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**Redfish (*Sebastes* spp.) in Management Unit 4VWX:
An Assessment of Present Stock Status**

by

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Abstract

Landings of redfish from Divisions 4VWX in 1985 increased 35%, to a provisional total of 13,900 t, over 1984. This total represents 46% of the 1985 TAC. Commercial catch rates series for the two major gear types conducting this fishery show a general increase since the early 1900s. A multiplicative analysis of these catch rate series corroborate this result although the increasing trend is associated with a wide confidence interval. Research vessel survey results show that estimated trawlable redfish biomass has been increasing since 1980. Interannual variability in these recent estimates is felt to be generated by the presence of two very large and contagiously distributed year-classes. Estimates of the length-frequency distribution of 4VWX redfish show two very large year-classes with a combined modal length of 18 cm in July 1985. These continue to be the largest incoming year-classes observed over the 17 years in which the July surveys have been conducted. These fish are expected to begin recruiting to the fishery in the late 1980s to early 1990s.

Résumé

Les débarquements de sébaste des divisions 4VWX en 1985 ont augmenté de 35% par rapport à 1984 pour atteindre un total provisoire de 13 900 t. Ce total représente 46 % du TPA pour 1985. Les séries des taux de capture commerciale pour les deux principaux types d'engins utilisés pour cette pêche indiquent un accroissement général depuis le début des années 1900. Une analyse multiplicative de ces séries de taux de capture confirme ce résultat quoique la tendance à l'accroissement soit associée à un grand intervalle de confiance. Les résultats de relevés par des navires de recherche indiquent que la biomasse chalutable estimée de sébaste augmente depuis 1980. On pense que la variabilité de ces estimations récentes, d'une année à l'autre, est attribuable à l'existence de deux classes d'âge très importantes qui suivent une distribution contagieuse. Les estimations de fréquences de longueurs de la sébaste 4VWX indiquent deux très importantes classes d'âge pour lesquelles la longueur modale combinée était de 18 cm en juillet 1985. Ces classes sont restées les plus importantes observées dans les débarquements pendant les 17 années au cours desquelles des relevés ont été effectués en juillet. On prévoit que le recrutement de ces poissons dans le stock pêchable débutera vers la fin des années 1980 et le début des années 1990.

History of the Fishery

The fishery for redfish in 4VWX was developed in the mid-1930s. No large catches were reported until 1936 when the USA landed 7,195 t. The period of initial exploitation was completed in 1949 with a maximum catch of 77,142 t. Between 1952 and 1970 catches fluctuated between 10,000 and 40,000 t. Landings by Canadian fishermen were relatively insignificant until the beginning of the 1960s when their nominal catches averaged 2,658 t of an average total nominal catch of 33,473 t (1960-1964). Since 1967, Canadian fishermen have landed the largest proportion of the total catch. In 1961 the distant water fleet, composed mostly of vessels from the U.S.S.R., but later augmented by Polish, Japanese, and French vessels, began contributing significantly to total redfish catches from these divisions. The combined efforts of Canada, the USA, and the distant water fleet culminated in a nominal catch of 62,381 t in 1971 (Table 1, Figure 1). Since the establishment of Canada's 200 mile zone in 1977, the distant water fleet has not contributed significantly to 4VWX redfish catches. However, in 1984 and 1985 the Japanese fleet removed 1,330* and 923* t respectively.

From a maximum in 1971 catches declined rapidly, reaching 13,154 t in 1979. Landings increased between 1979 and 1982 but dwindled to 10,244 t in 1984. For 1985 the provisional total of 13,900 t represents a 35% increase over 1984 but accounts for only 46% of the T.A.C.. A detailed history of TACs, quotas and landings since 1975 is given in Table 2.

The overall increase in landings observed for 1985 resulted from increases in 4Vn (38%), 4Vs (53%), and 4X (8%) while landings from Division 4W remained stable (Figure 2). Contributions (percent) by area are given below for 1985.

4Vn --	22.1	4W --	11.6
4Vs --	26.1	4X --	31.4

Of the Scotia-Fundy landings in 4VWX by far the largest proportion is taken by two classes of vessel; tonnage class 4 (OTB1-TC4) side trawlers and tonnage class 5 (OTB2-TC5) stern trawlers (Table 3, Figure 3a). Until 1977 the largest proportion of landings were made by side trawlers, since then the majority of the landings have been made by stern trawlers. In 1985 TC-4 side trawlers accounted for 26.5% of total landings while TC-5 stern trawlers contributed 26.9%. Although their relative contributions to the total landings is essentially equal in 1985 the relative distribution of their landings over the management unit differ. Landings from 4Vn and 4Vs are largely due to stern trawlers while landings in 4W and 4X are predominantly from side trawlers (Figure 3b).

The seasonal distribution of landings by the two major gear types (Tables 4 and 5) indicate that the bulk of the landings are made during the third quarter of the year.

* Provisional data

Commercial Catch Rate Series

Catch rates, calculated from total annual effort and total annual catch for the two major gear types (Figure 4), show a rapid increase for side trawlers over the past 5 years. Over this period catch rates have increased from 0.42 t/hr to 1.44 t/hr. Stern trawler catch rates have been much more variable between years over the entire series. Between 1976 and 1982 catch rates for this gear type increased from 0.34 t/hr to 0.913 t/hr. From this maximum the rate declined for two successive years and has shown a marginal increase to 0.73 t/hr in 1985.

To minimize the effects of seasonal variation on catch rates the two series were also calculated using total catch and total effort from the third quarter of each year (Figure 5). This series demonstrates the same general trends as those observed for the annual series. Stern trawler catch rates increased from 1976 to 1982, declined dramatically from 1982 to 1984, and increased to 1985. The rapid increase in side trawler catch rates is equally evident in this series starting in 1980 rather than 1981 for the annual series.

