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Assessment Update for the Yellowtail Stocks in Divisions 3LNO

by

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INTRODUCTION

This stock has been under quota regulation since 1973. Nominal catches by country for the period 1966-81 and TAC's for 1973-82 appear in Table 1. Tables 2 and 3 give the nominal catches by division and catch-effort data respectively for the years 1966-81. Approximately two-thirds of the TAC was taken in both 1980 and 1981, owing to a significant reduction in directed effort for yellowtail in both years.

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: These were calculated in the usual manner by applying quarterly age-length keys (sexes separate) to monthly frequencies for each NAFO Division. Total numbers caught at age were obtained by combining male and female numbers from all Divisions. Numbers at age for 1968-81 are in Table 5.

Weight at age: Average weights at age for 1981 were obtained by applying a length-weight equation to monthly average lengths (weighted by the number caught at age). Weights at age for 1968-81 are in Table 6.

Partial recruitment: Three versions of partial recruitment were used in this assessment (Table 7):

PR Ave - Derived from average F 's from cohort (1968-76) and, when used in yield per recruit calculations with average weights (1968-74) produces a value of 0.52 for $F_{0.1}$ (Brodie and Pitt, 1981).

PR1 - Same as PR ave for ages 5-10. PR at age 4 was adjusted to give a population at age 4 in the VPA approximately equal to the geometric mean of age 4 population, 1968-81.

PR2 - Derived from a cohort run using catch-at-age for 1978-81. The values represent the average of the fishing mortality in 1979 and 1980, standardized at age 9. The value for age 4 was adjusted by the ratio of the catch at age 4 in 1980 to 1981.

Virtual Population Analysis: Two separate analyses were carried out - one using PR1 and a range of terminal F 's from 0.4 to 0.5 and one using PR2 and F_t 's between 0.6 and 1.0. Results were as follows:

Option 1 (PR1 used): Terminal F was determined by regressions of 4+ Biomass on CPUE (Table 8) and F (ages 4-10) on effort (Table 9). The correlation coefficient r decreased slightly as F_t increased from .4 to .5. The best predicted value for 1981 biomass came from a VPA run with F_t between .45 and .5 (Fig. 2). In the regression of F on effort, r once again decreased marginally as F_t increased with the best predicted value for weighted F in 1981 coming from the VPA run initiated by $F_t = .5$ (Fig. 3).

Option 2 (PR2 used): This analysis was calibrated using the same criteria used above. Regression of 4+ biomass on CPUE (Table 10) showed that r was highest for the values at $F_t = .7$ but that the predicted value for 1981 was closest for the run at $F_t = .9$. F on effort (Table 11) revealed that r decreased as F_t increased and that the best predicted value for 1981 came from the regression using VPA values from the run at $F_t = 1.0$. The fact that the 1968-80 regression line passes through the origin at some value of terminal F between 0.8 and 0.9 also may be of some value here.

The option 1 VPA at $F_t = .45$ is presented in Tables 12a-c and the Option 2 VPA at $F_t = .9$ is shown in Tables 13a-c.

Research Vessel Surveys: Results of research vessel surveys in Divisions 3L and 3N are presented in Tables 14 and 15. The omission of a key stratum, 361, (Fig. 1) in 1981 precluded the use of the survey data in tuning the virtual population analysis.

Recruitment: The 1968-77 geometric mean of age 4 numbers from the option 2 VPA at $F_T = 0.90$ was used to estimate recruitment for projections to 1983. This value was 100×10^6 fish.

DISCUSSION

Abundance indices: Catch per unit effort from Canada (N) otter trawlers, tonnage class 5 showed a steady increase between 1976 and 1980, with a slight drop in 1981 to a level of 0.614 t/hr (Table 3). Research vessel surveys indicate a fairly stable population size since 1978, with the numbers for 1981 being biased downward by the omission of a key stratum from the 1981 survey. Estimation of year class strength from the research vessel survey data is practically impossible since yellowtail of age 4 and less are not fully recruited to the research gear.

Virtual Population Analysis: A comparison of the population numbers in 1981 from both VPA runs (Tables 12a and 13a) showed little difference, as would be expected.

Catch Projections: Tables 16a-16e show the results of a projection to 1983, using the 1981 population from the VPA run at $F_T = .90$. Long-term (1968-74) average weights (Table 6) were found to be close to current average weights and were therefore used in projecting. PR Ave (Table 7) was also used. Assuming that 23,000 t will be removed in 1982, the projected catch in 1983 at $F_{0.1} = .518$ would be approximately 19,000 t.

REFERENCES

Brodie, W. B., and T. K. Pitt. An assessment of the yellowtail stock in Divisions 3LN0. NAFO SCR Doc. 81/VI/54, Ser. No. N338.

Table 1. Nominal catches by country and TACs of Yellowtail-NAFO Divisions 3LN0.

