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American Plaice In NAFO Divisions 3L, 3N, and 3O -
A Stock Assessment Update

by

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Introduction

This stock has been commercially exploited since the early 1950's and has been under quota regulation since 1973. Nominal catches, by country, for 1966-82 and TAC's, 1973-83 are listed in Table 1 and nominal catches, by NAFO Division, for 1965-82 are given in Table 2.

Stock assessment

Sampling: The length measurements and otolith samples listed in Table 4 were provided by the Canadian Commercial Groundfish Sampling Section in St. John's.

Numbers at age: The catch at age for 1982 was calculated in the usual manner by applying quarterly sexed age-length keys to monthly frequencies for each NAFO Division. Males and females were combined from all divisions to give total numbers caught. Table 5 shows the catch at age for 1982, along with the corresponding variances, standard errors, and coefficients of variation. Table 6 contains the catch matrix for Div. 3L+3N for 1960-82. The decline in catch for ages 6-10 in 1981 was attributed to the fact that a higher proportion of the catch in 1981 was taken in NAFO Div. 3L, where a high percentage of discarding occurred (Stevenson 1982). Although the percentage of the total catch taken in Div. 3L decreased in 1982, there was evidence that discarding of age 6 and 7 fish was significantly higher in 1983 than 1982 (Stevenson, pers. comm.). Because of a short series of information on discarding, the numbers in Table 6 have not been adjusted up to total calculated catch and, therefore, reflect only the number of fish landed.

Weight at age: Average weights at age for 1982 (Table 5) were calculated from average lengths at age using monthly samples weighted by the numbers caught at age. These average lengths were then converted to average weights by a length-weight equation. Table 7 gives the average weights at age for American plaice in Div. 3L, 3N, and 3O over the period 1960-82.

Partial recruitment: Attempts were made in both this assessment and the 1982 assessment to calculate partial recruitment rates for use in the cohort analysis using a) average F 's from a cohort run using the 1978-81 and 1978-82 catch matrices and b) the ratio of per mille age frequencies in the commercial catch and the research vessel catch. Since both these methods proved to be unsatisfactory, a modified version of the partial recruitment vector calculated in 1981 from average F 's was used in 1982. The modifications affected ages 6-10 and were based on the ratio of the 1981 catch at age (per mille) and the 1980 catch at these ages. The same partial recruitment vector (Table 8) was used in the cohort analysis presented here.

Terminal fishing mortality: An estimate of F_T was obtained from calibrating the cohort analysis using the following methods:

- a) Regression of age 8+ biomass from cohort on directed catch per hour, 1965-82 (Table 3, Fig. 1). Table 15 shows the results of these regressions at values of F_T from 0.35 to 0.45. The correlation coefficient increases over this range of values and the best predicted value for 8+ biomass in 1982 using the 1982 value for CPUE = 0.562 is from the run $F_T = 0.40$. A comparison of the 1982 8+ biomass and CPUE with the average 1968-70 8+ biomass and CPUE revealed that there was very little difference when the

values from the cohort run at $F_T = 0.375$ were used: 236,500 + 8+ biomass and CPUE = 0.564 for the average 1968-70 and 231,000 + 8+ biomass and CPUE = 0.562 for 1982.

- b) Regression of weighted fishing mortality (ages 8-18) from cohort analysis on total fishing effort (Table 16, Fig. 2). The series of cohort runs with $F_T = 0.275$ to 0.400 show that r^2 reaches a peak of 0.659 for the regression using weighted F from the cohort run at $F_T = 0.375$ and that the best predicted value for weighted F , ages 8-18, using the 1982 value for effort = 79,500 hours is from the run at $F_T = 0.30$. The best comparison between 1982 effort and weighted F and 1966-68 average effort (77,300 hours) and weighted F (0.157) was provided by the values from the cohort run at $F_T = 0.325$, where, with effort in 1982 = 79,500 hours, weighted F was 0.155.
- c) Regression of population numbers (ages 8-18) from cohort analysis on population numbers (ages 8-18) from spring research vessel surveys (Tables 10 and 17, Fig. 3). Over a range of cohort runs with $F_T = 0.25$ to 0.35, r^2 shows very little variation, with a peak value of 0.676 at $F_T = 0.300$. Using the 1982 survey value of 394.3×10^6 fish at ages 8-18, the best predicted value of age 8-18 population numbers came from the regression using the values from the cohort run at $F_T = 0.25$.

$F_{0.1}$: Long-term (1960-80) average weights and partial recruitment were used in the Thompson-Bell yield per recruit calculations (Table 9). These are the same values used in the two previous assessments (Pitt and Brodte 1981; Brodte and Pitt 1982) and result in an $F_{0.1}$ value of 0.252.

Recruitment for stock projections: The geometric mean (1976-81) of age 6 numbers from the cohort run at $F_T = 0.35$ was used to estimate recruitment at age 6 for the years 1982-84. This value was 229.0×10^6 fish, which is slightly lower than the figure of 236.5×10^6 fish used in the 1982 assessment.

Discussion

Abundance indices: Catch per unit effort from Can (N) otter trawlers, tonnage class 5, showed an increasing trend over the period 1975-80, when it reached 0.597 t/hr, the highest value since 1968. Since 1980, CPUE has shown a slight decline to 0.570 t/hr in 1981 and 0.562 t/hr in 1982. These values remain significantly higher than those found in the period 1969-79. Research vessel surveys conducted in the spring indicate that the population size in Div. 3L and 3N has been relatively stable since 1977, although there has been a decrease in the numbers of age 5-7 fish in the 1981 and 1982 surveys (Table 10). Tables 11 and 12 show that the mean numbers and weights caught per tow have remained stable for Div. 3LN combined over the period 1977-82. Research vessel surveys conducted in the fall of 1981 and 1982 indicate relative stability in the population (Tables 13 and 14), although these results do not show the decrease in age 5-7 fish between 1981 and 1982 that was shown in the spring survey data. It should be noted that the fall survey estimates cannot be compared to the spring survey results as absolute indices of abundance because different strata are used in each series to calculate the estimates.