Although the side trawler catch rates indicate a clear increase over the past 5 to 6 years the interpretation of the stern trawler catch rate series is somewhat more difficult given its demonstrated variability. The examination of a composite catch rate index (produced by the multiple regression package STANDAR) indicates a generally increasing trend since 1977; however, the model accounted for only 11% of the variability observed in the catch rate data resulting in relatively wide confidence intervals around the observed trend. The detailed results of the analysis are given in Figure 6. Data for side and stern trawlers were combined into a single variable given the relative similarities of their separate catch rate series. The second gear variable was composed of mid-water trawl catches. Catches by miscellaneous gear types were excluded from the analysis. Tonnage classes associated with each gear type were entered as separate variables. One observation from a TC 1 vessel was excluded from the analysis. Unit areas were combined to the division and subdivision level (4Vn, 4Vs, 4W). Unit areas in Division 4X were combined into two groups 4Xe (4Xm, n, o) and 4Xw (4Xpq, r, s) based on their relative contributions to total landings. The decision to enter these divisions and subdivisions as separate variables is based on the fact that catch rates for the major gear types (OTB1-TC4 and OTB2-TC5) differ significantly between these areas (Figures 7 and 8). This is particularly evident for the side trawler catch rate series which shows an increase from 4Vn to 4X. Months were combined to quarters and years were entered as separate variables.

Research Vessel Biomass Estimates

Estimates of total trawlable biomass of redfish present in management unit 4VWX declined between 1984 and 1985. The arithmetic mean (Figure 9) series is extremely variable showing some interannual variations of over 200,000 t. Given the life history of redfish it is not possible that these represent actual fluctuations in biomass but rather variability in the estimate as a result of sampling deficiencies. The geometric mean

(Figure 9) series does not suffer from these large interannual variations. The precipitous increase between 1983 and 1984 was due mainly to two extremely large catches of small fish in a single survey stratum reflecting the presence of two very large incoming year-classes. The 1985 estimate therefore appears to be in line with the slow increase in overall biomass which commenced in 1980-1981, following the gradual decline observed between 1970 and 1980.

Changes in biomass estimates for individual areas (Figure 10) indicate that levels in 4Vn are relatively stable, and that 4Vs shows a stable or slightly increasing trend since 1980. The dramatic changes in 4W and 4X between 1983 and 1985 are due mainly to extremely large catches in three strata in 1984. The estimated redfish biomass in Stratum 57 (4W) in 1984 was approximately six times the largest previous estimate. In Division 4X the increased biomass estimate in 1984 was due primarily to large catches in Strata 70 and 84. For Stratum 70 the 1984 estimate was the third highest yet made while for Stratum 84 it was the second highest. In Strata 57 and 70 the large catches observed in 1984 were composed largely of redfish 14-16 cm in length indicating that they belonged to the pair of large incoming year-classes which have been observed since 1982 (Zwanenburg *et al.* 1982, Zwanenburg 1983, Zwanenburg 1984, Zwanenburg 1985). Large catches of fish belonging to these two year-classes will likely continue to cause large fluctuations in a generally increasing trend of estimated biomass as these fish increase in weight.

Research Vessel Length-Frequency Estimates

Redfish length-frequency estimates for the entire management unit from 1970-1985 are shown in Figure 11. The feature of primary interest is the large group first observed in 1982 at a modal length of 8 cm. Closer examination of this peak revealed that it is actually composed of two groups; one first appearing in the fall of 1981 primarily in 4Vs and the other in the summer and fall of 1982, again primarily in 4Vs and to some extent in 4Vn (Zwanenburg 1985). These two groups are easily followed through the population in 1983 to a point where they appear to dominate the population in 1984 at a modal length of 15 cm and again in 1985 at a length of 18 cm. Examination of redfish length-frequency estimates for individual areas within the management unit (Figure 12) indicate that these year-classes dominate the population in all areas save for the western portions of Division 4Xw (4Xpqrs) in 1985.

The relative size of these incoming year-classes can be judged by examination of a recruitment index (Figure 13) calculated for each individual area (4Vn to 4Xw) as:

$$RI_j = \frac{\sum_{i=1}^{i=15} f_{ij}}{\sum_{i=1} f_{ij}}$$

where f_{ij} is the number of fish estimated at length I and j refers to the year of the survey. From this analysis it becomes apparent that these two year-classes represent the largest incoming year-classes since the inception of the surveys.

Summary and Conclusions

Commercial catch rate series calculated for the two major gear types conducting the redfish fishery indicate a generally increasing trend since the late 1970s and early 1980s. In the last several years the two catch rate series have given somewhat contradictory results. Calculation of a combined catch rate index for the fishery in general, corroborates a continuing increase although confidence intervals around this trend are wide.

Estimates of trawlable redfish biomass derived from July groundfish surveys indicate a generally increasing trend since 1980. The presence of two extremely large year-classes may be introducing large interannual variability in the estimates but should result in a continued increase in trawlable biomass as they grow.

Estimated length-frequency distributions for the entire management unit indicate two very large year-classes with a modal length of 18 cm in July 1985 which have come to dominate the population in terms of numbers. A comparison of these two year-classes to other recruiting year-classes seen through the 1970s indicate that they are by far the largest observed to date. They are expected to begin recruiting to the fishery in the late 1980s or early 1990s.

References

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Table 1. Total redfish landings from 4VWX.

Year	4Vn	4Vs	4W	4X	Total
1968	7730	2222	1169	1982	13103
1969	6259	9347	3684	2763	22053
1970	4246	6694	16215	4424	31579
1971	6954	23698	19953	11776	62381
1972	4525	14580	22223	8972	50300
1973	7125	11213	14709	7126	40173
1974	6985	8112	11587	6153	32837
1975	7821	6772	9487	3903	27983
1976	5704	4718	3225	4812	18459
1977	5223	7123	2274	3225	17845
1978	3937	7856	1621	2680	16094
1979	4706	4979	1948	1521	13154
1980	3893	5431	2441	2351	14116
1981	6657	6789	3045	2453	18944
1982	6561	4585	598	4347	16091
1983	3706	3758	1491	3926	12881
1984	2215	2367	1636	4006	10224*
1985	3072	3633	1612	4359	13900**

* Provisional data.