Year	Canada	France	USSR	Other	Total	TAC
1966	4,185	0	2,834	7	7,026	
1967	2,122		6,736	20	8,878	
1968	4,180	14	9,146	0	13,340	
1969	10,494	1	5,207	6	15,708	
1970	22,814	17	3,426	169	26,426	
1971	24,206	49	13,087	0	37,342	
1972	26,939	358	11,929	33	39,259	
1973	28,492	368	3,545	410	32,815	50,000
1974	17,053	60	6,952	248	24,313	40,000
1975	18,458	15	4,076	345	22,894	35,000
1976	7,910	31	57	59	8,057	9,000
1977	11,295	245	97	1	11,638	12,000
1978	15,091	375	-	-	15,466	15,000
1979	18,573	306	-	-	18,351	18,000
1980	12,001	366	-	-	12,377	18,000
1981 ^a	14,068	414	-	-	14,482	21,000
1982						23,000

^aPreliminary.

Table 2. Breakdown of nominal catches of yellowtail by NAFO Divisions 3L, N & O (metric tons).

	3L	3N	3O	Total
1965	117	2,958	55	3,190
1966	62	6,442	522	7,026
1967	453	6,117	2,308	8,878
1968	2,815	8,459	2,066	13,340
1969	5,287	7,215	3,206	15,708
1970	7,419	18,668	339	26,426
1971	6,632	25,174	5,536	37,342
1972	9,292	25,788	4,179	39,259
1973	4,856	23,693	4,266	32,815
1974	1,944	19,329	3,440	24,313
1975	2,638	16,156	4,100	22,894
1976	516	5,023	2,518	8,057
1977	2,651	7,381	1,606	11,638
1978	2,547	11,079	1,840	15,466
1979	2,595	14,556	1,200	18,351
1980	1,898	9,805	674	12,377
1981	2,352	11,558	572	14,482

Table 3. Nominal catch and effort data for yellowtail in NAFO Divisions 3LNO (Column 2) refers to reported "directed" catch by Canada (N) Tonnage Class 5 Otter trawlers.

Year	Directed catch (tons)	CPUE (tons/hr)	Total catch (tons)	Total calculated effort (hours)
1968	2,216	0.705	13,340	18,921
1969	3,165	0.610	15,708	25,750
1970	12,444	0.598	26,426	44,191
1971	14,094	0.600	37,342	62,236
1972	14,544	0.607	39,259	64,677
1973	21,225	0.645	32,815	50,876
1974	14,025	0.421	24,318	57,762
1975	13,345	0.402	22,894	56,950
1976	4,889	0.332	8,057	24,268
1977	5,029	0.423	11,638	27,513
1978	9,289	0.496	15,466	31,181
1979	13,273	0.517	18,351	35,495
1980	7,855	0.640	12,377	19,939
1981	10,400	0.614	14,482	23,098

Table 4. List of landings (Canadian), and sampling information for Yellowtail in NAFO Divisions 3L, 3N, and 30, 1981.

Qrt.	Landings			Measurements			Otoliths			Samples		
	3L	3N	30	3L	3N	30	3L	3N	30	3L	3N	30
1	2	112	7	-	-	-	-	-	-	-	-	-
2	1,341	1,102	106	3,539	4,047	-	385	468	-	9	8	-
3	788	7,639	267	1,357	15,154	806	136	555	166	2	28	2
4	118	2,355	128	771	4,916	-	119	510	-	2	10	-

Table 5.

YELLOWTAIL . DIVI LHO . CATCH NUMBERS (x10⁻³)

I	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
4 I	573	80	141	169	1943	3734	1375	955	409	1391	691	1061	1142	3245
5 I	6202	2993	2776	7534	10128	21280	19800	11240	2529	3211	3654	4783	5130	5077
6 I	12483	15035	19839	30365	22502	23709	18100	20931	7650	6851	10979	13067	8383	8191
7 I	9154	12076	20615	22117	19416	17053	11200	12737	5361	7331	11028	14284	7199	9991
8 I	1421	3150	4557	5869	10553	4713	2400	2536	953	4078	3870	4940	1519	4361
9 I	47	326	610	2152	4206	862	850	372	74	1433	310	773	224	356
10 I	1	40	68	245	1110	300	130	23	15	289	34	109	28	29

Table 6.

YELLOWTAIL, DIV3LNO, WEIGHT MATRIX (KG)

I	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
4	0.247	0.247	0.247	0.247	0.247	0.247	0.200	0.184	0.200	0.214	0.249	0.178	0.271	0.230
5	0.305	0.305	0.305	0.305	0.305	0.305	0.300	0.298	0.322	0.324	0.315	0.278	0.274	0.344
6	0.456	0.456	0.456	0.456	0.456	0.456	0.452	0.450	0.486	0.409	0.430	0.378	0.493	0.372
7	0.610	0.610	0.610	0.610	0.610	0.610	0.600	0.569	0.615	0.532	0.557	0.504	0.635	0.545
8	0.725	0.725	0.725	0.725	0.725	0.725	0.725	0.743	0.814	0.648	0.740	0.668	0.750	0.726
9	0.842	0.842	0.842	0.842	0.842	0.842	0.842	0.953	1.029	0.809	0.981	0.787	0.927	0.999
10	1.030	1.030	1.030	1.030	1.030	1.030	1.030	1.111	1.201	0.905	1.235	0.756	1.221	1.303

Table 7. Partial recruitment vectors, 3LNO Yellowtail. Derivation of each is explained in the text.