Cohort analysis: Because of uncertainties in the catch at age and weight at age data prior to 1965, only the 1965-81 values from the cohort runs were used in calibrating the analysis. The three methods used to tune the analysis showed that terminal F in 1982 was between 0.30 and 0.40, and more likely in the range of 0.325 to 0.375. Table 18 shows the cohort run using terminal $F = 0.350$.

Catch projections: Projected catches to 1984 are shown in Table 19. This projection was made using the population in 1982 from the cohort run at $F_T = 0.35$, replacing the number at age 6 with the geometric mean value of 229.0×10^6 . Average weights, 1979-81 and average partial recruitment 1979-81 (Table 8) were used and the resulting $F_{0.1}$ catch in 1984 was

47,000 t, assuming that 49,000 t will be taken in 1983. This value is calculated for Div. 3LN only and a final estimate of the TAC should include an allowance for Div. 3Ø, where the catch in 1982 was 5100 t and catches since 1978 have averaged 4200 t.

References

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- Pitt, T. K., and W. B. Brodie. 1981. A stock assessment update of American plaice in NAFO Divisions 3L, 3N, and 3Ø. NAFO SCR Doc. 81/VI/61, Ser. No. N345.
- Stevenson, S. C. 1982. Summary of discarding and estimates of total removals by Canadian trawlers during the 1981 Divisions 3LNO American plaice fishery. CAFSAC Res. Doc. 82/19.

Table 1. Nominal catches of American plaice for ICNAF Divisions 3LNO 1966-82 and TAC's from 1973-83.

Year	Canada	France	Poland	USSR	Other	Total	TAC
1966	51,225	1,246	860	11,484	196	65,011	-
1967	54,190	1,326	3,234	35,139	524	94,413	-
1968	48,674	406	203	23,751	133	73,167	-
1969	64,815	43	34	14,493	52	79,437	-
1970	54,929	389	40	10,232	1,055	66,645	-
1971	49,394	323	370	17,173	628	67,888	-
1972	41,605	322	2,515	14,164	755	59,361	-
1973	38,586	310	1,116	12,516	315	52,843	60,000
1974	35,101	418	615	10,074	89	46,297	60,000
1975	34,015	442	537	7,682	545	43,221	60,000
1976	47,806	305	5	3,280	429	51,825	47,000
1977	42,579	31	0	1,023	349	43,982	47,000
1978	48,634	168	0	1,048	178	50,028	47,000
1979	47,131	131	0	1,190	120	48,572	47,000
1980	48,282	183	0	336	284	49,085	47,000
1981	48,177	210	-	847	924	50,158	55,000
1982 ^a	49,701	145	-	-	-	49,846	55,000
1983							55,000

^a: Provisional

Table 2. Breakdown of plaice nominal catches in Divisions 3LNO by Division (metric tons). Some totals include small portion of catch not broken down by Division.

Year	Division 3L	Division 3N	Division 3O	Total
1965	25,034	26,270	1,957	53,279
1966	18,575	34,698	11,741	65,011
1967	38,511	24,364	31,534	94,413
1968	39,126	20,038	14,003	73,167
1969	52,880	14,442	12,115	79,437
1970	39,347	21,032	6,266	66,645
1971	37,851	22,873	7,164	67,888
1972	33,330	17,378	8,644	59,361
1973	20,103	20,883	11,857	52,843
1974	16,609	21,118	8,561	46,297
1975	15,171	21,308	6,742	43,221
1976	25,122	18,623	8,080	51,825
1977	23,763	16,543	3,675	43,982
1978	30,145	13,443	6,440	50,028
1979	28,708	14,712	5,149	48,572
1980	31,728	15,107	2,250	49,085
1981	37,269	10,628	2,261	50,158
1982 ^a	32,675	12,028	5,143	49,846

^a: Provisional

Table 3. Catch and effort data for American plaice for NAFO Division 3L and 3N. Directed catch (Column 2) refers to catch directed for plaice by Canada (N) otter trawls tonnage class 5.

Year	Directed catch (tons)	CPUE (tons/hr)	Total catch (tons)	Total effort (hours) (calculated)
1965	18,082	0.905	51,304	56,690
1966	29,536	0.876	53,273	60,814
1967	34,416	0.818	62,875	76,864
1968	31,344	0.629	59,164	94,060
1969	39,251	0.548	67,322	122,850
1970	24,020	0.516	60,379	117,014
1971	24,439	0.479	60,724	126,772
1972	23,137	0.481	50,708	105,422
1973	20,027	0.517	40,986	79,277
1974	20,957	0.434	37,727	86,929
1975	27,111	0.416	36,479	87,690
1976	35,710	0.430	43,745	101,733
1977	32,117	0.406	40,306	99,276
1978	33,290	0.460	43,588	94,757
1979	30,763	0.495	43,420	87,717
1980	34,982	0.597	46,835	78,451
1981	34,199	0.570	47,897	84,030
1982	33,052	0.562	44,703	79,543

Table 4. List of commercial sampling by quarter and division, available for 1982, American plaice, NAFO Divisions 3LNO, provided by St. John's Commercial Sampling Section.

Quarter	Measurements			Otoliths			Catch (tons)			No. samples		
	3L	3N	3Ø	3L	3N	3Ø	3L	3N	3Ø	3L	3N	3Ø
1	1,632	-	2,037	187	-	390	929	6	676	4	-	5
2	15,775 293 ^a	317	4,546	757 88 ^a	127	802	9,731 1,711 ^a	775	3,195	37 1 ^a	1	14
3	10,155 3,187 ^a	7,649	-	528 524 ^a	979	-	10,047 2,043 ^a	7,087	327	20 10 ^a	24	-
4	17,374 610 ^a	7667	1,220	764 205 ^a	849	117	7,441 40 ^a	4,069	683	43 3 ^a	18	2

^a Inshore fixed gear.

Table 5. Catch and weight at age for American plaice in Divisions 3LN for 1982.

