Northwest Atlantic Fisheries Organization

Serial No. N164

NAFO SCR Doc. 80/VI/108
(Revised)

SCIENTIFIC COUNCIL MEETING - JUNE 1980

Estimates of Stock biomass and Long-term Mortality of the Northern Witch Flounder Stock (Divisions 2J+3KL)

by

W. R. Bowering and J. Baird
Department of Fisheries and Oceans, Northwest Atlantic Fisheries Center
P. O. Box 5667, St. John's, Nfld., Canada A1C 5X1

The Fishery

The fishery for this stock (NAFO Divisions 2J+3KL) has been traditionally comprised of two segments, the Canada(N) inshore or near-shore gillnet fishery and the offshore otter trawl fishery. Most fish have been taken from the Division 3K region with fair proportions taken offshore in Divisions 2J and 3L.

Landings were on a general increase from 1967-73 on what was probably a virgin accumulated stock (Fig. 1). The increasing trend for the gillnet fishery was short lived and peaked in 1971. Since that time the inshore gillnet fishery for witch has declined steadily and in 1978 and 1979 the catches were no more than a few hundred tons even though gillnet effort has increased substantially over the past few years. The otter trawl fishery began to decline dramatically from 1973 from about 20,000 tons to less than 3,000 tons in 1979. The effort in this fishery has probably been reduced but no way near the extent expressed by the landings. It should be noted that the landings in the early 1970's may not be accurate for the total catch since the offshore landings to a large extent were broken down from unspecified flounder statistics.

This sort of trend in catches is not unusual for witch flounder since the stock tends to accumulate over a long period of time and gets knocked down with intense fishing and when left alone will build up again. This process for such a slow-growing species however, takes a long period of time. While the extreme decrease in gillnet landings may be a reflection of the stock status, it is difficult to assess whether or not it may be a result of geographical redistribution. This species was traditionally fished with Greenland halibut and cod in the gillnet fishery. With the apparently large increases in the size of both cod and Greenland halibut stocks it may be possible that the lesser aggressive witch may have been forced from these areas. Canadian observers on Polish vessels in Division 3K during 1979 reported large catches of witch in depths greater than 700 meters which would be considered rather unusual for this species. This would tend to support the possibility of redistribution.

Sampling

Because of very low landings during 1979 it was impossible to obtain adequate samples from either sector of the commercial fishery. Neither sample could be collected from the gillnet fishery and only one sample was available from the Canadian offshore fishery. Samples from the Polish portion of the fishery were not available at the time of this meeting.

Biomass Surveys

Stratified- random biomass surveys by the Canadian research vessel *Gadus Atlantica* have been conducted throughout the whole stock area during the last couple of years. Results of these surveys are shown as average numbers and weights per set and are found in Tables 1 and 2 for Division 2J, in Tables 3 and 4 for Div. 3K and Tables 5 and 6 for Div. 3L.

In Division 3L, stratified-random biomass surveys of the Canadian research vessel *A. T. Cameron* have been conducted since 1971. These results are presented in Tables 7 and 8.

Division 2J

Division 2J is the northern limits of this species (Bowering,1976) consequently it would be expected that the numbers available in this area might be less than farther south. The biomass surveys in Table 1 indicate that the portion of the stock in Div. 2J comprises 1000-1500 tons of trawlable biomass. This was evident from both surveys in 1979 and proportionately similar to the fall survey of 1978 (*Gadus* Cruise No. 15).

Division 3K

This division is the location of the main biomass of witch flounder in thsi stock area as expressed by the commercial fishery. The results of the biomass surveys (Table 3) indicates the same. The autumn survey in 1978 (*Gadus* Cruise No. 15) indicated a trawlable biomass of about 24,000 tons with the estimates from both 1979 surveys indicating about 30,000 tons.

Division 3L

The *Gadus* surveys are not really comparable for Div. 3L but since the 1978 summer survey (*Gadus* Cruise No. 12) and the 1979 survey (*Gadus* Cruise No. 21) did fish the main strata where witch would be found, they would indicate trawlable biomass from about 5,000 to 9,000 tons, the larger figure being the most recent.

The results from the *A. T. Cameron* surveys (Table 7) over the past 4 years when coverage has been fairly complete indicate a stable biomass of about 8,000 tons. The 1978 figure, while appearing low would be greatly influenced by stratum 346 which was not fished in 1978. An estimate from this area would probably bring the total figure more in line with the others.

From all the survey data here it would seem that a reasonable estimate of trawlable biomass might be in the order of about 35,000 tons for the whole stock area.

Commercial Age Composition

or 1976-79, the commercial age composition of the Canadian otter trawlers is presented in Fig. 2. The figures may not be representative of the whole fishery particularly 1979 where sampling was sparse, however, it is probably an indicator of which age groups make up the fishery. The main bulk of the age groups in 1976 still comprised the fishery, however, where there were fish up to 25 years old in 1976, there now appears to be few fish beyond age 16.

Long Term Mortality Estimates

Estimates of average mortality were made from both commercial and research data. The commercial otter trawl data were combined for 1976-79 and catch curves were constructed (Fig. 3 and 4). For the males the value was $Z = 0.68$ and $Z = 0.58$ for the females. These values generally represent a long term average over about 12 years which indicated average removals of about 10-12 thousand tons. This is probably not very indicative of recent years where the accumulated stock has been removed. Mortality values would probably be higher at lower catch levels for recent years.

Mortality estimates were also derived from the research vessel data presented earlier in this document. Since the fishery as well as the estimated biomass are almost entirely located in Div. 3K, the catch curves were constructed for Div. 3K only. The calculations were made on the estimated population numbers at age from the 1978 and 1979 fall surveys combined. The results are presented in Fig. 5 and 6. The values derived from these are $Z = 0.77$ for the males and $Z = 0.60$ for the females. The values are very closely in agreement with those of the commercial data and represent much the same average landings over the same period of time. The values from both sets of calculations were placed upon yield per recruit curves (Fig. 7).

Summary

The values of F derived from both sets of data are very similar and indicate that the long term average of about 10,000-12,000 tons is beyond $F_{0.1}$ but not to a large degree. The extreme reduction in catch from gillnets with increased effort is difficult to explain fully although the reduced population would certainly be a first thought. The relative stability over the last few years indicated that catch levels averaging about 7,000 tons would appear to bring this stability about.