Age	PRAve	PR1	PR2
4	.01	.08	.035
5	.13	.13	.068
6	.46	.46	.222
7	1.00	1.00	.628
8	1.00	1.00	.970
9	1.00	1.00	1.000
10	1.00	1.00	1.000

Table 8. Regression of 4+ biomass from "option 1" VPA on commercial CPUE. VPA runs are at the indicated levels of F_T .

Year	CPUE (t/hr)	Terminal F		
		.40	.45	.50
4+ Biomass from VPA (t X 10 ³)				
1968	.705	85.2		
1969	.610	99.2		
1970	.598	101.1		
1971	.600	91.7		
1972	.607	77.3		
1973	.645	65.9		
1974	.421	50.4		
1975	.402	40.8	40.7	40.7
1976	.332	45.9	45.8	45.7
1977	.423	53.3	52.4	51.6
1978	.496	65.6	62.9	60.7
1979	.517	57.6	53.7	50.5
1980	.640	92.8	84.0	77.0
1981	.614	96.0	85.3	76.8
1968-80 r		.821	.811	.794
intercept		-10.31	-9.66	-9.18
slope		151.64	148.06	145.27
predicted 1981		82.8	81.3	80.0
1968-81 r		.824	.817	.795
intercept		-12.48	-10.32	-8.65
slope		157.36	149.82	143.87
predicted 1981		84.1	81.7	79.7

Table 9. Regression of fishing mortality, ages 4-10, weighted by population numbers, on effort. VPA runs are "option 1" and are at the indicated levels of F_T .

Year	Effort (hr X 10 ⁻³)	Terminal F		
		.40	.45	.50
		Weighted F		
1968	18.9	.130		
1969	25.8	.133		
1970	44.2	.203		
1971	62.2	.321		
1972	64.7	.422		
1973	50.9	.443		
1974	57.8	.394		
1975	57.0	.450		
1976	24.3	.133	.133	.134
1977	27.5	.190	.195	.199
1978	31.2	.190	.199	.207
1979	35.5	.264	.286	.306
1980	19.9	.093	.104	.115
1981	23.1	.112	.135	.150
1968-80 r		.907	.901	.892
intercept		-0.025	-0.016	-0.007
slope		0.007	0.007	0.007
predicted 1981		.139	.145	.151
1968-81 r		.914	.908	.898
intercept		-0.031	-0.018	-0.007
slope		0.007	0.007	0.007
predicted 1981		.135	.145	.151

Table 10. Regression of 4+ biomass from "option 2" VPA on commercial CPUE. VPA runs are at the indicated levels of F_T .

Year	CPUE (t/hr)	Terminal F				
		.60	.70	.80	.90	1.00
		4+ Biomass from VPA (t X 10 ⁻³)				
1968	.705	85.2				
1969	.610	99.2				
1970	.598	101.1				
1971	.600	91.7				
1972	.607	77.3				
1973	.645	65.9				
1974	.421	50.4				
1975	.402	40.7				
1976	.332	45.6	45.5	45.4	45.4	45.3
1977	.423	50.6	49.7	49.1	48.6	48.2
1978	.496	63.5	60.3	57.9	56.0	54.6
1979	.517	61.2	55.6	51.4	48.1	45.6
1980	.640	106.6	93.4	83.5	75.7	69.6
1981	.614	121.8	101.4	91.3	81.2	73.1
1968-80 r		.821	.825	.811	.790	.768
intercept		-15.55	-14.01	-12.84	-11.87	-11.16
slope		163.12	156.97	152.33	148.60	145.78
predicted 1981		84.6	82.4	80.7	79.4	78.4
1968-81 r		.785	.821	.817	.796	.767
intercept		-21.66	-17.14	-14.58	-12.17	-10.30
slope		179.24	165.22	156.93	149.39	143.51
predicted 1981		88.4	84.3	81.8	79.6	77.8

Table 11. Regression of fishing mortality, ages 4-10, weighted by population numbers, on effort. VPA runs are "option 2" and are at the indicated levels of F_T .