AGE	WEIGHT	CATCH	VAR.(CATCH)	STD.ERROR	COEF.VAR
5	0.285	20	44.828	6.70	0.33
6	0.313	271	3696.978	60.80	0.22
7	0.375	1576	33037.630	181.76	0.12
8	0.444	4303	81070.536	284.73	0.07
9	0.512	7878	118025.907	343.55	0.04
10	0.550	11345	201157.580	448.51	0.04
11	0.609	14704	285935.865	534.73	0.04
12	0.752	13687	254257.892	504.24	0.04
13	0.995	7418	139060.095	372.91	0.05
14	1.299	3836	46385.404	215.37	0.06
15	1.602	1718	13523.429	116.29	0.07
16	2.054	524	2295.739	47.91	0.09
17	2.211	146	462.299	21.50	0.15
18	2.677	69	162.566	12.75	0.18
19	3.437	8	29.069	5.39	0.72

Table 6 AM, PLAICE DIVISIONS 3LN CATCH MATRIX (NUMBERS x 10³)

AGE	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
6	309	189	428	960	1788	3041	5139	2228	1894	2079	1768	1565	2199	837	5222	2645	3400	6537	3538	6069	2924	538	271
7	816	501	632	1740	4662	6969	8224	7216	3347	6674	2314	7524	2023	4909	7305	6693	7398	8065	7874	12560	9110	2018	1576
8	1324	1161	1054	1337	3035	8964	9122	5093	7913	12023	9066	9354	6576	8158	8070	8266	15963	10827	9238	16872	11601	4330	4303
9	1685	2324	1139	1442	5760	6789	7798	6330	9065	15409	12264	13868	9856	10096	6675	7802	15166	12653	11583	13242	13571	7134	7878
10	2210	2994	1605	2086	8180	7285	5954	9133	9405	10830	10225	12670	10907	7741	6445	10772	10303	12370	11329	11329	13735	10761	11345
11	2462	2327	2339	2894	6493	5521	5823	9106	6255	10793	10128	9833	10866	7789	5924	6867	5954	8859	8859	8075	10796	13178	14704
12	3367	2143	2594	3892	5737	5578	4644	9700	11193	8811	7473	8074	9147	5245	3839	3880	4273	3750	5825	3406	7698	11222	13687
13	2668	3673	2317	3633	3028	5023	4696	6324	7098	5978	5034	4647	5796	5111	2940	3110	2415	2014	2977	1640	3385	8553	7418
14	2486	2433	3151	3591	2830	4174	4105	4377	5126	4496	4223	3328	3720	2896	1642	2175	1994	1311	1738	594	1460	5527	3836
15	1401	1746	2217	2308	2124	1773	2959	3615	2558	2955	3851	2920	2151	1560	866	1091	1176	872	1161	294	619	2903	1718
16	1387	1408	1320	1296	1350	2054	1626	2501	2075	1586	2176	1753	1806	1828	595	595	448	308	469	148	244	1099	524
17	931	581	942	623	607	1270	1037	1314	1230	1051	1236	898	1239	802	187	373	193	161	152	57	79	383	146
18	293	775	771	620	563	556	933	1110	615	609	834	447	527	913	65	190	45	93	53	13	25	231	69
19	236	303	480	395	536	618	390	283	330	296	315	360	286	337	20	80	20	25	18	5	2	101	8

Table 7 AM, PLAICE DIVISIONS 3LN WEIGHT MATRIX (WEIGHTS IN KG)

AGE	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	
6	0.193	0.189	0.177	0.227	0.285	0.289	0.277	0.287	0.276	0.290	0.275	0.259	0.278	0.244	0.252	0.248	0.261	0.264	0.266	0.266	0.320	0.328	0.381	0.313
7	0.274	0.279	0.276	0.297	0.378	0.365	0.369	0.383	0.348	0.332	0.330	0.331	0.372	0.292	0.339	0.347	0.345	0.359	0.363	0.374	0.410	0.410	0.408	0.375
8	0.363	0.373	0.380	0.384	0.491	0.498	0.499	0.469	0.450	0.412	0.397	0.404	0.484	0.380	0.416	0.418	0.403	0.431	0.414	0.448	0.483	0.483	0.453	0.444
9	0.487	0.493	0.522	0.525	0.547	0.625	0.640	0.610	0.602	0.564	0.536	0.494	0.527	0.519	0.568	0.578	0.548	0.623	0.515	0.546	0.537	0.480	0.512	0.512
10	0.594	0.596	0.611	0.621	0.639	0.703	0.788	0.788	0.697	0.670	0.680	0.612	0.629	0.629	0.694	0.706	0.658	0.676	0.618	0.574	0.570	0.523	0.550	0.550
11	0.695	0.741	0.738	0.731	0.760	0.827	0.876	0.847	0.851	0.785	0.795	0.772	0.753	0.816	0.917	0.922	0.841	0.884	0.773	0.683	0.653	0.542	0.609	0.609
12	0.857	0.865	0.885	0.845	0.851	0.869	0.988	1.030	0.991	0.982	0.841	0.909	0.867	1.041	1.108	1.099	1.029	1.013	0.928	0.906	0.742	0.670	0.752	0.752
13	0.903	0.888	0.905	0.867	0.920	0.932	0.984	1.064	1.064	1.050	1.043	1.034	1.175	1.243	1.340	1.339	1.152	1.199	1.199	1.188	0.989	0.786	0.995	0.995
14	1.193	1.199	1.206	1.152	1.208	1.258	1.287	1.369	1.397	1.401	1.166	1.132	1.175	1.334	1.567	1.536	1.357	1.389	1.389	1.389	1.352	1.000	1.299	1.299
15	1.262	1.264	1.272	1.255	1.289	1.377	1.413	1.631	1.597	1.602	1.311	1.279	1.380	1.524	1.922	1.813	1.658	1.768	1.768	1.886	1.739	1.300	1.602	1.602
16	1.308	1.324	1.330	1.314	1.576	1.614	1.656	1.890	1.681	1.870	1.673	1.600	1.654	1.816	2.387	2.319	2.137	2.196	2.196	2.118	1.770	1.762	2.054	2.054
17	1.411	1.423	1.423	1.423	1.921	1.905	1.922	2.166	2.197	2.240	1.854	1.911	1.854	2.104	2.458	2.578	2.318	2.324	2.324	2.302	2.140	2.079	2.211	2.211
18	1.516	1.516	1.525	1.493	1.934	1.943	1.917	2.305	2.297	2.348	2.073	2.117	1.915	2.104	2.871	2.880	2.716	2.546	2.546	3.199	2.700	2.168	2.677	2.677
19	1.562	1.558	1.572	1.962	1.997	1.957	2.025	2.527	2.488	2.595	2.285	2.285	2.129	2.294	3.004	2.942	2.864	3.072	3.072	3.243	3.000	2.554	3.457	3.457

Table 8. Partial recruitment vectors, average, and current for American plaice in NAFO Divisions 3LN.

