

Figure 6.—Size distributions of male and female Pacific whiting sampled during the commercial fishery, 1977-82.

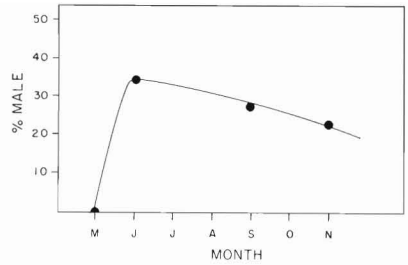

Figure 7.—Percentage of males in catch of Pacific whiting by month, averaged for 1979-82.

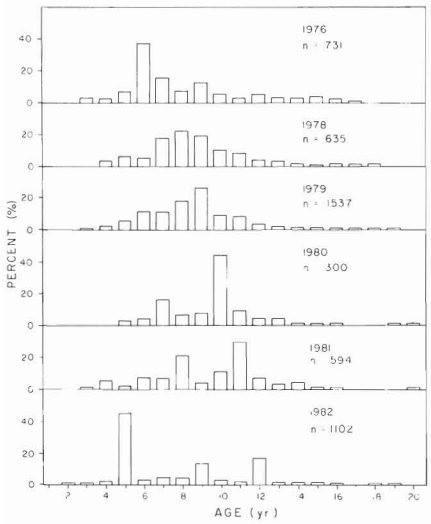

Figure 8.—Age composition of Pacific whiting catches, 1976-82.

Table 4.—Length frequency of Pacific whiting sampled throughout the period of residency in the Canadian zone, 1979.

Length (cm)	May			June			September			October			November			Total		
	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T
42								1	1							1	1	
43		1	1		2	2	1	0	1							1	3	4
44		0	0		2	2	4	2	6							4	4	8
45		0	0		1	1	2	3	5	1	1	2	2		2	5	5	10
46		1	1		2	2	11	6	17	9	7	16	0		0	20	16	36
47		4	4	6	9	15	6	14	20	19	11	30	0		0	31	38	69
48		4	4	14	23	37	28	27	55	45	39	84	2	1	3	89	94	183
49		2	2	22	17	39	58	50	108	81	56	137	2	4	6	163	129	292
50		9	9	45	69	114	60	69	129	115	137	252	9	8	17	229	292	521
51		6	6	36	82	115	72	126	198	167	223	390	12	23	35	287	460	747
52		10	10	38	88	126	73	151	224	171	290	461	15	34	49	297	573	870
53		8	8	55	96	151	57	153	210	168	329	497	22	40	62	302	626	928
54		9	9	44	116	160	50	152	202	147	340	487	14	59	73	255	676	931
55		10	10	26	81	107	44	161	205	110	286	396	16	50	66	196	588	784
56		7	7	14	94	108	39	119	158	62	248	310	19	65	84	134	533	657
57		6	6	12	52	64	20	89	109	45	176	221	9	47	56	86	370	456
58		6	6	7	51	58	15	90	105	25	123	148	9	35	44	56	305	361
59		2	2	2	35	37	4	51	55	9	113	122	7	48	55	22	249	271
60		7	7	6	39	45	4	41	45	10	58	68	3	36	39	23	181	204
61		1	1	1	10	11	2	23	25	1	50	51	2	26	28	6	110	116
62		2	2	2	10	12	0	24	24	4	19	23	0	23	6		78	84
63		1	1	1	12	13	2	12	14	1	22	23	3	10	13	7	57	64
64		1	1	1	5	6		14	14	1	15	16	2	12	14	4	47	51
65		2	2		5	5		9	9		11	11	0	6	6	0	33	33
66		0	0		5	5		6	6		10	10	1	5	6	1	26	27
67		0	0		0	0		2	2		3	3		1	1		6	6
68		1	1		3	3		2	2		3	3		1	1		10	10
69					0	0		2	2		4	4					6	6
70					0	0		0	0		0	0					0	0
71					0	0		1	1		1	1					2	2
72					2	2					0	0					2	2
73											0	0					0	0
74											0	0					0	0
75											1	1					1	1
Total	100	100	332	911	1,243	552	1,400	1,952	1,191	2,576	3,767	149	534	683	2,224	5,521	7,745	

Table 5.—Contribution (percent catch by number) of the strong 1970, 1973, and 1977 year classes to the Pacific whiting fishery in the Canadian zone.