Year	Effort (hr X 10 ⁻³)	Terminal F Weighted F				
		.60	.70	.80	.90	1.00
1968	18.9	.130				
1969	25.8	.133				
1970	44.2	.203				
1971	62.2	.321				
1972	64.7	.422				
1973	50.9	.443				
1974	57.8	.394				
1975	57.0	.450				
1976	24.3	.134	.135	.135	.135	.135
1977	27.5	.204	.208	.211	.214	.216
1978	31.2	.195	.207	.217	.225	.232
1979	35.5	.244	.272	.297	.320	.341
1980	19.9	.079	.092	.104	.116	.127
1981	23.1	.090	.107	.123	.141	.158
1968-80 r		.907	.901	.892	.882	.870
intercept		-0.027	-0.017	0.007	0.002	0.010
slope		0.007	0.007	0.007	0.007	0.007
predicted 1981		.137	.144	.151	.157	.162
1968-81 r		.914	.908	.901	.890	.878
intercept		-0.039	-0.026	-0.014	-0.002	0.009
slope		0.007	0.007	0.007	0.007	0.007
predicted 1981		.131	.139	0.147	.154	.161

Tables 12a-c. Results of "Option 1" VPA at $F_T = 0.45$.

		POPULATION NUMBERS (X 10 ⁻³)													
AGE		1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
4	1	152402	142912	116403	108009	118805	110625	73957	69746	78399	100678	103473	101143	140722	106129
5	1	106797	112411	105803	86113	79870	86347	78754	53610	50850	57729	73392	76062	74019	103270
6	1	53212	73808	80712	76002	57351	50519	45870	41507	30143	35506	40018	51242	52254	50445
7	1	17688	28800	41871	42921	30654	23472	17472	18689	13171	15827	20465	20320	26852	31559
8	1	2378	5422	11145	13693	13234	6552	3326	3630	3292	5230	5553	5919	3244	13775
9	1	157	576	1384	4409	5194	1184	964	484	591	1630	535	912	376	1125
10	1	2	76	154	511	1457	419	166	32	53	375	56	137	50	92
4+	1	332636	364004	357473	331658	306565	279118	220510	187698	176500	216974	243491	255735	297517	306395
5+	1	180233	221092	241069	223649	187760	168493	146554	117952	98100	116296	140019	154591	156795	200266
6+	1	73437	108681	135266	137536	107890	82146	67799	64342	47250	58567	66627	78530	82776	96996
7+	1	20224	34873	54554	61534	50539	31627	21929	22834	17107	23061	26609	27288	30522	46551

		POPULATION BIOMASS (MIL-YEAR) (t)													
AGE		1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
4	1	32454	30487	24823	23029	25123	23166	12648	11003	13508	18472	22177	15464	32800	20732
5	1	27233	29185	27475	21582	19544	19517	17447	12146	13756	15660	19421	17629	16846	29854
6	1	18133	25691	27287	22774	17292	14193	13683	11109	10800	11165	12498	14267	20233	14720
7	1	6328	11344	15379	15391	9529	6289	5285	5045	5288	5218	6531	4690	12441	12100
8	1	921	2144	5266	6356	3619	2114	1069	1244	1924	1334	1901	1343	1500	7035
9	1	94	269	738	2245	1597	436	231	186	489	378	286	234	187	790
10	1	1	46	100	321	615	193	67	16	46	136	37	39	34	84
4+	1	85164	99165	101068	91699	77319	65909	50430	40749	45810	52364	62852	53667	84040	85317
5+	1	52710	68678	76245	68670	52195	42743	37782	29745	32302	33892	40675	38203	51241	64585
6+	1	25477	39493	48770	47088	32651	23226	20335	17600	18547	18232	21254	20573	34395	34730
7+	1	7344	13803	21483	24314	15359	9033	6652	6491	7747	7067	8756	6307	14162	20010

		FISHING MORTALITY													
AGE		1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
4	1	0.004	0.001	0.001	0.002	0.019	0.040	0.022	0.016	0.006	0.016	0.008	0.012	0.009	0.036
5	1	0.069	0.031	0.031	0.106	0.158	0.333	0.340	0.276	0.059	0.066	0.059	0.075	0.083	0.059
6	1	0.314	0.267	0.332	0.608	0.593	0.762	0.598	0.848	0.344	0.251	0.378	0.346	0.204	0.207
7	1	0.882	0.649	0.818	0.877	1.243	1.654	1.271	1.437	0.624	0.747	0.940	1.535	0.367	0.450
8	1	1.119	1.065	0.627	0.669	2.114	1.616	1.628	1.515	0.403	1.981	1.506	2.456	0.759	0.450
9	1	0.420	1.020	0.696	0.807	2.218	1.663	3.102	1.907	0.156	3.066	1.062	2.603	1.112	0.450
10	1	0.800	0.900	0.700	0.785	1.860	1.600	2.000	1.600	0.390	1.920	1.140	2.100	1.000	0.450

Tables 13a-c. Results of "Option 2" VPA at $F_T = 0.9$.