Age	Average (1960-80)	Average (1979-81)	1982
5	.005	-	-
6	.025	.067	.008
7	.100	.194	.037
8	.220	.305	.123
9	.300	.369	.231
10	.470	.502	.515
11	.580	.668	.750
12	.730	.872	.800
13	1.000	1.000	1.000
14	1.000	1.000	1.000
15	1.000	1.000	1.000
16	1.000	1.000	1.000
17	1.000	1.000	1.000
18	1.000	1.000	1.000
19	1.000	1.000	1.000
20	1.000	-	-

Table 9 Yield per recruit analysis for Divisions 3LN American plaice.

YIELD PER RECRUIT ANALYSIS

AGE	WEIGHT-AT-AGE	PARTIAL RECRUITMENT	FISHING MORTALITY	CATCH (NUMBER)	YIELD (KG)	AVG. WEIGHT (KG)	YIELD PER UNIT EFFORT
5	0.209	0.005	0.1000	0.120	0.117	0.972	1.712
6	0.261	0.025	0.2000	0.191	0.164	0.858	1.202
7	0.341	0.100	F0.1-- 0.2615	0.222	0.178	0.803	1.000
8	0.428	0.220	0.3000	0.238	0.184	0.773	0.901
9	0.552	0.300	0.4000	0.277	0.194	0.711	0.710
10	0.625	0.470	0.5000	0.299	0.199	0.664	0.583
11	0.700	0.580	0.6000	0.321	0.202	0.628	0.493
12	0.880	0.730	0.7000	0.339	0.204	0.600	0.427
13	1.020	1.000	0.8000	0.355	0.205	0.576	0.377
14	1.250	1.000	0.9000	0.369	0.206	0.559	0.337
15	1.524	1.000	1.0000	0.382	0.207	0.543	0.305
16	1.803	1.000	1.1000	0.393	0.208	0.530	0.278
17	2.022	1.000	1.2000	0.403	0.209	0.518	0.256
18	2.233	1.000	1.3000	0.413	0.210	0.508	0.237
19	2.401	1.000	1.4000	0.421	0.210	0.499	0.221
20	2.428	1.000	1.5000	0.429	0.211	0.491	0.206
			FMAX-- 3.1357	0.512	0.214	0.417	0.100

NATURAL MORTALITY RATE : 0.2
 F0.1 COMPUTED AS 0.2615 AT 1/F OF 0.1781
 FMAX COMPUTED AS 3.1357 AT 1/F OF 0.2135

Table 10. American plaice population numbers estimated from research vessel surveys in NAFO Division 3L and 3N ($\times 10^{-5}$) for selected strata.

	1971	1972	1973 ^a	1974	1975	1976 ^a	1977	1978	1979	1980	1981	1982
1		1.1						0.2	2.9		4.7	0.3
2		4.0			12.5	5.8	4.1	7.5	6.5	8.5	9.9	4.9
3	55.0	8.9		12.3	50.8	114.9	38.6	194.7	18.3	55.2	78.4	46.3
4	158.5	159.0		75.3	86.8	208.1	205.3	317.9	196.6	115.9	106.8	165.7
5	527.3	313.0		114.6	121.3	281.6	550.7	967.5	651.7	580.8	200.1	163.0
6	679.7	567.9		311.6	269.6	269.7	1,010.9	963.2	1,012.7	1,009.8	547.3	387.8
7	906.5	570.9		368.6	428.8	615.5	1,553.4	1,189.7	1,034.2	1,070.1	823.5	611.8
8	381.6	456.0		376.0	541.2	1,080.8	1,473.2	1,114.3	1,188.4	1,275.0	1,136.6	953.7
9	658.2	300.9		322.1	407.4	816.6	927.5	754.4	838.2	989.9	905.8	1,158.2
10	327.9	344.0		323.8	334.3	691.5	844.2	570.8	710.7	628.9	587.1	860.4
11	297.7	212.7		176.2	169.6	415.6	374.3	214.4	359.3	284.3	312.2	505.3
12	266.7	206.7		149.6	116.8	255.2	249.9	148.6	154.1	184.6	136.7	229.0
13	187.9	104.3		94.6	61.1	125.5	108.2	69.9	57.0	94.5	64.9	118.1
14	130.3	83.4		48.6	34.5	39.9	46.0	44.6	32.6	38.9	22.5	62.4
15	67.5	58.1		31.3	17.0	34.4	31.6	22.9	22.4	23.3	25.1	22.8
16	49.9	40.2		11.0	13.3	16.9	18.4	9.4	10.7	18.7	14.6	18.2
17	26.4	12.8		2.3	3.5	11.3	8.0	5.9	4.0	8.8	7.8	11.4
18	20.8	4.5		0.4	1.3	3.1	4.4	1.2	0.9	3.2	3.2	3.8
19	5.6	2.4		0.8	0.7	0.9	0.8		0.2	0.8		0.2
20	3.2	2.7						0.5				
21	1.1											
22	1.6											
2*	4,752.4	3,452.3		2,419.1	2,670.5	4,987.3	7,449.5	6,597.4	6,298.5	6,391.2	4,982.5	5,323.0
4*	4,697.4	3,439.4		2,406.8	2,607.2	4,866.6	7,406.8	6,395.2	6,273.7	6,327.5	4,894.2	5,271.8
6*	4,011.6	2,967.4		2,216.9	2,399.1	4,376.9	6,650.8	5,109.8	5,425.4	5,630.8	4,587.3	4,943.1
8*	2,426.4	1,828.6		1,536.7	1,700.7	3,491.7	4,086.5	2,956.9	3,378.5	3,550.9	3,216.5	3,943.5
12*	761.0	515.0		338.6	248.2	487.2	467.3	303.0	281.9	372.8	274.8	465.9

^a: Indicates inadequate coverage by research vessel.