This fishery is now primarily a by-catch fishery especially with the lack of inshore landings, consequently large landings are not expected. However, to be realistic and to come in line with the apparent status of this stock, a TAC of about 8,000 tons would appear to be more appropriate.

TABLE 1

GADUS 2J Witch Average Weight Per Set

Stratum	GADUS 3 1977	GADUS 12 1978	GADUS 15 1978	GADUS 27 1979	GADUS 29 1979
201	0.0 (2)		0.0 (3)		0.0 (2)
202	0.0 (2)	0.0 (2)	0.0 (2)	0.0 (2)	0.0 (2)
203	0.0 (2)	0.0 (2)		0.0 (2)	
204	1.59(2)	0.0 (2)		1.02(2)	
205	0.0 (4)		0.0 (4)		0.0 (2)
206	0.43(11)		0.0 (7)		0.0 (8)
207	0.0 (5)		0.0 (4)		0.0 (5)
208	3.46(4)	0.67(2)	0.61(3)	2.49(2)	0.91(2)
209	0.52(7)	0.44(2)	0.0 (4)	1.02(2)	0.0 (5)
210	1.58(6)	0.30(3)	0.34(4)	0.68(2)	2.84(2)
211	12.26(2)	1.81(2)	9.53(2)	4.76(2)	0.0 (2)
212	26.06(4)	1.36(2)		13.15(2)	
213	1.48(8)	0.0 (3)	2.50(4)	0.30(3)	1.59(4)
214	1.55(6)	0.0 (3)	0.69(4)	0.0 (2)	0.0 (4)
215	1.59(4)	0.0 (3)	0.27(5)	0.0 (2)	0.11(4)
216	0.0 (2)	0.0 (2)		0.0 (2)	1.24(2)
217	0.0 (3)	0.0 (2)		0.57(2)	
218	0.0 (2)	0.0 (2)			
219					
220		0.0 (2)			
221					
222	4.82(4)	0.0 (2)	2.86(3)	0.0 (2)	1.02(2)
223	0.68(2)	0.0 (2)		0.0 (2)	
224	0.0 (2)	0.0 (2)		0.0 (2)	
225	0.0 (2)				
226		0.0 (2)			
227	2.72(4)	1.59(2)		0.86(2)	
228	3.43(8)	0.74(3)		0.68(2)	3.63(4)
229	2.67(4)	0.0 (2)	4.99(2)	0.68(2)	4.43(2)
230	0.0 (3)	0.0 (2)			
231	0.0 (2)	0.0 (2)			
232	0.0 (2)	0.0 (2)			
233					
234	0.0 (2)	0.76(3)	0.0 (2)	1.59(2)	0.0 (2)
235	17.76(4)	0.0 (2)		9.30(2)	
236	0.0 (2)				
Total Weight (Tons)	3829	397	993	1598	1058

Tables 2

GADUS 2J Witch Average Number Per Set

Stratum	GADUS 3 1977	GADUS 12 1978	GADUS 15 1978	GADUS 27 1979	GADUS 29 1979
201	0.0 (2)		0.0 (3)		0.0 (2)
202	0.0 (2)	0.0 (2)	0.0 (2)	0.0 (2)	0.0 (2)
203	0.0 (2)	0.0 (2)		0.0 (2)	
204	1.50(2)	0.0 (2)		1.50(2)	
205	0.0 (4)		0.0 (4)		0.0 (2)
206	0.36(11)		0.0 (7)		0.0 (8)
207	0.0 (5)		0.0 (4)		0.0 (5)
208	5.25(4)	1.00(2)	1.00(3)	3.50(2)	1.00(2)
209	0.71(7)	0.50(2)	0.0 (4)	0.50(2)	0.0 (5)
210	1.36(6)	0.67(3)	0.25(4)	0.50(2)	1.50(2)
211	12.00(2)	3.00(2)	10.50(2)	6.50(2)	0.0 (2)
212	27.97(4)	1.50(2)		12.50(2)	
213	1.62(8)	0.0 (3)	2.25(4)	0.33(3)	1.25(4)
214	1.67(6)	0.0 (3)	0.75(4)	0.0 (2)	0.0 (4)
215	1.25(4)	0.0 (3)	0.20(5)	0.0 (2)	0.25(4)
216	0.0 (2)	0.0 (2)		0.0 (2)	1.50(2)
217	0.0 (3)	0.0 (2)		0.50(2)	
218	0.0 (2)	0.0 (2)			
219					
220		0.0 (2)			
221					
222	5.50(4)	0.0 (2)	5.00(3)	0.0 (2)	1.50(2)
223	0.50(2)	0.0 (2)		0.0 (2)	
224	0.0 (2)	0.0 (2)		0.0 (2)	
225	0.0 (2)				
226		0.0 (2)			
227	2.50(4)	2.00(2)		0.75(2)	
228	2.87(8)	1.33(3)		1.00(2)	3.00(4)
229	3.67(4)	0.0 (2)	8.50(2)	1.00(2)	3.50(2)
230	0.0 (3)	0.0 (2)			
231	0.0 (2)	0.0 (2)			
232	0.0 (2)	0.0 (2)			
233					
234	0.0 (2)	1.00(3)	0.0 (2)	1.00(2)	0.0 (2)
235	24.25(4)	0.0 (2)		11.00(2)	
236	0.0 (2)				
Total Number	4,166,413	565,834	1,211,873	1,657,526	869,900