POPULATION NUMBERS (X 10 ⁻³)														
AGE	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
4	152402	142912	116403	108009	118805	110625	73957	69468	76217	82959	90798	104142	134741	121032
5	106797	112411	105803	86113	79870	86347	78754	53610	50645	56112	60265	66672	76241	98840
6	53212	73808	80712	76002	57351	50519	45870	41507	30143	35353	38820	41518	45300	52091
7	17688	28800	41871	42921	30654	23472	17472	18689	13171	15827	20352	19435	19676	26413
8	2378	5422	11145	13693	13234	6552	3326	3630	3292	5230	5553	5838	2631	8485
9	157	576	1384	4409	5194	1184	964	484	591	1630	555	912	325	679
10	2	76	154	511	1457	419	166	32	53	375	56	137	50	55
4+	332636	364004	357473	331658	306565	279118	220510	187420	174111	197485	216379	238655	278963	307596
5+	180233	221092	241069	223649	187760	168493	146554	117952	97895	114527	125582	134513	144222	186563
6+	73437	108681	135266	137536	107890	82146	67799	64342	47250	58414	65316	67840	67981	87724
7+	20224	34873	54554	61534	50539	31627	21929	22834	17107	23061	26496	26322	22682	35633

POPULATION BIOMASS (MID-YEAR) (t)														
AGE	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
4	32454	30487	24823	23029	25123	23166	12648	10759	13130	15196	19451	15925	31399	23694
5	27233	29185	27475	21582	19544	19517	17447	12146	13698	15207	15848	15373	17372	28537
6	18133	25691	27287	22774	17292	14193	13683	11109	10800	11111	12048	11057	17261	15251
7	6328	11344	15379	15391	9529	6289	5285	5045	5288	5218	6474	4235	8449	9634
8	921	2144	5266	6356	3619	2114	1069	1244	1924	1334	1901	1275	1081	3627
9	94	269	738	2245	1597	436	231	186	489	378	286	234	141	390
10	1	46	100	321	615	193	67	16	46	136	37	39	34	42
4+	85164	99165	101068	91699	77319	65909	50430	40705	45375	48581	56045	48138	75737	81179
5+	52710	68678	76245	68670	52195	42743	37782	29745	32245	33385	36594	32213	44338	57485
6+	25477	39493	48770	47088	32651	23226	20335	17600	18547	18178	20746	16840	26966	28948
7+	7344	13803	21483	24314	15359	9033	6652	6491	7747	7067	8698	5783	9705	13698

FISHING MORTALITY														
AGE	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
4	0.004	0.001	0.001	0.002	0.019	0.040	0.022	0.016	0.006	0.020	0.009	0.012	0.010	0.031
5	0.069	0.031	0.031	0.106	0.158	0.333	0.340	0.276	0.059	0.068	0.073	0.086	0.081	0.061
6	0.314	0.267	0.332	0.608	0.593	0.762	0.598	0.848	0.344	0.252	0.392	0.447	0.239	0.200
7	0.882	0.649	0.818	0.877	1.243	1.654	1.271	1.437	0.624	0.747	0.949	1.700	0.541	0.565
8	1.119	1.065	0.627	0.669	2.114	1.616	1.628	1.515	0.403	1.981	1.506	2.588	1.054	0.873
9	0.420	1.020	0.696	0.807	2.218	1.663	3.102	1.907	0.156	3.066	1.062	2.603	1.471	0.900
10	0.800	0.900	0.700	0.785	1.860	1.600	2.000	1.600	0.390	1.920	1.140	2.100	1.000	0.900

Table 14. Abundance of Yellowtail ($\times 10^{-3}$) from research vessel surveys for selected strata in Divisions 3L and 3N.

Age	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
1											
2				88				76	24	15	
3	1,599	3,965	264	895	174	1,212	93	1,180	287	1,525	314
4	18,797	29,756	3,844	7,966	3,015	5,134	1,383	4,111	1,889	3,355	556
5	42,304	58,604	25,409	25,576	15,104	22,921	8,383	15,788	3,957	11,491	2,471
6	79,562	67,380	32,789	43,865	21,794	31,345	20,425	29,167	15,737	29,669	10,623
7	72,076	36,341	33,541	22,134	25,186	28,750	54,476	30,258	40,589	42,454	27,166
8	9,691	11,556	12,804	2,663	6,174	5,824	44,686	15,786	19,334	13,788	28,951
9	3,090	1,222	4,355	391	688	120	12,437	1,640	2,261	950	5,455
10	42	71	360		46	0	1,889	17	269	30	1,479
11						16	143				
12							21				
Total	227,161	208,895	113,366	103,569	72,181	95,322	143,936	98,023	84,347	103,277	77,015
Age 7 and older	84,667	49,190	51,060	25,188	32,094	34,710	113,652	47,701	62,453	57,222	63,051

Table 15. Average number per set at age and average numbers and weights for totals for yellowtail in NAFO Divisions 3L and 3N (see Fig.1). A key stratum, number 361, was not fished in 1981, and in 1975 and 1976 strata 373 and 375 respectively were missed.