Table 11. Mean numbers per tow (with upper and lower 95% confidence limits) from research vessel surveys (spring) in NAFO Divisions 3L and 3N. Estimates are from the same selected strata each year.

Year	3L			3N		
	Upper	Mean	Lower	Upper	Mean	Lower
1971	(441.8)	297.6	(153.4)	(112.7)	67.8	(22.9)
1972	(418.1)	213.8	(9.6)	(72.4)	62.3	(52.2)
1973 ^a						
1974	(177.0)	136.3	(95.6)	(69.9)	49.5	(29.0)
1975	(387.1)	228.1	(69.0)	(123.1)	64.3	(5.4)
1976 ^a						
1977	(609.2)	495.2	(381.1)	(176.1)	99.8	(23.5)
1978	(515.3)	397.2	(279.1)	(186.1)	123.8	(61.5)
1979	(494.4)	393.8	(293.1)	(164.2)	94.0	(23.7)
1980	(582.9)	411.4	(239.8)	(88.6)	68.0	(47.4)
1981	(384.2)	291.7	(199.2)	(257.5)	180.1	(102.8)
1982	(529.1)	365.7	(202.4)	(68.8)	52.3	(35.8)

^a: Indicates inadequate coverage by research vessel.

Table 12. Mean weight caught (kg) per tow (with upper and lower 95% confidence limits) for research vessel surveys (spring) in NAFO Divisions 3L and 3N. Estimates are from the same strata each year.

Year	3L			3N		
	Upper	Mean	Lower	Upper	Mean	Lower
1971	(196.0)	130.2	(64.4)	(104.2)	58.5	(12.9)
1972	(127.9)	75.3	(22.6)	(76.1)	58.2	(40.2)
1973 ^a						
1974	(73.9)	53.1	(32.2)	(39.7)	30.0	(20.4)
1975	(117.1)	69.8	(22.6)	(31.6)	25.2	(18.9)
1976 ^a						
1977	(145.8)	124.1	(102.3)	(64.3)	47.0	(29.7)
1978	(120.1)	99.5	(78.9)	(63.4)	47.4	(31.4)
1979	(130.7)	106.5	(82.4)	(73.3)	38.6	(3.9)
1980	(173.8)	122.0	(70.3)	(44.7)	34.7	(24.8)
1981	(123.1)	95.7	(68.3)	(127.3)	87.7	(48.2)
1982	(145.9)	111.7	(77.6)	(43.2)	33.9	(24.7)

^aIndicates inadequate coverage by research vessel.

Table 13. American plaice population numbers ($\times 10^{-5}$) estimated from research vessel surveys (fall) in NAFO Division 3L. Estimates in each year are for the same strata.

Age	Year	
	1981	1982
1	16.6	2.6
2	22.1	33.6
3	160.0	106.3
4	239.8	374.3
5	428.4	686.2
6	598.8	1235.2
7	1621.7	1550.2
8	1400.5	1526.3
9	1176.0	829.3
10	1059.9	452.6
11	429.1	228.6
12	311.2	100.5
13	119.4	36.3
14	32.9	13.4
15	9.2	14.7
16	2.2	5.8
17		2.4
18		0.3
Totals:		
2+	7611.1	7196.1
4+	7429.0	7056.2
6+	6760.8	5995.7
8+	4540.3	3210.3
12+	474.8	173.5

Table 14. Mean numbers and weights (kg) caught per tow (with upper and lower 95% confidence limits) from research vessel surveys (fall) in NAFO Division 3L. Estimates in each year are for the same strata.

Year	Upper	Numbers		Upper	Weights	
		Mean	Lower		Mean	Lower
1981	(395.5)	306.2	(216.9)	(151.9)	109.1	(66.3)
1982	(355.7)	289.2	(222.6)	(99.3)	82.0	(64.8)

Table 15. Regression of mid-year biomass from cohort analyses, ages 8+, on commercial CPUE for American plaice in NAFO Divisions 3LN. Cohort runs are at the indicated levels of F_T .

Year	Directed CPUE (t/hr)	Terminal F			
		.350	.375	.400	.450
		8+ Biomass (t x 10 ⁻³)			
1965	.905	306.7			
1966	.876	318.2			
1967	.818	298.4			
1968	.629	272.3			
1969	.548	238.8			
1970	.516	198.6	198.6	198.5	198.5
1971	.479	164.3	164.3	164.3	164.2
1972	.481	140.5	140.4	140.4	140.2
1973	.517	119.5	119.3	119.2	119.0
1974	.434	131.8	131.4	131.1	130.6
1975	.416	152.2	151.2	150.4	149.0
1976	.430	170.2	168.3	166.6	163.8
1977	.406	215.7	211.8	208.4	202.8
1978	.460	240.0	233.5	227.8	218.3
1979	.495	277.4	267.8	259.4	245.4
1980	.597	274.4	262.6	252.4	235.3
1981	.570	240.5	227.4	215.9	210.2
1982	.562	247.6	231.0	216.6	192.5
1965-82 r ²		.567	.609	.641	.680
intercept		46.435	40.081	34.555	25.314
slope		312.780	317.630	321.866	328.912
predicted 1982		222.2	218.6	215.4	210.2

Table 16. Regression of fishing mortality from cohort analyses, ages 8-18, weighted by population numbers on fishing effort for American plaice in NAFO Divisions 3LN. Cohort runs are at the indicated values of terminal F.