** Provisional data (total includes landings for which area is not yet available).

Table 2. TAC's, quotas, allowances, and catches since 1974.

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985			
TAC	30000	20000	20000	20000	20000	20000	30000	30000	30000	30000	30000			
Landings	27983	18459	17845	16094		13154		14116		18944	16092	12881	10224	13900
Canada:														
Quota	14860	12000	13000	17500	13000	18000	18500	29000	18500	29000	25000	27000	28000**	28000
Landings	17025	12625	14712	13576		12240		13108		17753	14366	11988	7987*	12837
France:														
Quota	740	250	250	250	500 ^a	500 ^a	500 ^a	500 ^a	500 ^a	500 ^a	500 ^a	500 ^{a, b}	500	500
Landings	186	279	63	121		20		21		3	2	4	2*	
Japan													1500	1500
													1330*	923*
Poland:														
Quota	970		Subsequent catches included with "Others".											
Landings	230													
USSR:														
Quota	4900	1000	500											
Landings	4849	1021	175	Subsequent catches included with "Others".										
USA:														
Quota	7430	6000	6000	1500	See "Others"	10500	0	0	0	0	0	0	0	0
Landings	5465	4446	2876	2147			885		762	1611	815	872*		29*
Others:														
Quota	1100	750	250 ^b	750 ^b	6500	1500	500	500	11000	500	0	0	0	0
Landings	228	88	19	250		894		102		426	113	74	33*	111*
Reserve										4500	2500	1000**		

^a St. Pierre vessels only

^b By-catch only

* Provisional Statistics

** Resource Short Plant Program

Landings to 1983 are from ICNAF and NAFO Statistical Bulletins.

In 1979, 1980 and 1981 quotas were amended during the year; initial and final ones are given.

Table 3. Total redfish landings by Scotia-Fundy OTB1-TC4 and OTB2-TC5 from 4VWX.

Year	4Vn		4Vs		4W		4X	
	OTB1	OTB2	OTB1	OTB2	OTB1	OTB2	OTB1	OTB2
1968	1892	70	985	217	198	103	1007	227
1969	2195	246	801	154	1537	177	1523	447
1970	1176	665	787	374	4087	1410	2222	752
1971	3189	511	4942	1441	4419	942	4515	1696
1972	1472	595	3077	968	5030	1482	1555	617
1973	1848	503	2246	298	3210	405	802	112
1974	2795	691	2924	423	1480	287	812	435
1975	1428	1492	1946	488	2174	487	475	378
1976	807	330	1717	171	1470	280	602	263
1977	1112	1115	2655	1099	635	654	479	307
1978	758	516	1795	2234	474	823	333	264
1979	1405	457	972	2185	546	1150	478	187
1980	1044	196	1286	2927	408	1672	516	586
1981	1795	1048	1640	3703	383	2044	1059	405
1982	743	1277	1756	1784	149	280	1035	1111
1983	1216	1319	1334	1514	308	723	1331	786
1984	319	582	562	1075	989	255	1328	171
1985	270	966	300	2506	978	195	2437	84

Table 4. Redfish landings by Scotia-Fundy OTB1-TC4 for 4VWX by Quarter.

Year	4Vn				4Vs				4W				4X			
	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th
1968	67	971	380	474	199	315	83	388	51	75	51	21	45	200	646	116
1969	191	788	681	535	263	303	108	127	19	267	1199	52	113	456	660	294
1970	345	139	268	424	250	60	59	418	45	839	2819	384	57	156	1465	544
1971	116	1477	1105	491	740	2204	1270	728	708	1085	2466	160	41	1270	2407	797
1972	507	583	278	104	575	1500	788	214	308	1726	2367	629	48	676	724	107
1973	263	443	545	597	354	683	538	671	611	920	1043	636	40	459	203	100
1974	339	185	1422	849	607	809	803	705	202	435	617	226	311	138	256	107
1975	130	255	676	367	174	780	577	415	382	618	503	671	19	232	197	27
1976	168	94	457	88	165	616	915	21	39	614	794	23	42	132	389	39
1977	12	116	712	272	70	880	1301	404	23	153	355	104	9	93	334	43
1978	8	143	540	67	60	840	641	254	4	56	386	28	11	20	185	117
1979	13	115	1061	216	2	263	650	57	17	308	183	38	96	120	106	156
1980	10	243	789	2	23	329	708	226	19	168	203	18	7	62	381	66
1981	7	211	1050	527	32	590	507	511	13	108	42	220	36	1	637	385
1982	1	162	523	57	29	291	762	674	0	53	75	21	0	77	422	536
1983	10	589	611	6	24	47	524	739	0	5	23	280	2	124	735	470
1984	4	35	241	39	3	88	467	4	13	0	447	529	112	334	537	345
1985	10	16	235	9	0	49	251	0	0	521	456	0	379	670	863	525

Table 5. Redfish landings by Scotia-Fundy OTB2-TC5 for 4VWX by Quarter.