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
3	1.44	3.57	0.24	0.81	0.19	1.09	0.08	1.06	0.26	1.37	0.32
4	16.92	26.79	3.46	7.17	3.27	4.62	1.24	3.70	1.70	3.02	0.57
5	38.09	52.76	22.88	23.02	16.39	20.64	7.55	14.21	3.56	10.35	2.54
6	71.63	60.66	29.52	39.49	23.65	28.22	18.39	26.26	14.17	26.71	10.93
7	64.89	32.72	30.20	19.93	27.33	25.88	49.05	27.24	36.54	38.22	27.96
8	8.73	10.40	11.53	2.40	6.70	5.24	40.23	14.21	17.41	12.41	29.43
9	2.78	1.10	3.92	0.35	0.75	0.11	1.20	1.48	2.04	0.86	5.64
10	0.04	0.06	0.32	-	0.05	-	1.70	0.02	0.24	0.03	1.52
11						0.04	0.13				
Average number per set	204.5	188.07	102.07	93.24	78.32	85.82	129.59	88.25	75.96	93.02	78.98
Average weight per set (kg)	90.01	75.10	41.20	41.15	34.80	37.33	56.96	36.54	36.18	48.65	43.16

Tables 16a-e. Results of projection using 1981 population from VPA at $F_T = 0.9$, PR Ave, and average weights at age.

POPULATION NUMBERS
($\times 10^{-3}$)

	1981	1982	1983
4	121032	100000	100000
5	98840	86882	73561
6	52091	68876	58718
7	26413	31601	36872
8	8485	11119	11554
9	679	2625	4065
10	55	204	960
4+	307595	301308	285730
5+	186563	201308	185730
6+	87723	114426	112169
7+	35632	45550	53451

POPULATION BIOMASS (AVERAGE)
(t)

	1981	1982	1983
4	25444.83	21267.88	21286.88
5	25302.14	21924.33	18776.59
6	18694.27	23355.48	20705.33
7	10782.84	12153.72	15361.82
8	3621.49	5082.52	5721.01
9	332.86	1393.78	2337.80
10	32.88	132.74	675.26
4+	84211.31	85310.45	84864.70
5+	58766.48	64042.57	63577.82
6+	33464.34	42118.24	44801.23
7+	14770.07	18762.76	24095.89

CATCH NUMBERS
($\times 10^{-3}$)

	1981	1982	1983
4	3245	608	446
5	5077	6599	4146
6	8191	16638	10819
7	9991	14070	13045
8	4361	4951	4088
9	356	1169	1438
10	29	91	340
4+	31250	44126	34322
5+	28005	43518	33875
6+	22928	36919	29730
7+	14737	20281	18910

CATCH BIOMASS
(t)

	1981	1982	1983
4	802	150	110
5	1548	2013	1264
6	3735	7587	4934
7	6095	8583	7957
8	3162	3589	2963
9	300	984	1211
10	30	94	350
4+	15671	23000	18790
5+	14869	22850	18680
6+	13321	20837	17415
7+	9586	13250	12482

FISHING MORTALITY

	1981	1982	1983
4	0.032	0.007	0.005
5	0.061	0.092	0.067
6	0.200	0.325	0.238
7	0.565	0.706	0.518
8	0.873	0.706	0.518
9	0.901	0.706	0.518
10	0.909	0.706	0.518
4+	0.141	0.210	0.165