TABLE 3

Gadus 3K — Witch average weight per set

Stratum	Gadus 12 1978	Gadus 15 1978	Gadus 27 1979	Gadus 29 1979
620	0.0(5)	4.54(7)	8.39(3)	3.30(7)
621	0.36(5)	3.97(7)	22.83(3)	9.41(8)
622	3.39(2)		16.48(3)	
623	1.34(3)	5.94(3)		6.57(3)
624	2.27(4)	6.51(3)	1.81(2)	2.15(2)
625	3.25(3)	12.71(3)	10.55(2)	32.51(3)
626	5.14(3)	47.79(4)	51.25(2)	53.83(3)
627	18.14(2)		23.59(3)	
628	12.02(2)	23.88(5)	56.83(3)	52.65(2)
629	10.58(3)	48.73(3)		28.58(2)
630	14.52(2)	6.92(2)	6.92(2)	16.55(2)
631	8.18(2)		12.26(3)	
632	2.67(4)	13.77(3)	4.43(2)	22.22(2)
633	0.29(4)	19.28(5)	9.90(4)	14.02(6)
634	5.79(4)	2.72(5)	1.81(2)	6.16(6)
635	4.59(4)	20.61(5)	13.46(3)	16.87(5)
636	4.99(4)	17.25(3)	9.88(2)	11.25(5)
637	3.76(5)	18.04(4)	8.78(3)	28.02(4)
638	6.43(3)	17.43(5)	29.95(2)	41.12(7)
639	1.76(4)	14.08(5)	6.01(2)	10.42(2)
640	5.45(2)			
641	0.0(2)		0.0(2)	
642	0.0(2)			
643	0.0(2)		0.0(2)	
644	0.0(2)		0.0(2)	
645	0.34(2)			
646	0.0(2)		0.0(2)	
647	0.0(2)		0.0(2)	
648	0.0(2)			
649	0.0(2)			
Total Weight	8763	23996	30223	31632

TABLE 4

Gadus 3K — Witch average number per set

Stratum	Gadus 12 1978	Gadus 15 1978	Gadus 27 1979	Gadus 29 1979
620	0.0(5)	4.86(7)	10.67(3)	2.86(7)
621	0.80(5)	7.14(7)	24.33(3)	9.75(8)
622	15.00(2)		21.33(3)	
623	2.00(3)	9.67(3)		5.67(3)
624	3.50(4)	7.00(3)	2.50(2)	2.50(2)
625	5.76(3)	17.33(3)	17.50(2)	43.00(3)
626	15.00(3)	81.50(4)	92.50(2)	77.67(3)
627	30.00(2)		47.33(3)	
628	15.50(2)	28.60(5)	68.33(3)	54.00(2)
629	18.67(3)	64.33(3)		45.00(2)
630	27.00(2)		12.50(2)	21.50(2)
631	29.50(2)		24.67(3)	
632	3.50(4)	16.67(3)	4.50(2)	23.50(2)
633	0.50(4)	20.06(5)	12.50(4)	15.06(6)
634	4.50(4)	3.20(5)	1.50(2)	5.33(6)
635	4.00(4)	17.60(5)	8.67(3)	15.40(5)
636	6.75(4)	14.33(3)	8.00(2)	10.00(5)
637	6.00(5)	17.00(4)	7.00(3)	34.00(4)
638	8.33(3)	27.60(5)	38.00(2)	59.14(7)
639	2.50(4)	16.00(5)	4.50(2)	9.50(2)
640	9.50(2)			
641	0.0(2)		0.0(2)	
642	0.0(2)			
643	0.0(2)		0.0(2)	
644	0.0(2)		0.0(2)	
645	0.50(2)			
646	0.0(2)		0.0(2)	
647	0.0(2)		0.0(2)	
648	0.0(2)			
649	0.0(2)			
Total Number	15105040	30009872	39612336	37822272

TABLE 5

GADUS 3L Witch Average Weight Per Set

Stratum	GADUS 12 1978	GADUS 21 1979	GADUS 25 1979
328		0.0 (5)	
341		0.11(4)	
342		0.19(4)	
343		0.0 (4)	
344	7.57(3)	0.13(4)	
345	5.45(2)		50.70(4)
346	10.67(2)	60.18(3)	11.12(4)
347	2.60(3)	2.32(4)	3.17(2)
348		0.58(7)	
349		1.54(5)	
350		0.11(8)	
363		0.16(7)	
364		0.0 (10)	
365		0.0 (4)	
366	0.0 (3)	1.42(4)	0.0 (2)
368	0.0 (2)	1.45(4)	0.83(3)
369	9.46(3)	2.04(4)	1.81(2)
370		0.0 (4)	
371		0.40(4)	
372		0.20(9)	
384		0.34(4)	
385		0.39(7)	
386	8.71(3)	31.92(4)	6.24(2)
387	3.86(2)	3.28(4)	3.27(5)
388	6.13(2)	2.89(4)	19.20(3)
389	4.31(3)	1.44(4)	
390		0.0 (5)	
391	2.39(2)	0.60(3)	0.34(2)
392		2.61(4)	1.74(3)
729			5.44(3)
730	2.72(2)		7.71(3)
731	12.94(2)		15.73(3)
732	11.81(2)		18.60(2)
733	2.27(2)		19.05(3)
734	12.49(2)		6.05(3)
736	1.36(2)		8.77(3)
735	2.95(2)		2.95(3)
Total Weight (Tons)	4804	7734	8744

TABLE 6

Gadus - 3L

Witch average number per set

Stratum	Gadus 12 1978	Gadus 21 1979	Gadus 25 1979
328		0.0(5)	
341		0.25(4)	
342		0.25(4)	
343		0.0(4)	
344	10.00(3)	0.25(4)	
345	10.50(2)		60.50(4)
346	15.50(2)	77.33(3)	14.75(4)
347	2.97(3)	3.25(4)	6.00(2)
348		0.71(7)	
349		1.60(5)	
350		0.13(8)	
363		0.14(7)	
364		0.0(10)	
365		0.0(4)	
366	0.0(3)	1.50(4)	0.0(2)
368	0.0(2)	1.75(4)	1.00(3)
369	7.67(3)	2.25(4)	1.50(2)
370		0.0(4)	
371		0.25(4)	
372		0.22(9)	
384		0.25(4)	
385		0.43(7)	
386	6.67(3)	27.50(4)	5.00(2)
387	6.50(2)	3.80(4)	4.80(5)
388	5.50(2)	2.75(4)	17.33(3)
389	3.33(3)	1.50(4)	
390		0.0(5)	
391	3.00(2)	1.00(3)	1.00(2)
392		3.50(4)	2.00(3)
729			6.33(3)
730	3.50(2)		8.67(3)
731	15.00(2)		17.67(3)
732	14.00(2)		18.50(2)
733	4.50(2)		23.67(3)
734	11.50(2)		6.00(3)
735	6.50(2)		2.67(3)
736	4.00(2)		9.00(3)
TOTAL NUMBER	5885021	8717717	10304402

TABLE 7.