Year	4Vn				4Vs				4W				4X			
	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th
1968	0	70	0	0	60	52	0	105	19	18	0	66	51	6	53	117
1969	0	28	6	212	90	7	10	47	45	1	119	12	100	49	185	113
1970	176	11	327	151	217	14	5	138	56	13	332	1009	20	167	225	340
1971	117	42	309	43	633	528	79	201	108	347	241	246	40	523	801	332
1972	92	289	185	29	466	191	194	117	165	341	744	232	19	266	257	75
1973	420	31	23	29	89	152	34	23	249	97	27	32	50	2	13	47
1974	231	146	58	256	208	116	61	38	7	102	143	35	0	38	322	75
1975	356	85	780	271	110	94	230	54	29	193	12	253	7	94	157	120
1976	194	130	0	6	90	51	23	7	26	218	5	31	24	99	58	82
1977	108	261	718	28	55	111	497	436	37	59	493	65	33	125	52	97
1978	55	39	345	77	197	1089	610	338	32	343	345	103	21	168	64	11
1979	72	132	211	42	155	518	308	1204	2	684	402	62	19	4	1	163
1980	48	6	124	18	149	609	1630	539	32	785	648	207	36	222	80	248
1981	4	363	622	59	95	1809	1685	114	37	1282	594	131	12	252	46	95
1982	0	191	919	167	39	154	1355	236	10	96	97	77	67	106	495	443
1983	8	73	1092	146	146	389	869	110	36	279	210	198	172	158	284	172
1984	6	191	248	137	654	159	183	79	83	64	85	23	14	106	43	8
1985	3	221	453	289	836	359	802	509	9	2	153	32	19	19	1	45

Figure 1. Commercial Redfish Landings from Subarea 4 (to 1955) and Division 4VWX (since 1954).

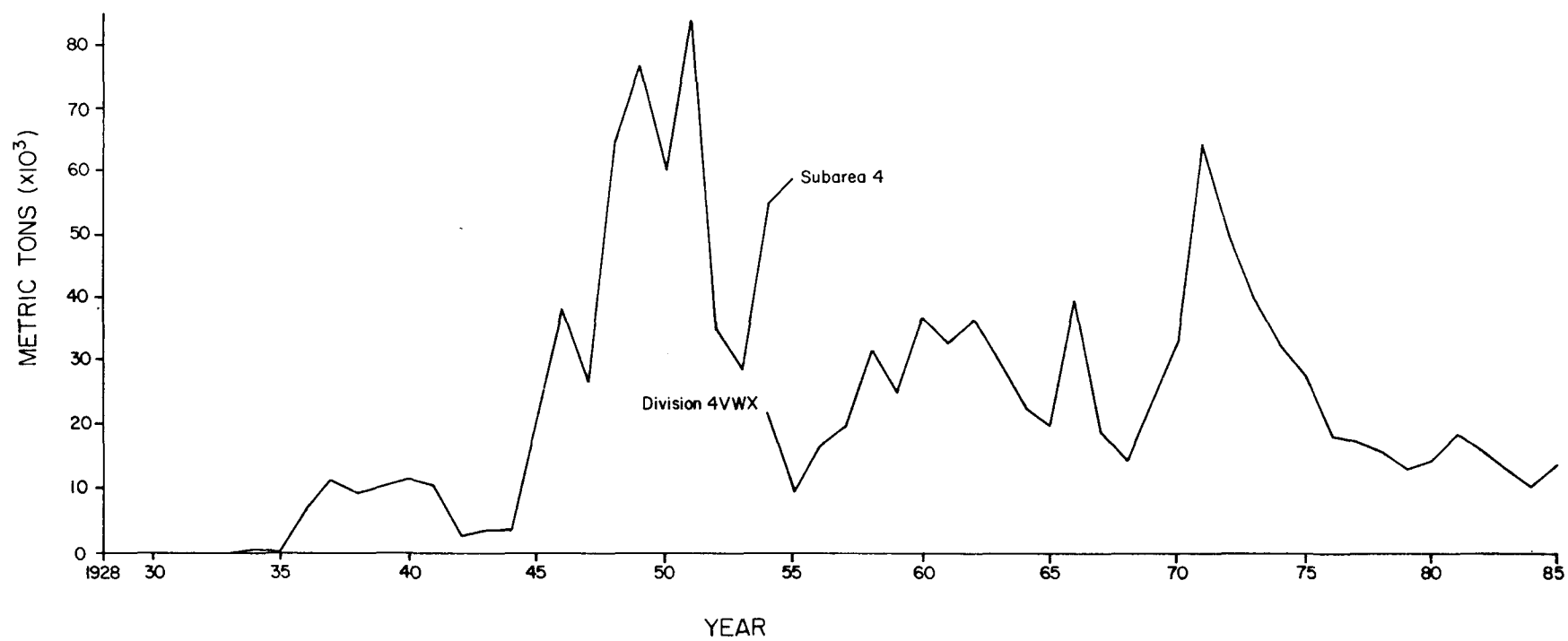
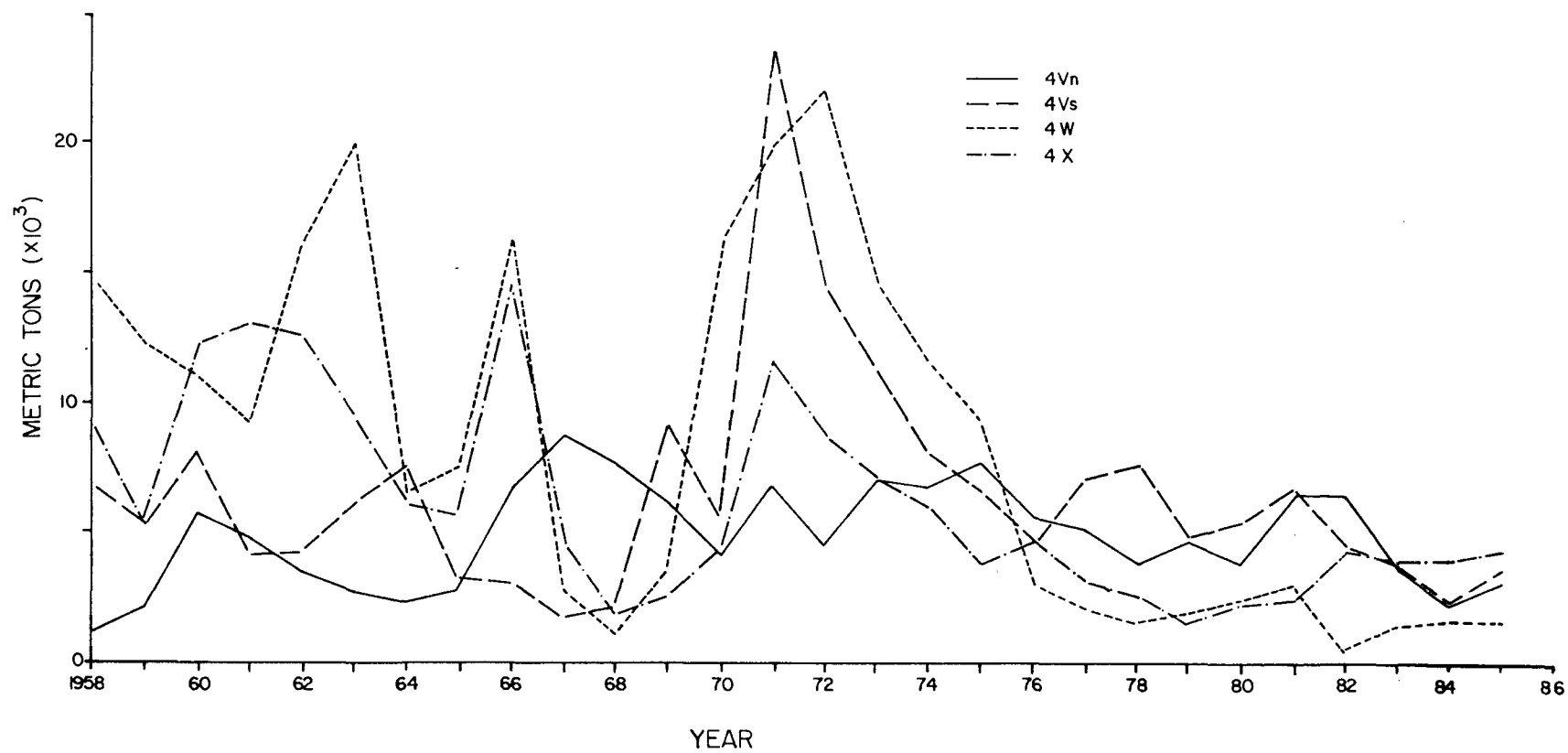