Year	Total effort (hr x 10 ⁻³)	Terminal F					
		.275	.300	.325	.350	.375	.400
		Weighted F					
1965	56.7	.122					
1966	60.8	.126					
1967	76.9	.163					
1968	94.1	.181					
1969	122.9	.231					
1970	117.0	.234	.234	.234	.235	.235	.235
1971	126.8	.279	.279	.279	.280	.280	.280
1972 ^a	105.4	.316	.316	.316	.317	.317	.317
1973 ^a	79.3	.304	.304	.305	.306	.306	.307
1974	86.9	.197	.198	.199	.200	.200	.201
1975	87.7	.162	.164	.165	.167	.168	.169
1976	101.7	.193	.197	.200	.203	.206	.208
1977	99.3	.129	.133	.137	.140	.143	.145
1978	94.8	.117	.122	.127	.131	.135	.139
1979	87.7	.103	.108	.113	.118	.123	.127
1980	78.5	.118	.126	.133	.140	.147	.153
1981	84.0	.130	.140	.151	.161	.171	.181
1982	79.5	.131	.143	.155	.168	.180	.193
	1965-82 r ²	.606	.630	.649	.657	.659	.645
	intercept	-0.0208	-0.0139	-0.0071	-0.0009	0.0057	0.0124
	slope	0.0020	0.0020	0.0019	0.0019	0.0019	0.0018
	predicted 1982	.140	.144	.148	.151	.154	.157

^aPoints not used in regressions.

Table 17. Regression of population numbers (ages 8-18) from cohort analyses on population numbers (ages 8-18) from research vessel surveys (selected strata). Cohort runs are at the indicated levels of F_T.

Year	Abundance (ages 8-18) from research vessel surveys in Div. 3LN (numbers x 10 ⁻⁶)	Terminal F				
		.250	.275	.300	.325	.350
		Population numbers (8-18) from cohort (x 10 ⁻⁶)				
1971	241.5	313.3	313.1	313.0	312.9	312.8
1972	176.6	268.0	267.6	267.3	267.1	266.9
1973 ^a		238.3	237.7	237.1	236.8	236.3
1974	153.6	247.6	246.0	244.7	243.6	242.7
1975	169.9	305.5	301.5	298.1	295.2	292.8
1976 ^a		394.5	386.1	379.1	373.2	368.2
1977	408.5	466.0	451.1	438.7	428.2	419.2
1978	295.6	600.0	572.5	549.6	530.3	513.8
1979	339.8	669.0	632.2	601.6	575.7	553.5
1980	355.0	674.0	630.7	594.7	564.2	538.1
1981	321.7	688.1	636.0	592.6	555.9	524.4
1982	394.3	660.6	603.9	556.6	516.7	482.5
	1971-82 r ²	.671	.675	.676	.676	.672
	intercept	23.29	50.59	73.26	92.47	108.99
	slope	1.63	1.45	1.30	1.18	1.07
	predicted 1982	666.4	623.3	587.3	557.0	530.9

^aIndicates inadequate coverage by research vessel.

Table 18. Cohort analysis for American plaire in Divisions 3LN. Terminal F=0.35

Table with columns for Age (6-19), Year (1960-1982), Population Numbers, and Fishing Mortality. The data is presented in two main sections: Population Numbers and Fishing Mortality. Each section contains two columns of data for each age group.

Table 19. Results of projections to 1984 for American plaice in Divisions 3LN.

CATCH NUMBERS				POPULATION NUMBERS				FISHING MORTALITY			
	1982	1983	1984		1982	1983	1984		1982	1983	1984
6	271	3894	3613	6	229000	229000	229000	6	0.001	0.019	0.018
7	1576	9062	8270	7	135116	187245	183973	7	0.013	0.055	0.051
8	4303	9185	10115	8	112592	109200	145124	8	0.043	0.086	0.080
9	7878	7939	6062	9	111762	88298	82022	9	0.081	0.104	0.097
10	11345	10141	7291	10	75663	84396	65133	10	0.180	0.142	0.132
11	14704	8091	9751	11	69964	51730	59958	11	0.262	0.189	0.175
12	13487	8757	6516	12	61549	44057	35067	12	0.280	0.246	0.228
13	7418	8538	5915	13	27554	38086	28192	13	0.350	0.283	0.262
14	3836	3564	4932	14	14249	15897	23505	14	0.350	0.283	0.262
15	1718	1843	2059	15	6382	8221	9811	15	0.350	0.283	0.262
16	524	825	1065	16	1946	3682	5074	16	0.350	0.283	0.262
17	146	252	477	17	542	1123	2273	17	0.350	0.283	0.262
18	69	70	145	18	256	313	693	18	0.350	0.283	0.262
19	8	33	40	19	30	148	193	19	0.346	0.283	0.262
6+	67483	71196	64051	6+	846605	861395	870018	6+	0.098	0.099	0.090
7+	67212	67302	62438	7+	617605	632395	641018				
8+	65636	58239	54168	8+	482489	445150	457046				
9+	61333	50054	44052	9+	369897	335950	311922				

CATCH BIOMASS				POPULATION BIOMASS (AVERAGE)			
	1982	1983	1984		1982	1983	1984
6	93	1336	1239	6	71145.84	70543.26	70590.21
7	626	3601	3286	7	48354.91	65675.56	64651.64
8	1985	3776	4666	8	46111.92	43809.99	58396.67
9	4104	4136	3575	9	50765.94	39663.40	36977.45
10	6380	5703	4100	10	35393.23	40196.94	31174.19
11	9205	5065	5478	11	35065.70	26830.30	31299.17
12	10575	6767	5035	12	37769.74	27457.72	22037.66
13	7327	8433	5842	13	20932.61	29838.69	22296.39
14	5129	4765	6594	14	14653.64	16860.14	25166.94
15	2820	3026	3379	15	8058.92	10705.77	12898.66
16	987	1555	2005	16	2818.92	5501.03	7652.25
17	318	549	1040	17	908.87	1941.67	3967.96
18	190	193	401	18	542.50	683.39	1529.00
19	23	97	119	19	67.82	343.55	453.29
6+	49763	49000	46759	6+	372590.54	380051.40	389093.72
7+	49670	47664	45520	7+	301444.70	309508.14	318503.51
8+	49044	44064	42233	8+	253089.79	243832.58	253851.87
9+	47059	40287	37567	9+	206977.88	200022.59	195455.90

SUMMARY OF PROJECTIONS

YEAR	1982	1983	1984
POPULATION NUMBERS	846605.00	861394.97	870018.35
POPULATION BIOMASS	372590.54	380051.40	389093.72
CATCH	49763.00	49000.01	46758.71
F OR QUOTA	49763.00	49000.00	0.21