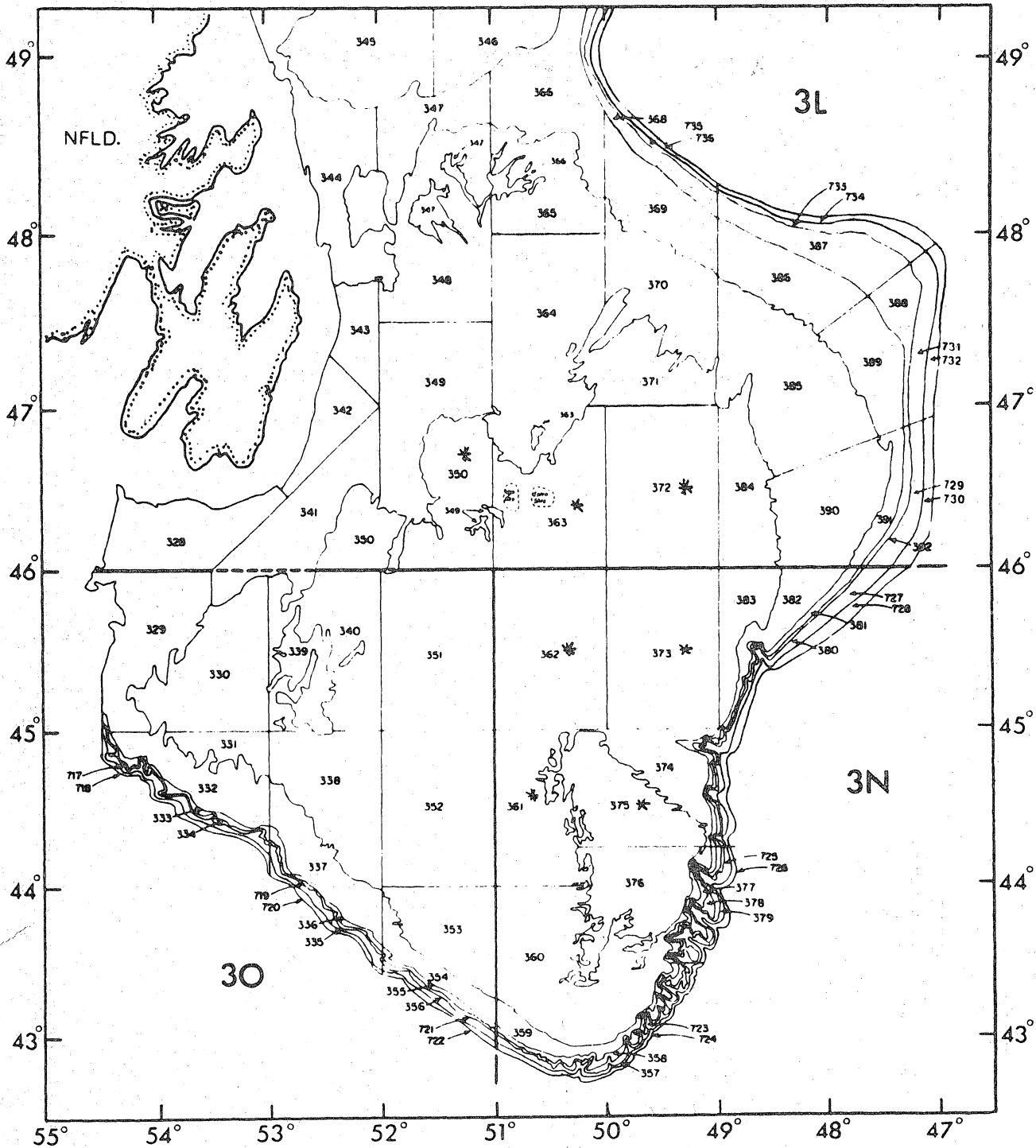


Fig. 1. Stratum map for NAFO Divisions 3LNO. Asterisks denote strata of prime importance in determining yellowtail abundance.