Figure 2. Redfish landings from Divisions 4VWX (1958 - 1985).



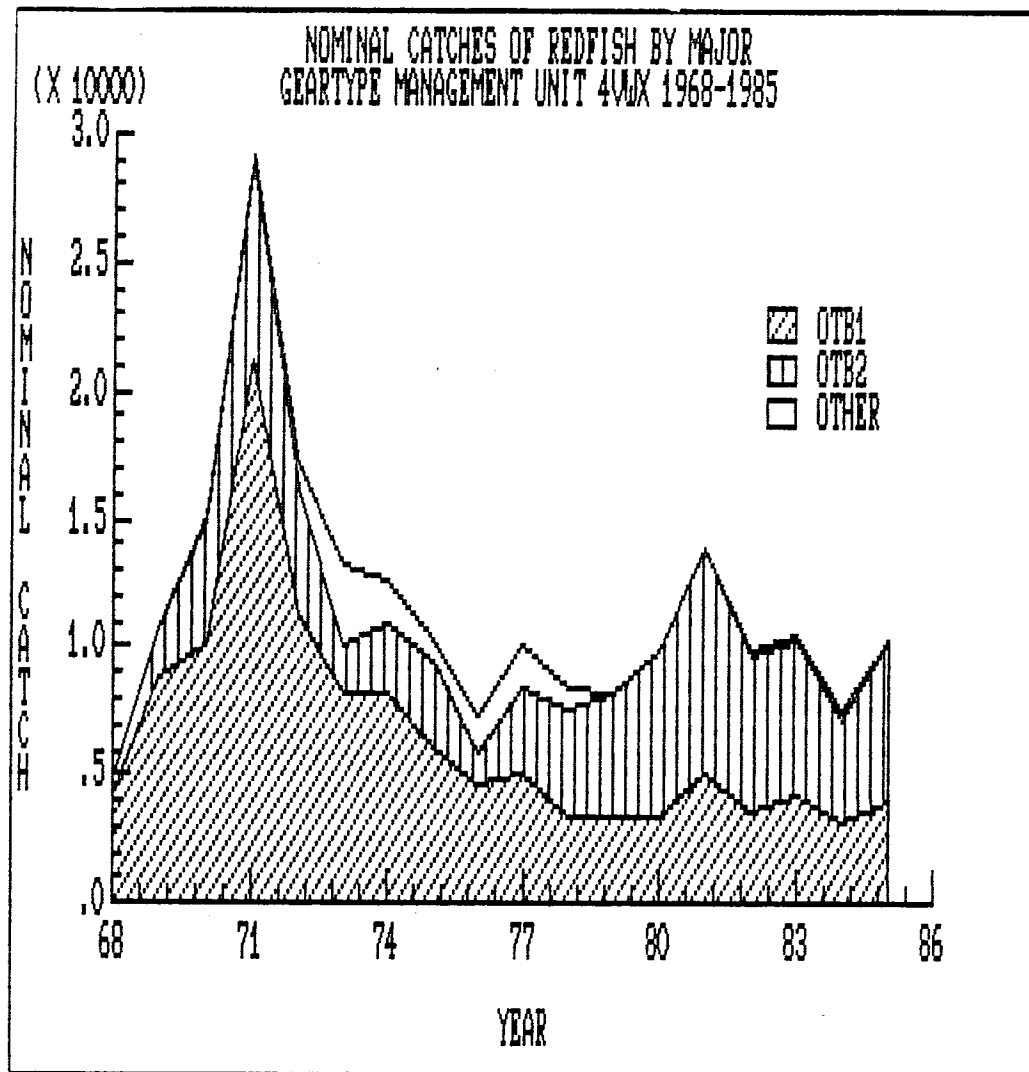


Figure 3a. Redfish landings (Scotia-Fundy) from management unit 4VWX by major gear type.