A.T. Cameron 3L — Witch average weight per set

Stratum	ATC 187 1971	ATC 199 1972	ATC 208-209 1973	ATC 222 1974	ATC 233 1975	ATC 246 1976	ATC 262 1977	ATC 276 1978	ATC 290 1979
328							0.0(3)		0.0(5)
341							0.0(4)	0.0(4)	0.15(6)
342							0.0(2)	0.0(2)	0.0(4)
343							0.0(2)	0.0(3)	0.29(4)
344						0.18(4)	0.91(4)	0.05(4)	0.91(2)
345						7.70(4)	36.06(4)	4.31(2)	19.97(4)
346					1.13(2)	28.15(2)	45.58(3)		53.85(4)
347	11.58(2)			0.45(2)	0.72(2)	4.81(3)	0.0(3)	0.45(4)	1.42(4)
348	2.12(3)	0.91(3)		0.0(6)	0.0(4)	0.0(6)	0.0(6)	0.0(6)	0.0(6)
349	0.0(3)	0.0(4)		0.0(4)	0.0(2)	0.0(3)	0.0(6)	0.0(6)	0.39(7)
350	0.0(3)	2.04(2)	0.0(4)	0.0(3)	0.0(3)	0.0(4)	0.0(4)	0.0(6)	0.08(9)
363	0.91(3)	0.38(3)	0.0(4)	0.0(4)	0.0(3)	0.0(4)	0.0(5)	0.0(5)	0.14(8)
364	2.50(4)	0.45(3)		0.0(4)	0.0(2)	0.0(3)	0.0(7)	0.0(6)	0.0(8)
365	0.0(3)	0.0(2)		0.0(3)	0.0(2)	0.0(3)	0.0(3)	0.0(2)	0.79(4)
366	5.30(3)			0.0(3)	0.91(4)	0.23(4)	0.57(4)		0.74(4)
368	0.68(2)			8.63(2)	3.06(2)	1.51(3)	3.74(3)		2.10(4)
369	10.90(3)			5.45(3)	1.86(3)	0.71(4)	2.23(3)	2.27(2)	2.10(4)
370	0.0(2)	0.45(3)		0.0(3)	0.0(3)	0.0(3)	0.0(3)	0.0(3)	0.0(4)
371	0.0(3)	1.13(2)		0.0(3)			0.0(3)	0.0(3)	0.0(3)
372	0.0(4)	0.0(3)	0.0(3)	0.0(3)	0.0(3)	0.0(3)	0.0(6)	0.0(7)	0.27(9)
384	0.61(3)	0.0(2)	0.0(3)	0.0(3)			0.0(2)	0.0(3)	0.0(4)
385	0.34(4)	0.57(4)	0.0(3)	0.0(2)	0.24(4)	0.0(2)	0.19(6)	0.26(6)	0.0(7)
386	18.16(2)			6.05(3)	9.20(3)	1.04(2)	20.13(3)	12.26(3)	12.60(4)
387	3.40(3)			15.13(3)	5.67(2)	29.14(3)	11.85(2)	5.15(3)	2.21(4)
388	0.68(2)		21.79(2)	9.69(3)	6.58(2)	99.30(2)	9.99(2)	22.70(2)	2.98(3)
389	0.0(3)	1.82(4)	2.27(2)	4.69(3)	3.18(2)	0.48(2)	2.57(3)	1.29(3)	0.11(4)
390	0.30(3)	0.30(3)	0.0(3)	0.0(3)	0.0(3)		0.0(2)	0.45(4)	0.0(5)
391		0.45(2)	0.0(2)	0.30(3)	0.0(2)		0.91(2)	0.0(2)	0.96(4)
392			5.45(3)	8.34(4)	0.0(2)		2.50(2)	0.45(3)	0.61(3)
Total Weight Tons	4885	1005	790	2554	1834	7512	9869	2644	7529

TABLE 8.

A.T. CAMERON 3L Witch Average Number

Stratum	ATC 187 1971	ATC 199 1972	ATC 208-209 1973	ATC 222 1974	ATC 233 1975	ATC 246 1976	ATC 262 1977	ATC 276 1978	ATC 290 1979
328							0.0 (3)		0.0 (5)
341							0.0 (4)	0.0 (4)	0.17(6)
342							0.0 (2)	0.0 (2)	0.0 (4)
343							0.0 (2)	0.0 (3)	0.25(4)
344						0.26(4)	0.75(4)	0.25(4)	1.00(2)
345						6.71(4)	41.96(4)	5.00(2)	21.75(4)
346					0.50(2)	40.50(2)	51.41(3)		65.00(4)
347	11.00(2)			0.50(2)	0.53(2)	2.47(3)	0.0 (3)	0.25(4)	1.50(4)
348	2.00(3)	0.67(3)		0.0 (6)	0.0 (4)	0.0 (6)	0.0 (6)	0.0 (6)	0.0 (6)
349	0.0 (3)	0.0 (4)		0.0 (4)	0.0 (2)	0.0 (3)	0.0 (6)	0.0 (6)	0.43(7)
350	0.0 (3)	1.50(2)	0.0 (4)	0.0 (3)	0.0 (3)	0.0 (4)	0.0 (4)	0.0 (6)	0.22(9)
363	0.33(3)	0.33(3)	0.0 (4)	0.0 (4)	0.0 (3)	0.0 (4)	0.0 (5)	0.0 (5)	0.25(8)
364	1.75(4)	0.33(3)		0.0 (4)	0.0 (2)	0.0 (3)	0.0 (7)	0.0 (6)	0.0 (8)
365	0.0 (3)	0.0 (2)		0.0 (3)	0.0 (2)	0.0 (3)	0.0 (3)	0.0 (2)	0.75(4)
366	3.67(3)			0.0 (3)	1.03(4)	0.25(4)	0.25(4)		1.00(4)
368	1.00(2)			6.50(2)	3.50(2)	2.00(3)	3.10(3)		3.00(4)
369	11.00(3)			4.67(3)	1.26(3)	0.78(4)	2.60(3)	2.00(2)	2.25(4)
370	0.0 (2)	0.33(3)		0.0 (3)	0.0 (3)	0.0 (3)	0.0 (3)	0.0 (3)	0.0 (4)
371	0.0 (3)	0.50(2)		0.0 (3)			0.0 (3)	0.0 (3)	0.0 (3)
372	0.0 (4)	0.0 (3)	0.0 (3)	0.0 (3)	0.0 (3)	0.0 (3)	0.0 (6)	0.0 (7)	0.33(9)
384	0.33(3)	0.0 (2)	0.0 (3)	0.0 (3)			0.0 (2)	0.0 (3)	0.0 (4)
385	0.25(4)	0.50(4)	0.0 (3)	0.0 (2)	0.26(4)	0.0 (2)	0.17(6)	0.17(6)	0.0 (7)
386	11.50(2)			4.00(3)	7.84(3)	1.03(2)	13.67(3)	8.67(3)	9.75(4)
387	3.33(3)			12.67(3)	5.00(2)	24.75(3)	10.50(2)	3.33(3)	3.00(4)
388	1.00(2)		19.00(2)	8.00(3)	6.50(2)	49.15(2)	12.00(2)	24.50(2)	3.67(3)
389	0.0 (3)	2.00(2)	1.50(2)	4.67(3)	3.50(2)	1.06(2)	1.67(3)	1.00(3)	0.25(4)
390	0.33(3)	0.33(3)	0.0 (3)	0.0 (3)	0.0 (3)		0.0 (2)	0.50(4)	0.0 (5)
391		0.50(2)	0.0 (2)	0.33(3)	0.0 (2)		1.00(2)	0.0 (2)	1.00(4)
392			4.33(3)	12.25(4)	0.0 (2)		2.50(2)	0.67(3)	0.33(3)
Total Number	3,911,381	788,724	654,472	2,159,100	1,644,944	6,501,691	10,310,592	2,365,212	8,429,761