AGE GROUPS CONSIDERED: 6+

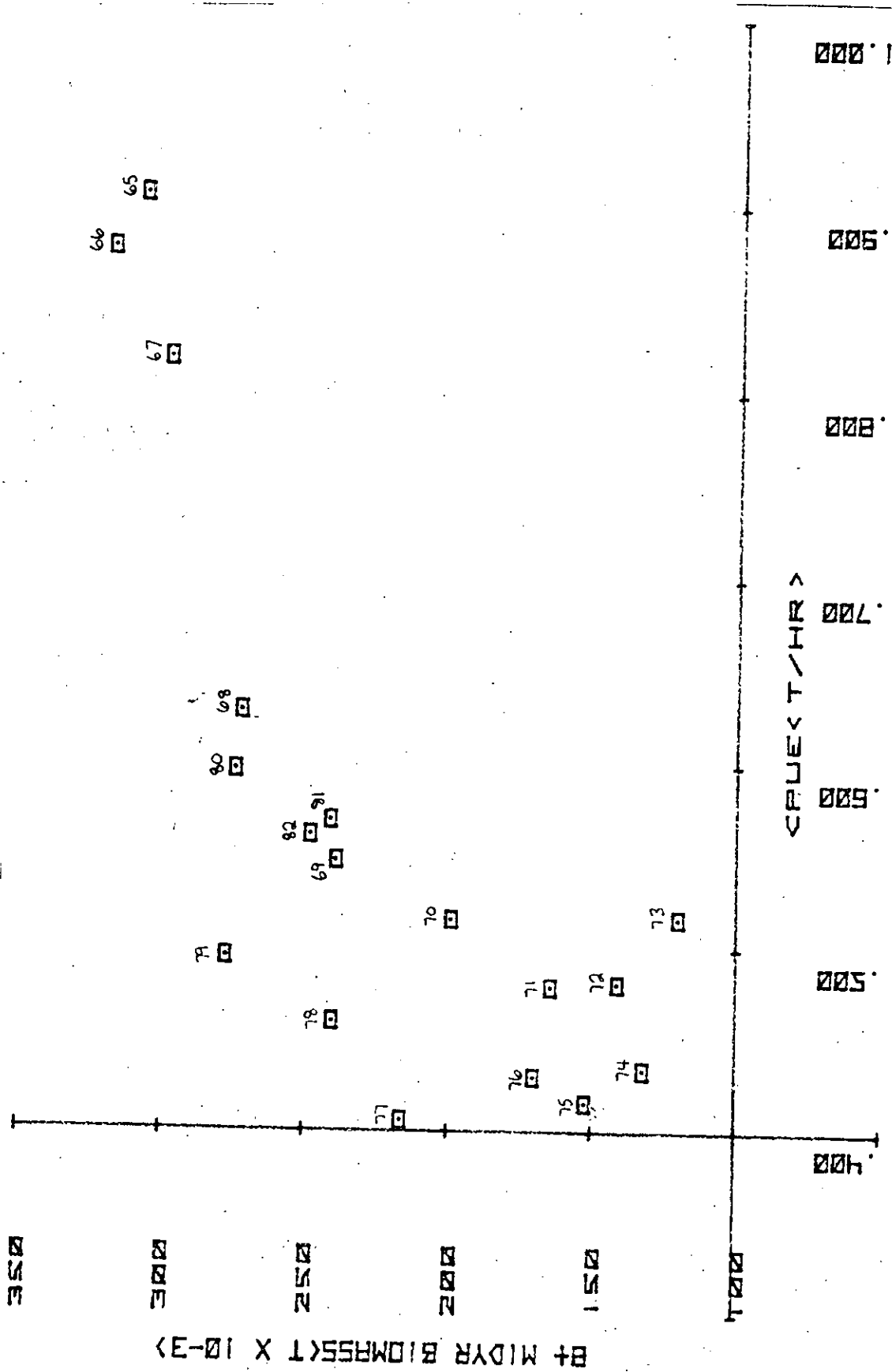


Fig. 1. Plot of 8+ mid-year biomass from cohort ($F_t=0.35$) on commercial CPUE for American plaice in Divisions 3LN, 1965-1982.