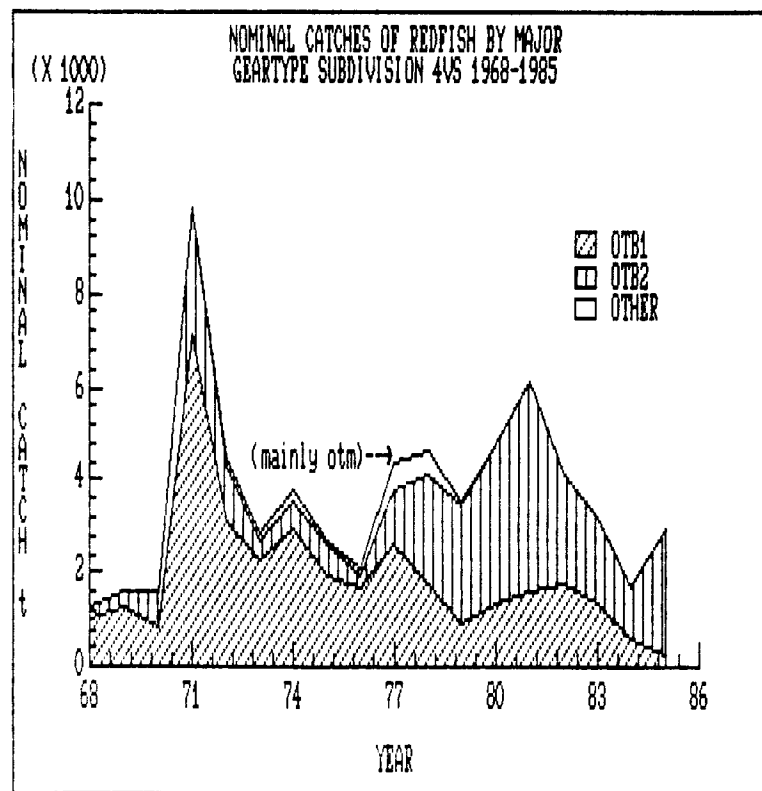
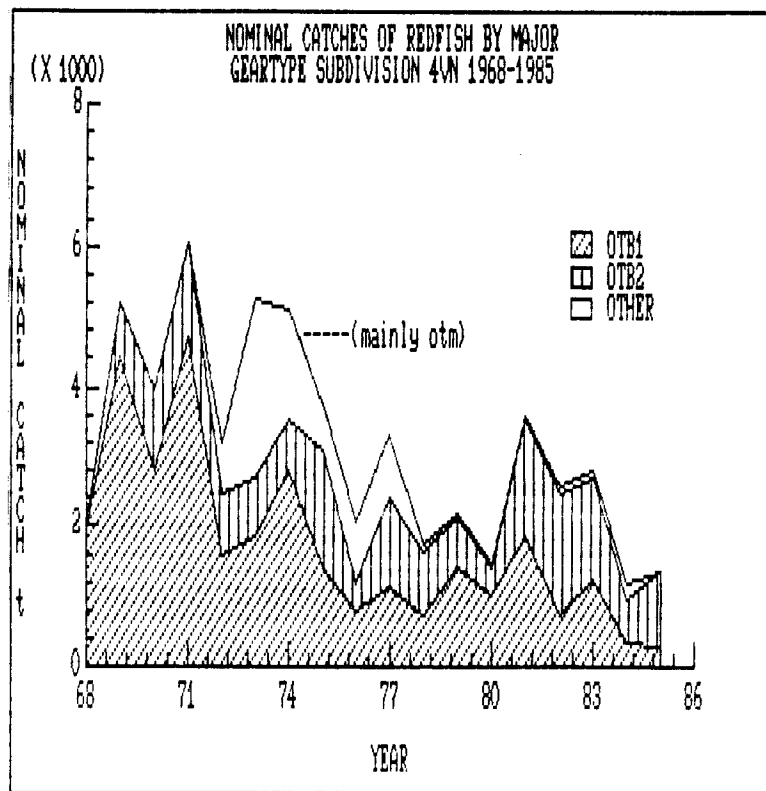


Figure 3b. Redfish landings (Scotia-Fundy) by area and major gear type.