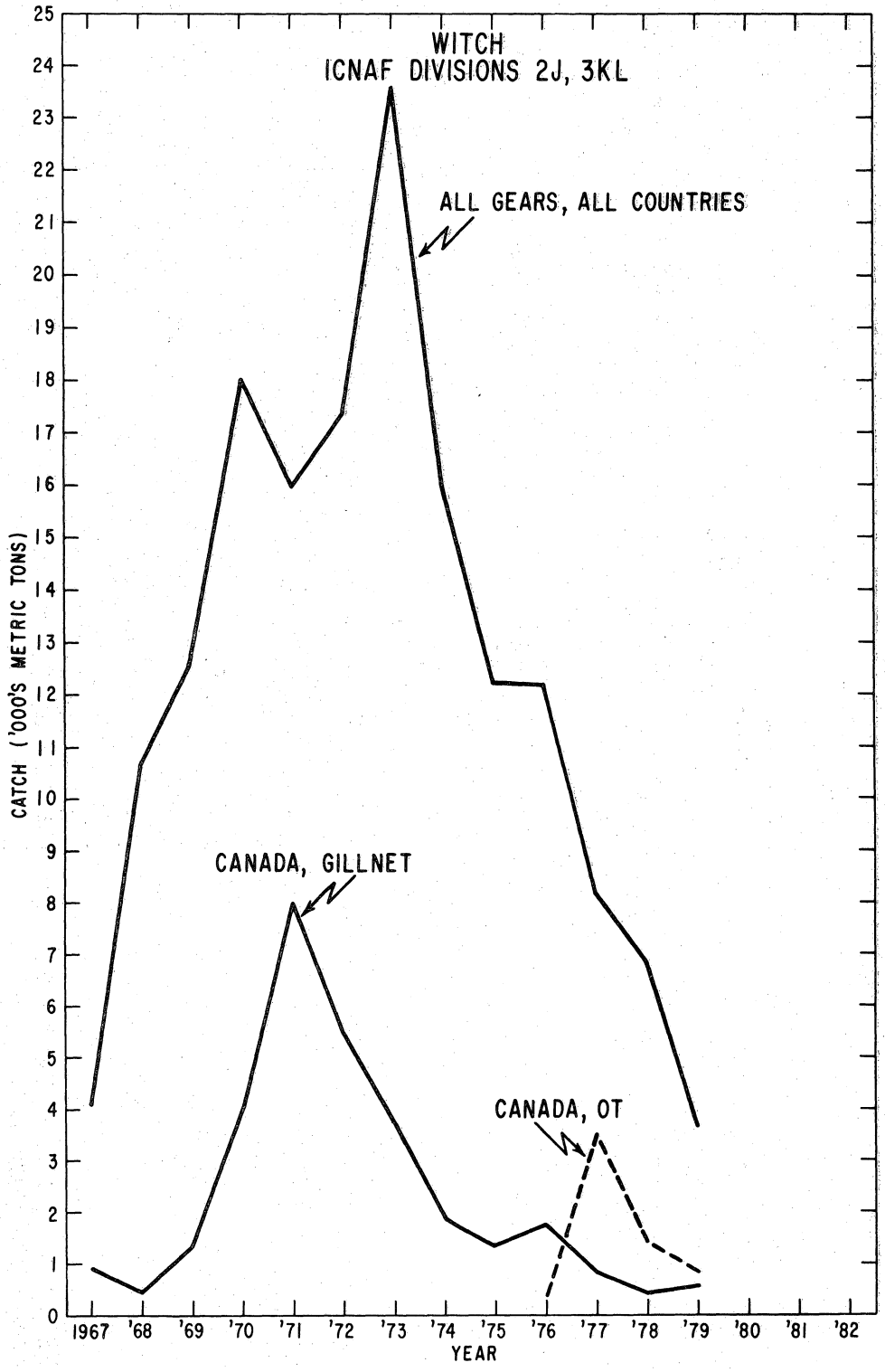
WITCH
ICNAF DIVISIONS 2J, 3KL
ALL GEARS, ALL COUNTRIES
CANADA, GILLNET
CANADA, OT
CATCH ('000'S METRIC TONS)
YEAR
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
1967
'68
'69
'70
'71
'72
'73
'74
'75
'76
'77
'78
'79
'80
'81
'82