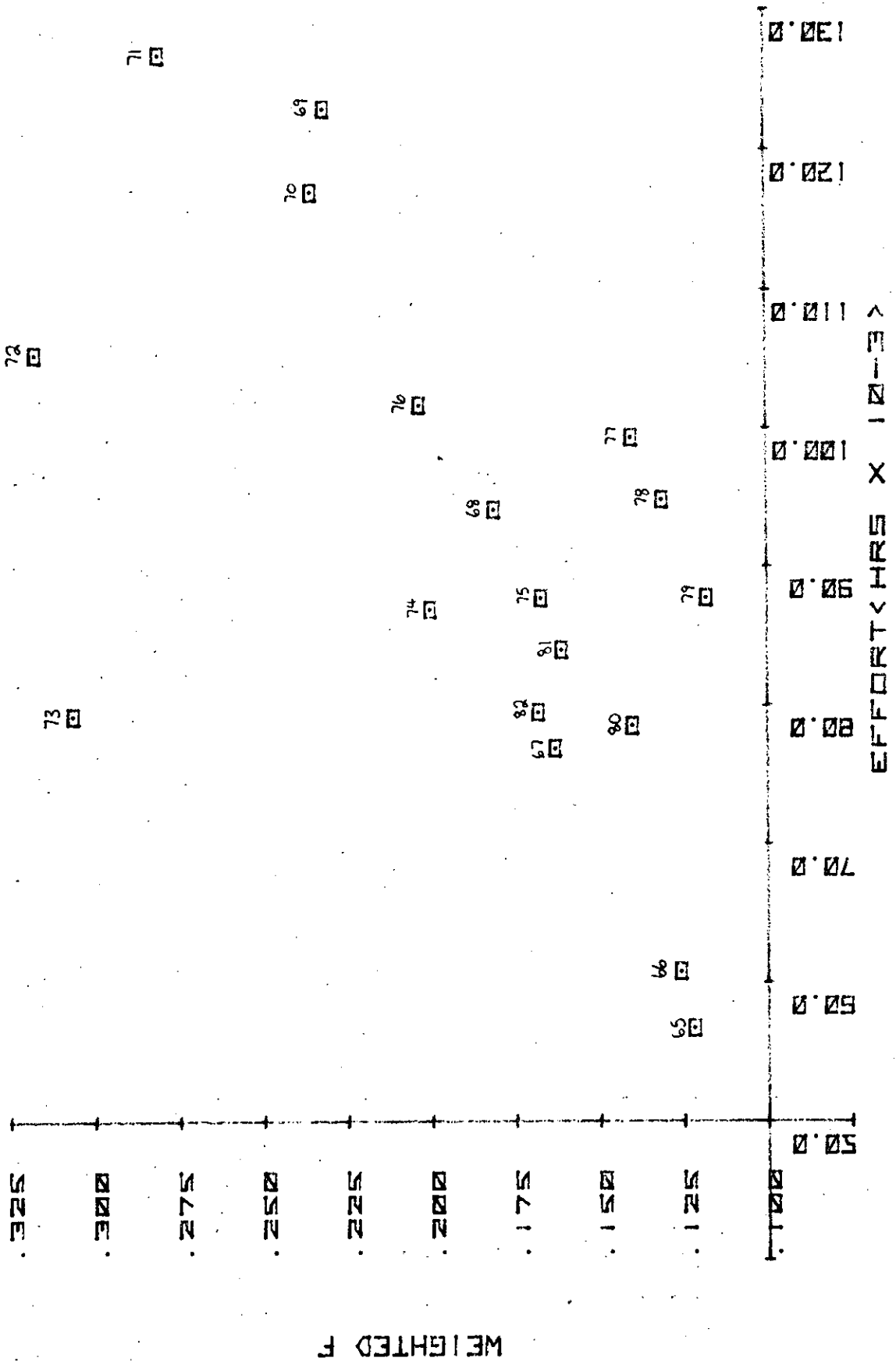


Fig. 2. Plot of 8+ fishing mortality (weighted by population numbers) from cohort at $F_t=0.35$ on fishing effort for plaice in Divisions 3LN from 1965-1982.

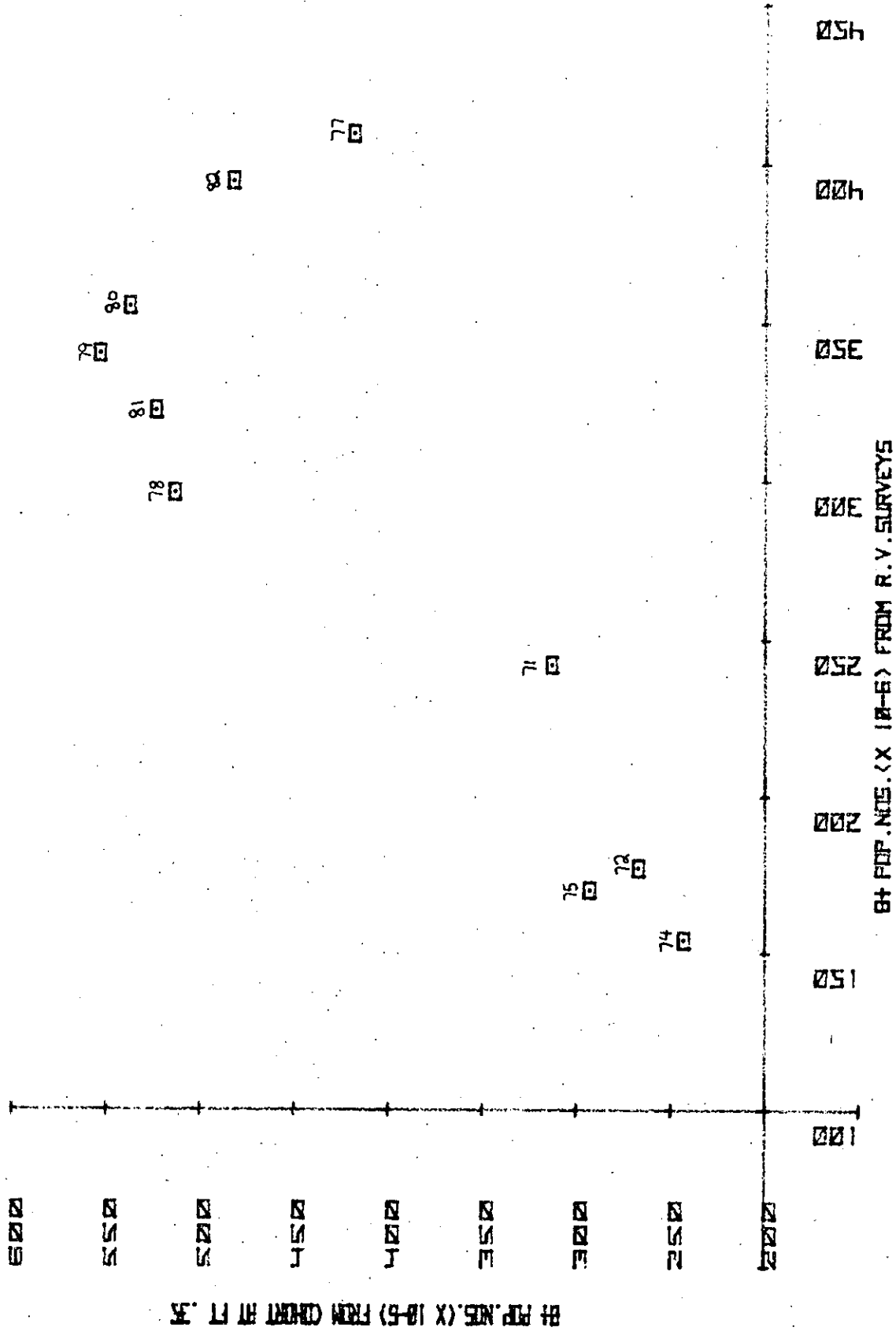


Fig. 3. Plot of 8+ population numbers from cohort at $T_1=0.35$ on 8+ population numbers from research vessel surveys for plaice in Divisions 3LN, 1971-1982.