Year class	Year					
	1976	1978	1979	1980	1981	1982
1970	36	22	26	44	29	17
1973	3	6	11	16	21	14
1977					5	45
Total	39	28	37	60	55	76

resulted from the strong influx of 5-year-olds (1977 year class) into the fishery. The entry of large numbers of this year class into the Canadian zone eliminated the dominance of the 1970 year class which was responsible for increase in mean size from 1977 to 1981.

The largest male measured 77 cm, but few males (about 1 percent) were larger than 60 cm. The largest female was 84 cm, but only 13 percent of the females were larger than 60 cm. The mean lengths of all males and all females sampled were 52 and 54.5 cm, respectively. These lengths can be converted to weights of 843 g, or 1.9 pounds, and 1,056 g, or 2.3 pounds, respectively (Shaw et al., In press). Samples collected throughout the year indicated very little variation in size (Table 4).

Females dominate the catch. In all years since 1977 the percentage of females has been relatively constant, ranging from 60 to 82 percent. Males arrived later than females and left earlier (Fig. 7). The later arrival of males and their earlier departure are consistent with observations of spawning behavior in the Strait of Georgia, where males are first to arrive and last to leave the spawning area (Beamish et al., 1978; Cass et al., 1978; McFarlane et al., 1982).

Age Composition and Strong Year Classes

Offshore Pacific whiting in the Canadian zone are generally older than those in areas to the south. The range of ages is from 2 to 20 years, but most fish (87-97 percent) are in the 5- to 12-year range. The age at which most fish are recruited to the fishery is 5 or 6 years. Even when strong year classes are present, such as the 1977 year class, they are not present in the Canadian fishery until age 5 (Fig. 8). Once these strong year classes are recruited, they dominate catches for a number of years. Currently the 1970, 1973, and 1977 year classes are dominant, and in 1982 these three year classes accounted for 76 percent of all fish sampled (Table 5). Understand-

Table 6.—Relative year-class strength of Pacific whiting after correcting for total mortality.

	1975		1976		1979	
Age	*n*	*n* corrected for total mortality	*n*	*n* corrected for total mortality	*n*	*n* corrected for total mortality
5	1	2	70	108	85	131
6	5	12	535	1,266	262	620
7	8	29	137	499	156	568
8	13	73	103	577	303	1,697
9	13	112	164	1,413	263	2,267
10	13	172	67	888	74	981
11	8	163	30	612	60	1,224
12	13	408	58	1,183	31	973
13	26	1,255	32	1,004	12	579
14	30	2,228	28	2,080	10	743
15	22	2,514	60	6,856	10	1,143
16	6	1,055	33	5,802	2	352
17			11	2,975	4	1,082
18					1	416
19					2	1,280

Table 7.—Mean size (cm) and age (years) of Pacific whiting found off the west coast of Vancouver Island and off Washington and Oregon, 1976 (sample size in parentheses.)

	West Coast Vancouver Island			Washington and Oregon		
Age	Male	Female	Total	Male	Female	Total
3				43.0 (1)	45.9 (7)	45.5 (8)
4	50.0 (1)		50.0 (1)	44.0 (3)	46.6 (7)	45.8 (10)
5		52.0 (1)	52.0 (1)	48.8 (18)	49.3 (26)	49.1 (44)
6	52.5 (8)	53.0 (30)	53.3 (38)	48.4 (126)	49.2 (209)	48.9 (335)
7	50.0 (1)	53.5 (11)	53.2 (12)	48.1 (26)	49.6 (54)	49.1 (80)
8	53.0 (4)	58.2 (17)	57.2 (21)	50.0 (18)	52.1 (25)	51.2 (43)
9	61.0 (9)	59.3 (38)	59.6 (47)	51.7 (20)	53.1 (30)	52.5 (50)
10	55.5 (2)	58.6 (13)	58.1 (15)	52.4 (8)	53.4 (14)	53.0 (22)
11	62.5 (2)	60.0 (6)	60.6 (8)	51.6 (5)		51.6 (5)
12	63.0 (6)	63.3 (12)	63.2 (18)	50.8 (4)	54.4 (7)	53.1 (11)
13	62.0 (2)	64.4 (7)	63.9 (9)	53.0 (3)	55.8 (5)	54.8 (8)
14		59.0 (4)	59.0 (4)	51.0 (1)	51.6 (8)	51.5 (9)
15	55.3 (4)	62.4 (14)	60.8 (18)	50.4 (5)	55.0 (11)	53.6 (16)
16	53.0 (1)	58.8 (4)	57.6 (5)	51.5 (4)	54.3 (7)	53.3 (11)
17		67.3 (4)	67.3 (4)	51.7 (3)		51.7 (3)
Total	40	161	201	245	410	655