Fig. 1

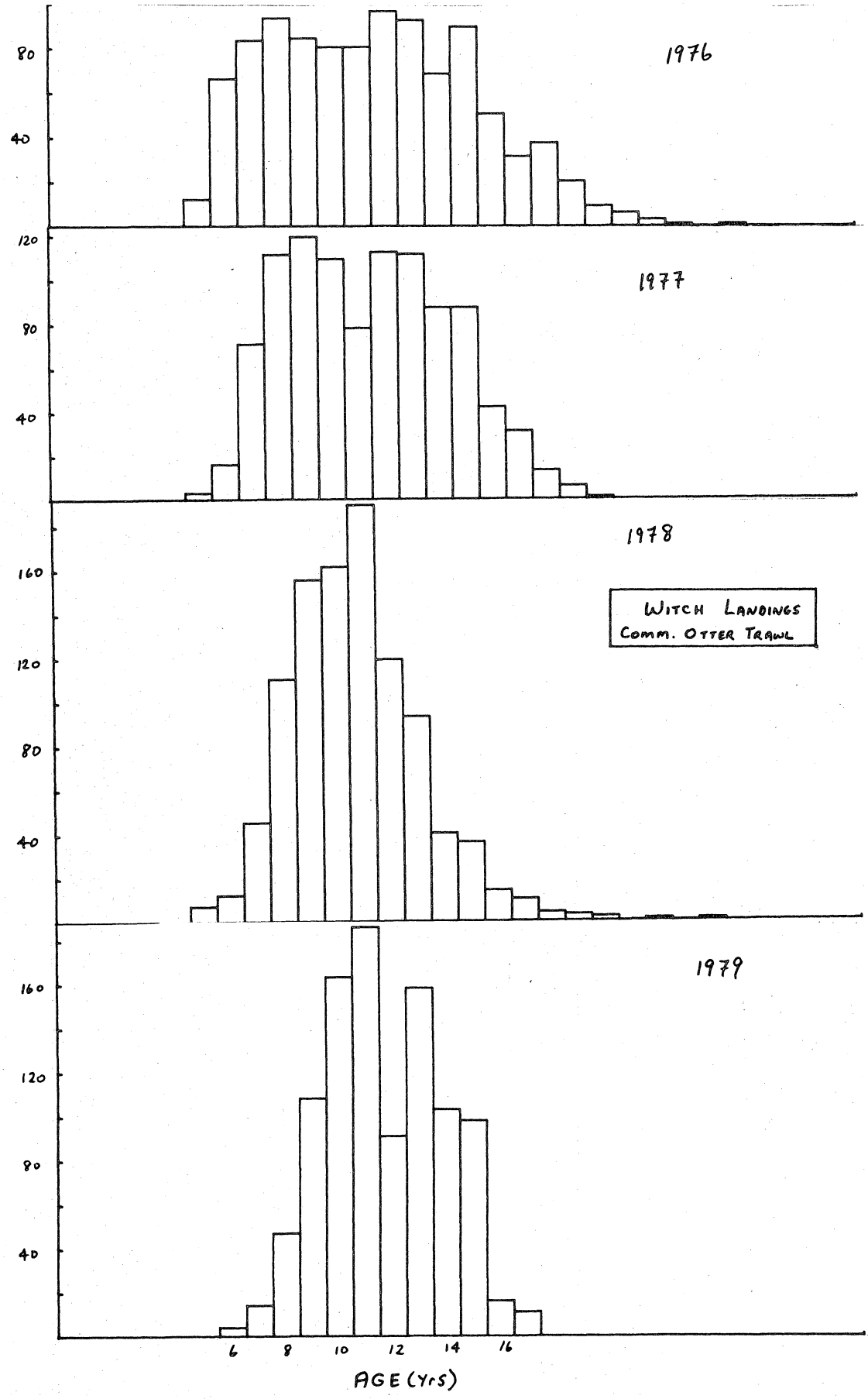
1976
1977
1978
1979
WITCH LANDINGS
COMM. OTTER TRAWL
NOS. PER THOUSAND
AGE (YRS)
6
8
10
12
14
16
40
80
120
160

Fig 2.