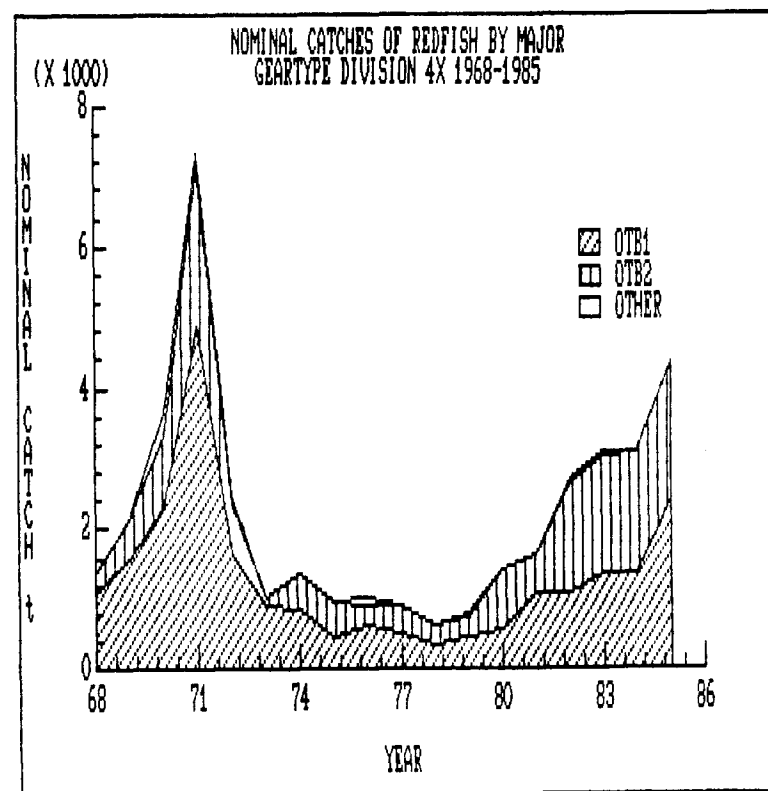
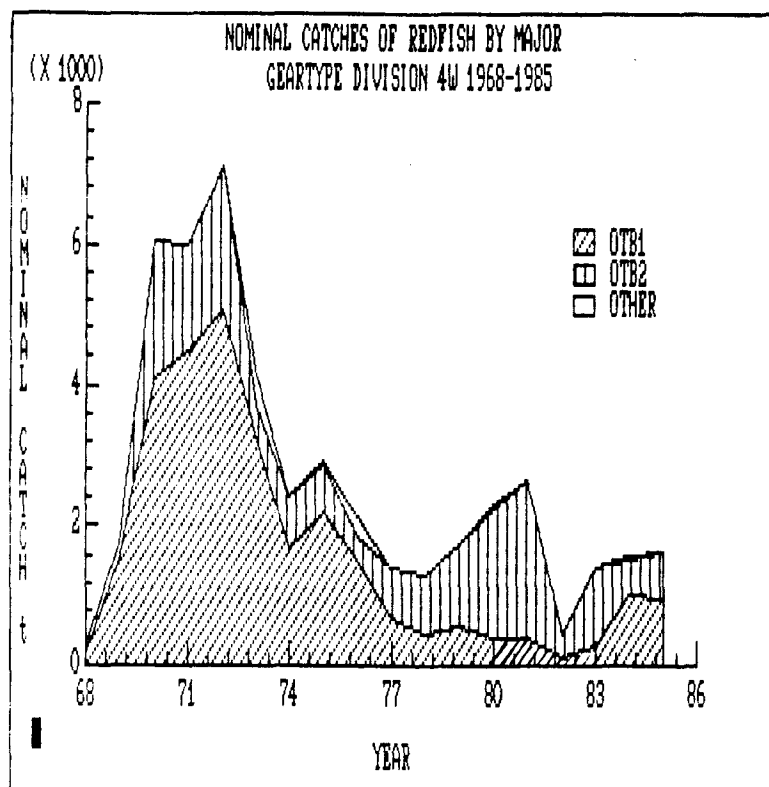


Figure 3b. (Continued).

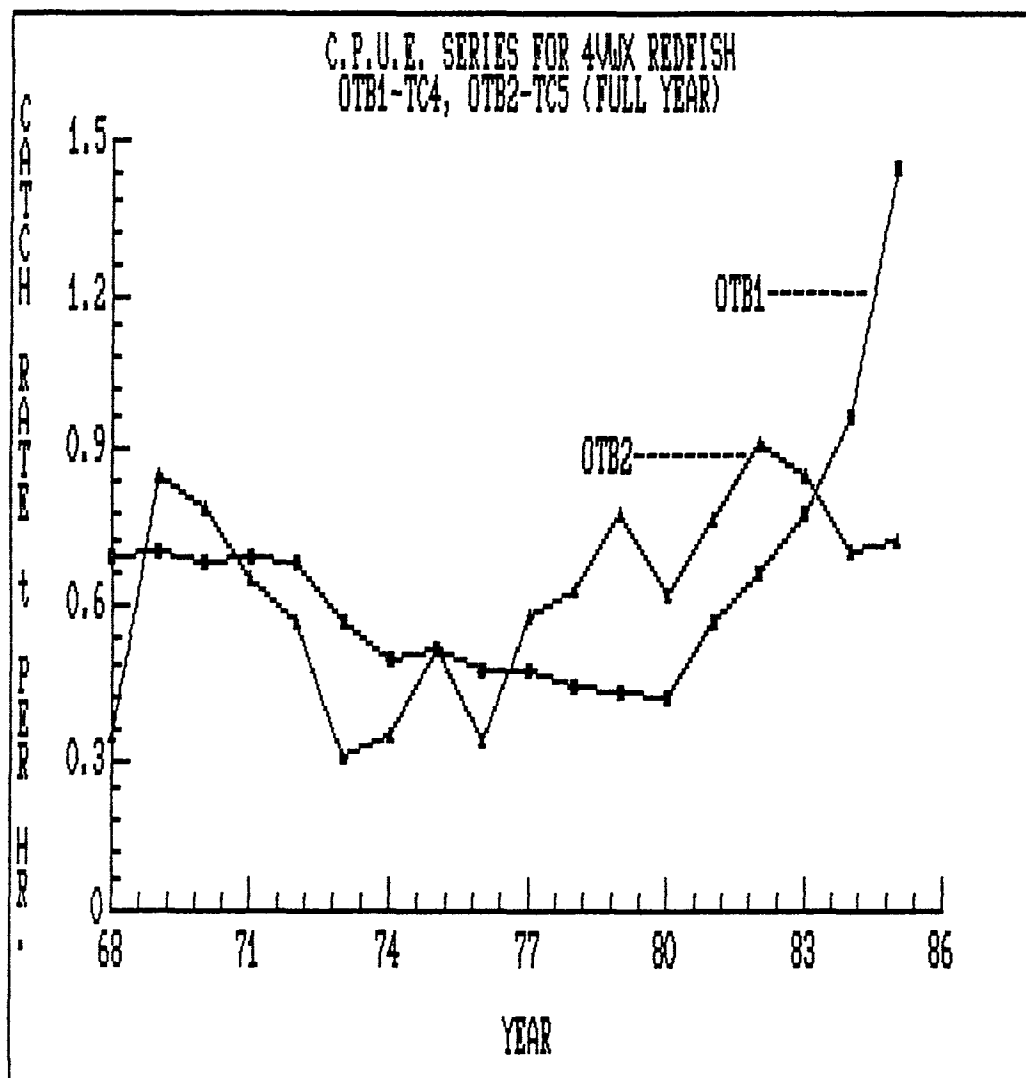


Figure 4. Redfish catch rate series (Scotia-Fundy vessels) calculated from total annual catch and total annual effort for the two major gear types in the fishery.