ably, the relative importance and the length of time in the fishery of these three year classes will vary according to their absolute abundance. It appears that strong year classes can continue to dominate for a number of years. For example, the 1970 year class has ranged from 17 to 44 percent of the catch since records were started in 1976. In 1982, it is still a prominant component as 12-year-olds representing 17 percent of the samples by numbers.

Strong year classes are a key parameter to understanding the biology of Pacific whiting populations. Dark et al. (1980) and Nelson and Dark (1985) reported that the 1977, 1973, and 1970 year classes were strong, and Stauffer and Smith (1977) reported indices of whiting larval abundance that suggest strong year classes occurred in the early 1970's, middle 1960's, and early 1960's.

A simple reconstruction of the age-frequency histograms for samples collected in 1975, 1976, and 1979 and corrected for a total annual mortality ($A = 0.35$; Beamish, 1981) indicates that there have been strong year classes in 1970, 1967, or 1968, 1964, and 1961 (Table 6). Presently there is a very strong 1980 year class[3] (G. McFarlane, unpubl. data) recruiting into the Canadian and U.S. fisheries. Thus, it is apparent that strong year classes have occurred in 1980, 1977, 1973, 1970, 1967 or 1968, 1964, and 1961. There appears to be a period of relatively successful years from 1960 to 1962; however, the small sample size of older fish and the possibility of aging errors make it difficult to assess relative year-class strength for these years. A reconstruction of cohort strength was also used for Pacific whiting by Bailey (1981) and appears to be an acceptable approximation of relative year-class strength. The development of strong year classes has been related to the presence of strong onshore currents (Ekman transport) during the spawning period (Bailey, 1981). However, the presence of an apparent 3-year cycle may also indicate a biological relationship.

Strong year classes do not persist as a dominant feature as long in the U.S. fishery. A commercial sample collected off California, Oregon, and southern Washington by U.S. scientists contained no major mode representing the 1970 year class after 1978 (Nelson and Dark, 1985). Thus by the time the fishery off the United States is usually underway, many of the largest and oldest fish have aggregated in the waters off Canada and northern Washington State.

A comparison of the mean size of similar age fish sampled in 1976 off Canada, Oregon, and Washington showed that not only do more of the larger fish occur in the Canadian zone, but individuals of any particular year class that move into Canadian waters are the larger fish of that year class (Table 7). The differences in the mean size of similar aged males and females from the two zones were highly significant (*t*-test, $p<0.01$, only sample sizes larger than 10 tested). These differences in size clearly demonstrate that large individuals undergo more extensive migrations and that larger individuals of each year class (after age 4 or 5) and large individuals in the population tend to migrate into the Canadian zone.

The mean size of males and females from the 1970 year class increased about 1 cm each year since 1976 (Fig. 9). Sampling problems and selective mortality rates can influence the estimate of annual growth. However, it is apparent that growth in length of older fish is minimal and that females probably are directing energy into reproduction and reserves for migration rather than for length increases.

The method of employing sections of otoliths or broken and burnt otoliths for aging Pacific whiting has not been validated. However, the identification of the prominence of the 1970 year class in successive age-frequency histograms up to the age of

[3]T. Dark, Northwest and Alaska Fisheries Center, NMFS, NOAA, 7600 Sand Point Way N.E., Seattle, WA 98115. Pers. commun., Nov. 1982.

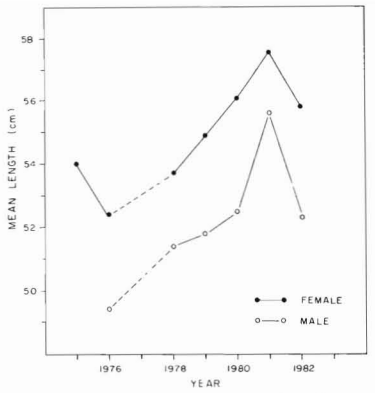

Figure 9.—Mean size of male and female Pacific whiting from the 1970 year class, 1976-80.