Comm. OT Witch
2J - 3KL
1976-1979 Male

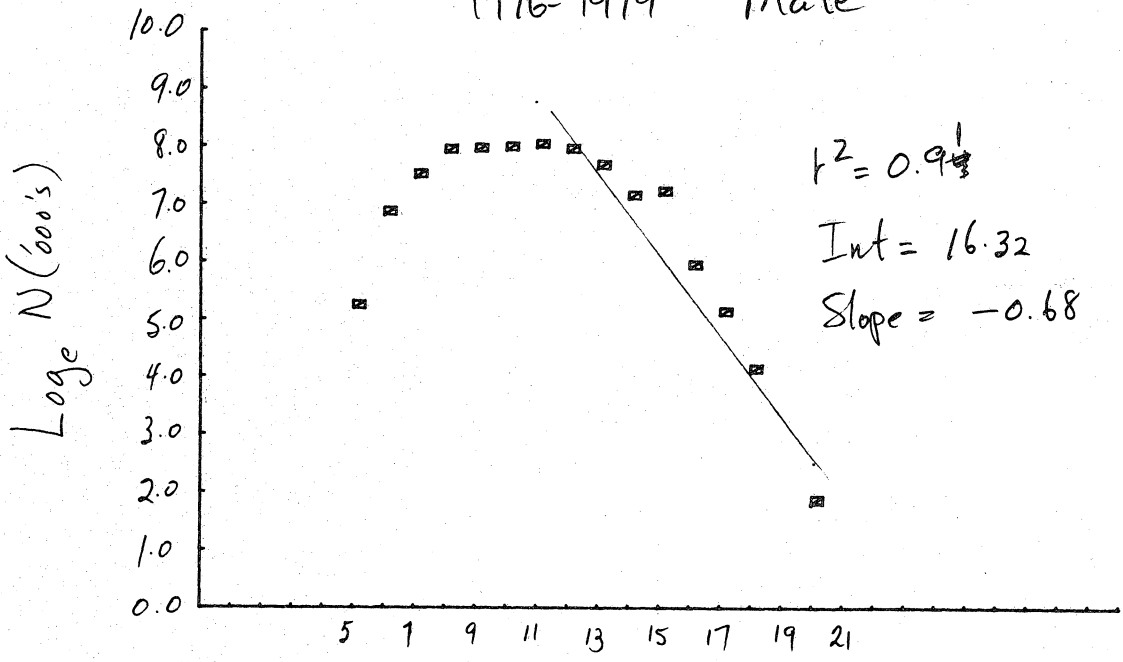

Fig 3

Comm. OT Witch
2J - 3KL
1976 - 1979 Female

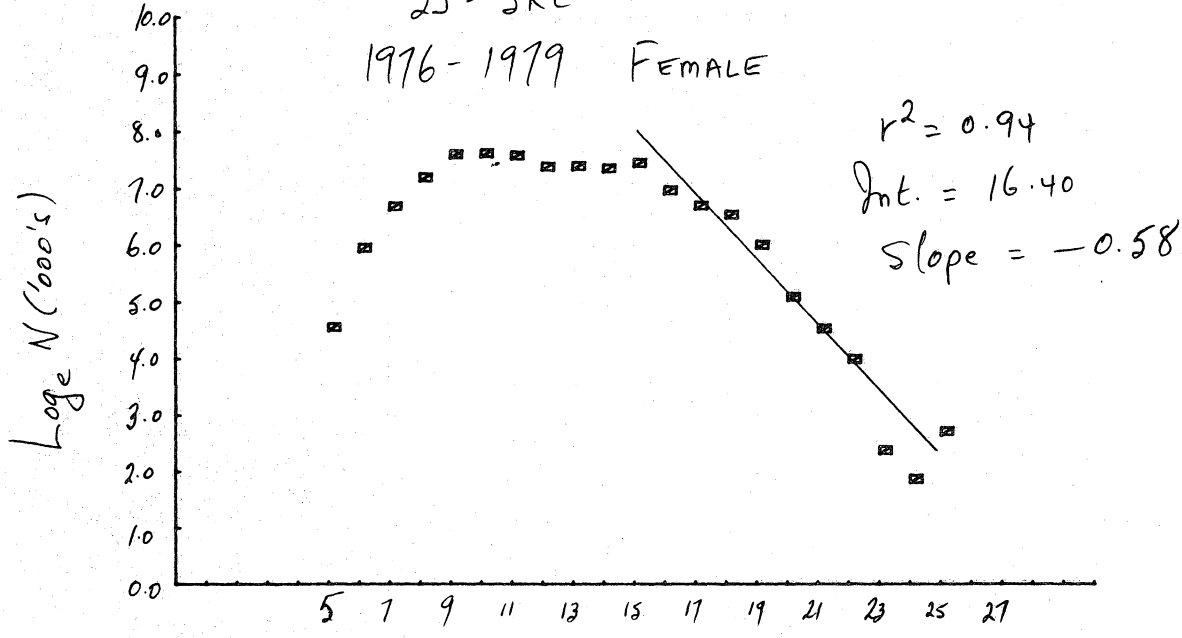

Fig 4

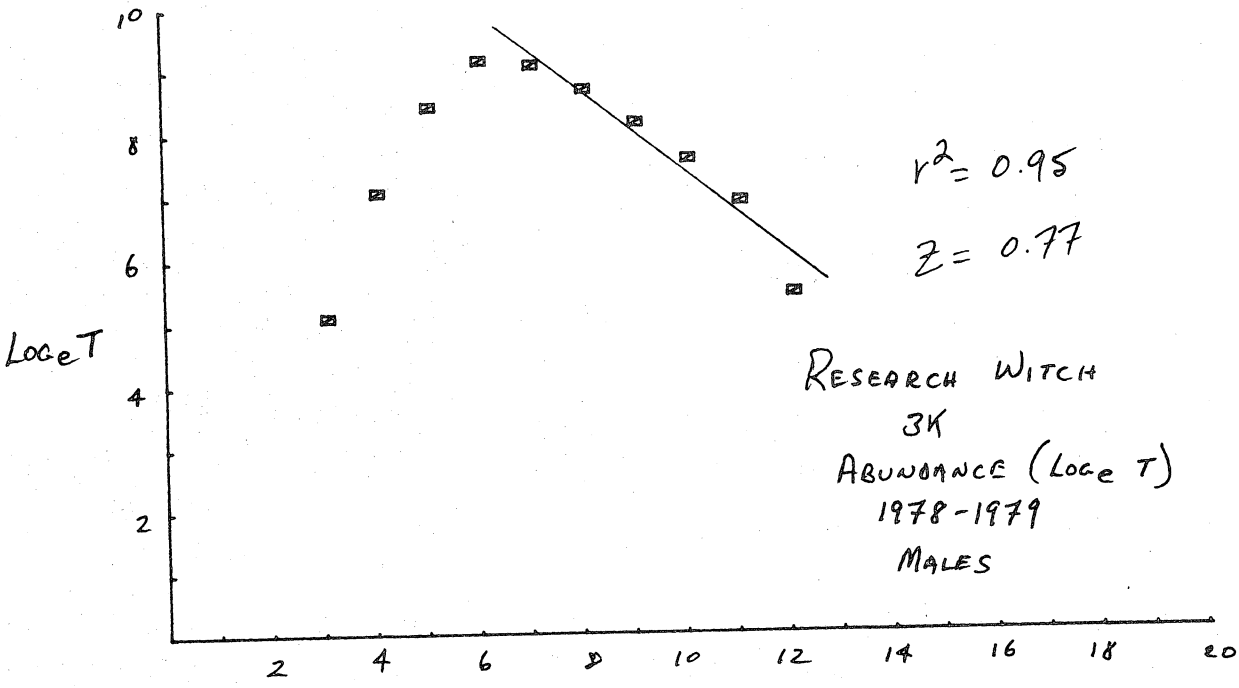
10
8
6
4
2
Loge T
2
4
6
8
10
12
14
16
18
20
Age (Yrs)
$r^2 = 0.95$
$Z = 0.77$
Research Witch
3K
Abundance (Loge T)
1978-1979
Males

Fig 5.