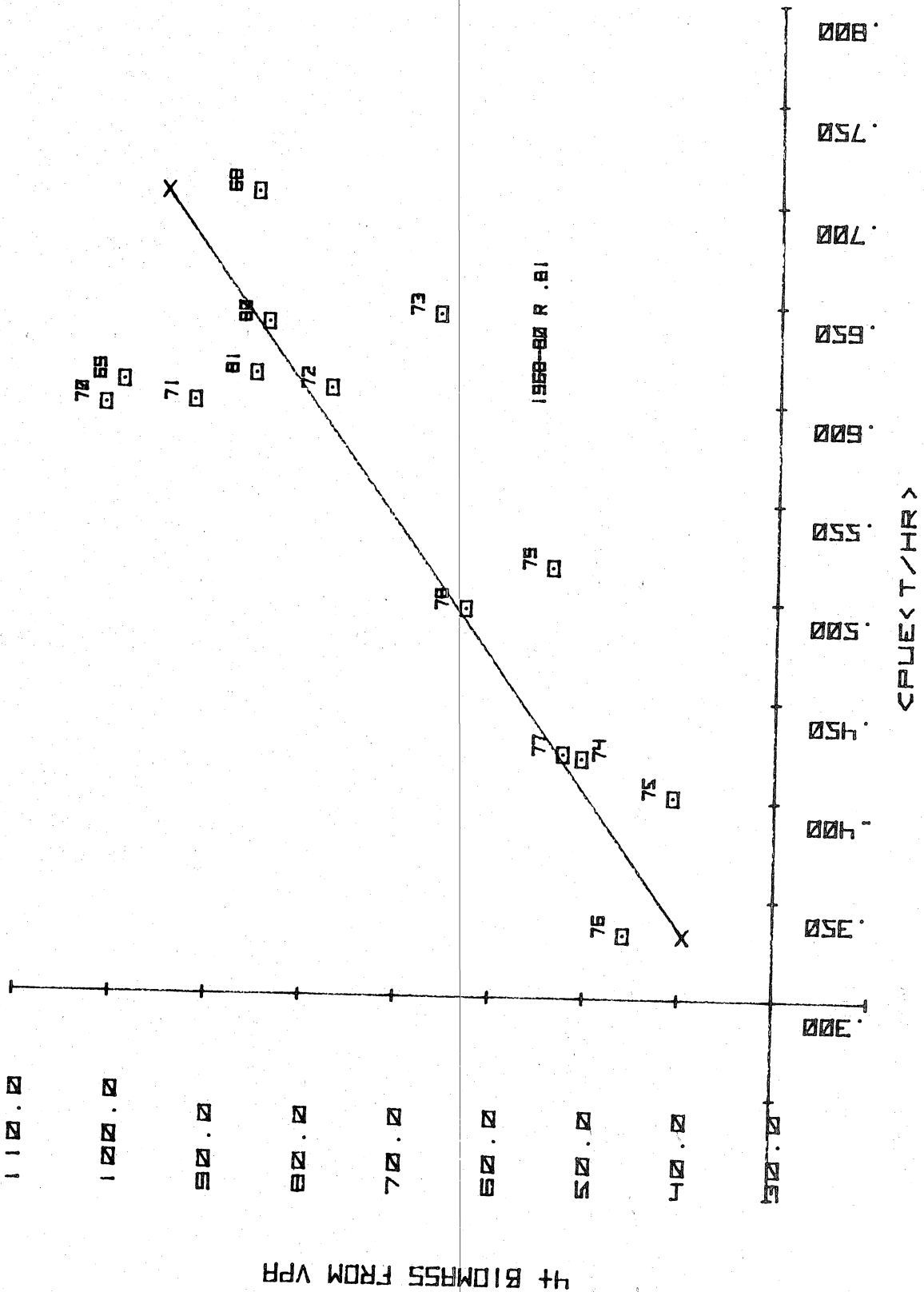


FIG. 2. 4+ BIOMASS ON CPUE

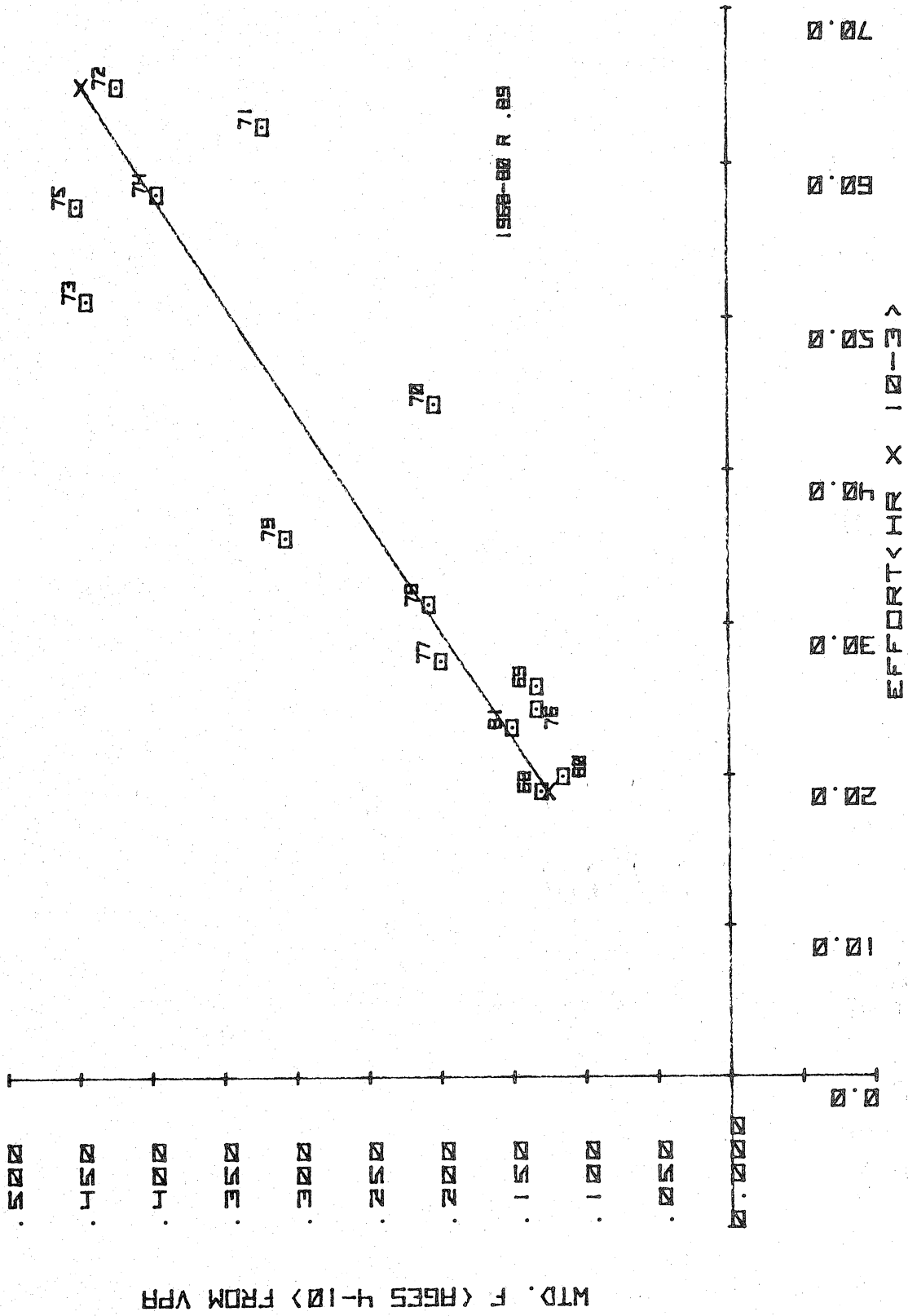


FIG. 3. WEIGHTED F ON EFFORT