12 in 1982 (Fig. 8) indicates that the zone identified as an annulus does form once a year and the method is valid at least up to age 12.

Commercial Fishery

Since 1968, the largest catches in the groundfish fishery on Canada's west coast have been Pacific whiting. Total reported catches have ranged from 65,000 t in 1969 to 3,900 t in 1976. Prior to 1975 the U.S.S.R. caught the major percentage of whiting in the Canadian zone (Fig. 1). Poland and Japan landed much smaller quantities. After 1977 and the declaration by Canada of an extended fishing zone, the commercial fishery was divided into domestic, joint venture, and foreign fisheries.

Total catches of whiting have increased steadily since 1977 (Table 8) to 32,207 metric tons (t) in 1982. Participating countries have included Japan, Poland, Greece, and the U.S.S.R. While there is still no domestic market for offshore whiting, landings by Canadian fishermen directly to foreign vessels have increased substantially to 19,613 t in 1982.

As shown, the strong year classes are recruited to the fishery off Canada at age 5 or 6. The age at recruitment probably depends on environmental conditions as well as year-class strength. The strong 1977 year class was recruited as 5-year-olds in 1982 and accounted for 45 percent of the catch (numbers). The 1970 and 1973 year classes were recruited primarily as 6-year-olds. Preliminary analysis of 1983 data indicates that the 1980 year class was present in the Canadian zone and accounted for 6.2 percent of the catch. The increased catches in 1972 and 1969 probably indicate the presence of strong year classes, but it is difficult without age composition data to determine the year classes responsible. It is probable that the high 1969 catch was composed of a large percentage of the strong 1961 year class. It is apparent that the fishery in the Canadian zone is dependent on strong year classes.

Table 8.—Total landings of Pacific whiting by foreign and domestic fisheries off Canada, 1978-82.

		Total landings (t)			
Year	Nation	Foreign national[1]	Joint venture	Domestic	Total
1978	Poland	589	1,814		
	U.S.S.R.	700	0		
	Japan	3,364	0		
	Total	4,653	1,814		6,467
1979	Poland	4,263	3,102		
	U.S.S.R.	0	1,131		
	Japan	3,637	0		
	Total	7,900	4,233	302	12,435
1980	Poland	4,456	4,560		
	U.S.S.R.	78	4,300		
	Japan	817	0		
	Greece	0	3,355		
	Total	5,351	12,215	96	17,661
1981	Poland	3,189	4,779		
	U.S.S.R.	227	7,342		
	Japan	187	0		
	Greece	0	4,927		
	Total	3,603	17,048	4,440	25,091
1982	Poland	10,357	10,222		
	U.S.S.R.	0	9,391		
	Japan	2,237	0		
	Total	12,594	19,613	2	32,209

[1]Includes landings from the supplementary fishery. Catches reported in this fishery cannot be verified by weight tallies, as domestic catches are.

Stock Abundance and Management

Total biomass estimates for Pacific whiting off the west coast of North America were 1,198,932 and 1,537,182 t in 1977 and 1980, respectively (Dark et al. 1980; footnote 3). It was estimated that about 350,000 t and 340,000 t in 1977 and 1980, respectively, were present in the International North Pacific Fisheries Commission (INPFC) Vancouver area, of which the majority would be in the Canadian zone.

While there is little doubt that the numbers of whiting present can support a commercial fishery, there is an unanswered and unstudied question about the desirability of overfishing the larger, older, and predominantly female fish in the Canadian zone. It may be argued that they are all surplus and can be harvested without management. Alternatively, it can be argued that management is necessary because the reproductive potential of this large body of females is high. It is possible that the apparent healthy state of the offshore Pacific whiting population is related to reduced fishing pressure on older fish as a consequence of their northern migration out of the area of intensive foreign effort. Preservation of these older, larger whiting that are predominantly females may be maintaining the reproductive potential of the populations, particularly if the population encounters unfavorable environmental conditions. Excessive removal of these older fish coupled with continued fishing pressure on younger fish might reduce the populations' ability to maintain recruitment, resulting in major declines in abundance. Older fish should be harvested conservatively until more is known about their relative importance in maintaining reproductive potential. Joint management strategies for the resource are currently being developed by Canada and the United States and will be reported elsewhere.

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