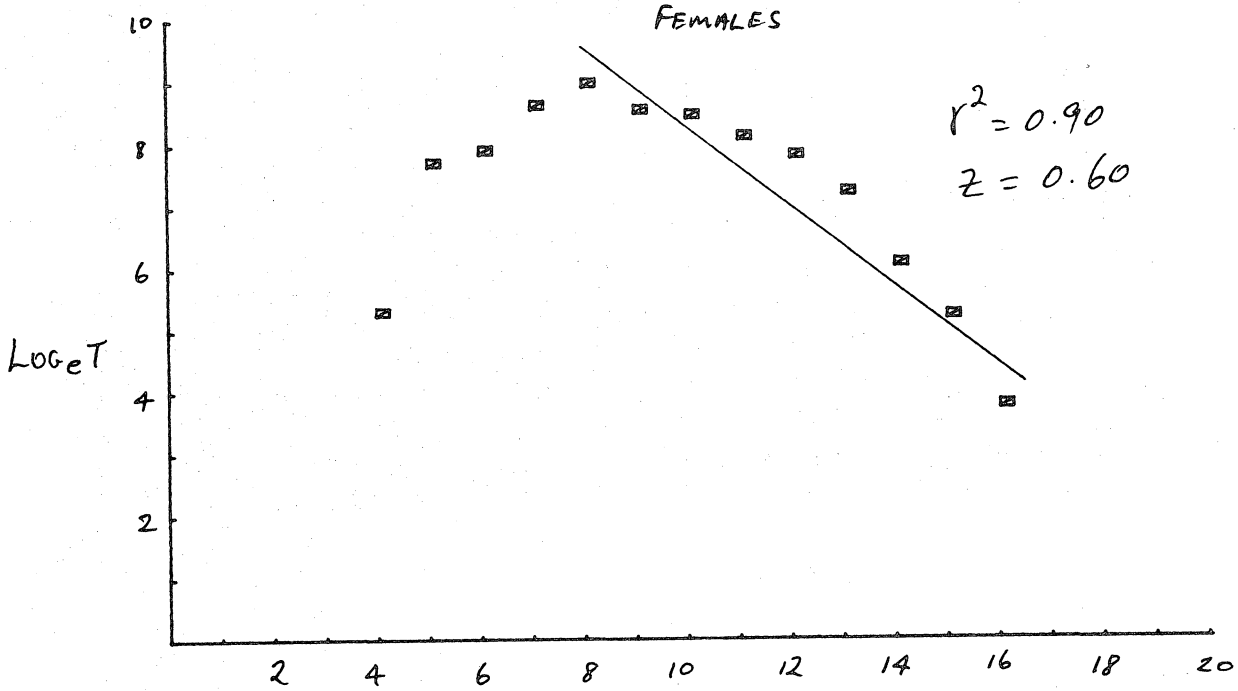
Research Witch
3K
Abundance (Loge T)
1978-1979
Females
10
8
6
4
2
Loge T
2
4
6
8
10
12
14
16
18
20
Age (Yrs)
$r^2 = 0.90$
$Z = 0.60$

Fig 6.

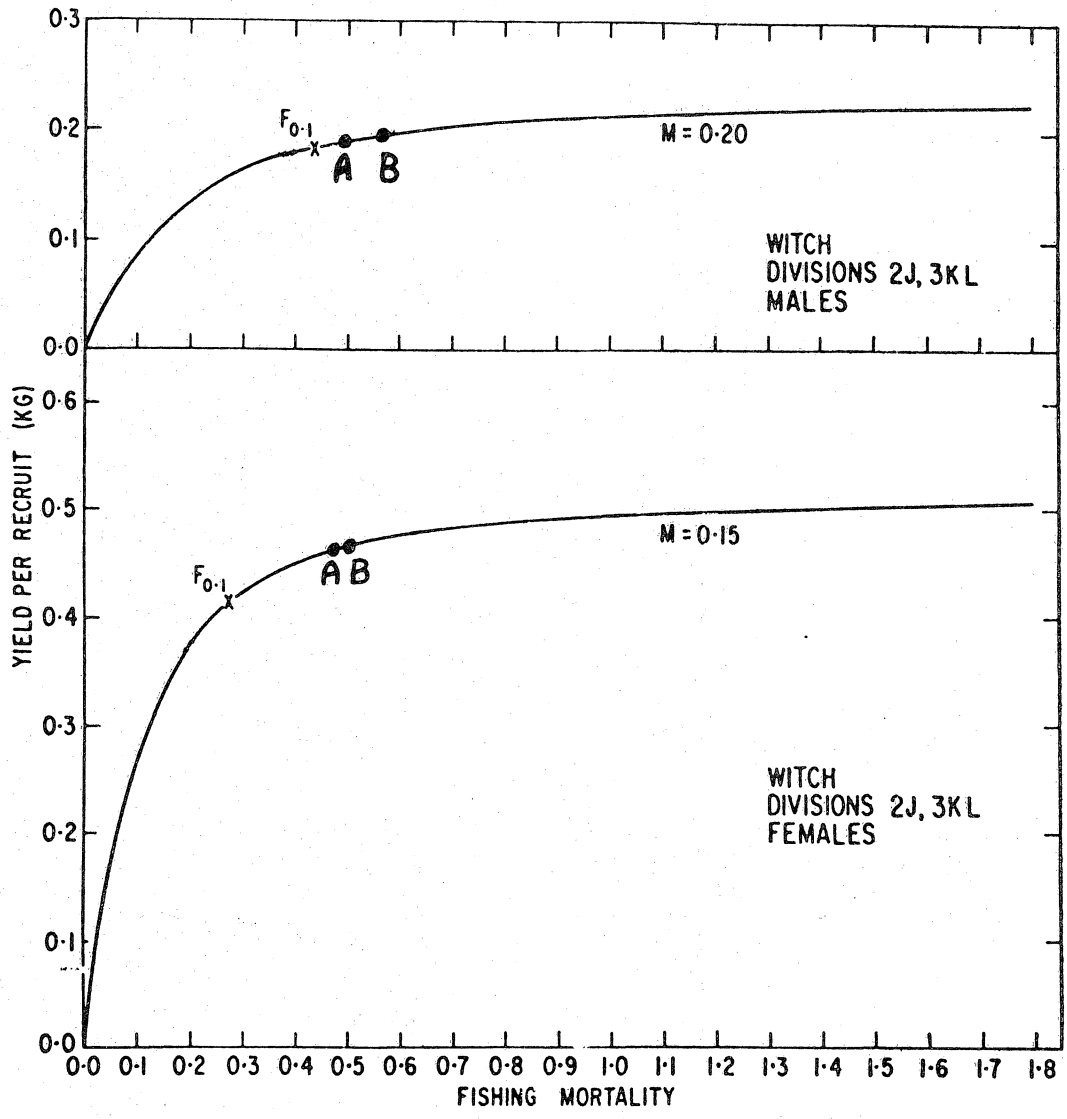

Fig. 7

A - From Commercial catch curves

B - From Research catch curves (Div 3K)