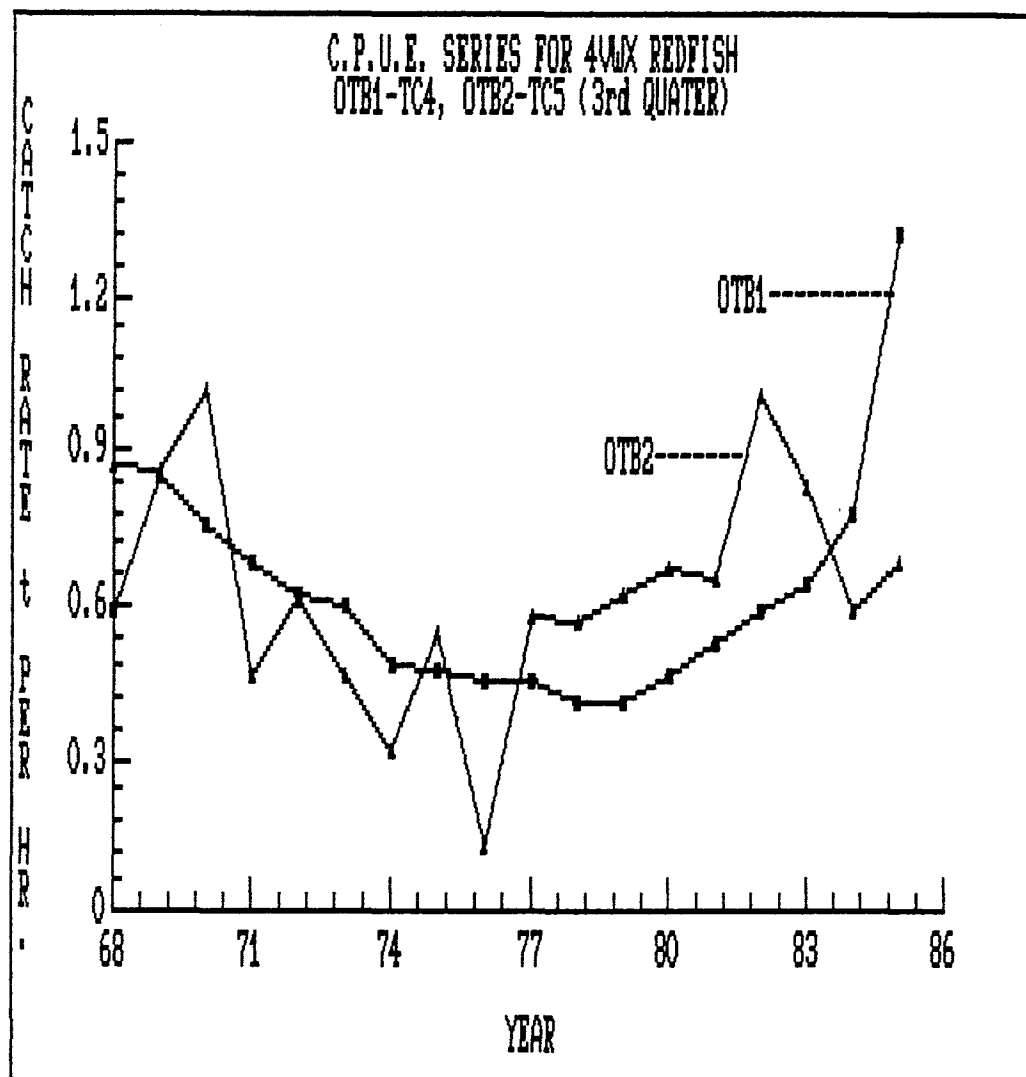


Figure 5. Redfish catch rate series (Scotia-Fundy vessels) calculated from 3rd quarter catch and effort for the two major gear types in the fishery.

PREDICTED CATCH RATE

STANDARDS USED VARIABLE NUMBERS: 1 4 115 7

YEAR	TOTAL CATCH	PROP.	CATCH RATE		EFFORT
			MEAN	S.E.	
68	13103000	0.224	645.418	77.808	20302
69	22053000	0.349	822.353	78.426	26817
70	31579000	0.288	684.084	58.330	46162
71	62381000	0.328	788.808	59.797	79083
72	50300000	0.215	802.426	65.453	62685
73	40173000	0.180	646.807	56.098	62110
74	32837000	0.287	671.858	51.972	48875
75	27983000	0.243	673.534	56.691	41547
76	18459000	0.245	550.127	47.605	33554
77	17845000	0.453	536.288	43.479	33275
78	16094000	0.441	601.574	50.419	26753
79	13154000	0.471	636.942	51.973	20652
80	14116000	0.576	629.447	47.267	22426
81	18944000	0.660	750.296	58.421	25249
82	16091000	0.516	778.654	61.355	20665
83	12881000	0.671	843.272	66.536	15275
84	10224000	0.580	814.810	70.414	12548
85	13900000	0.615	1180.256	98.442	11777

AVERAGE C.V. FOR THE MEAN: .084

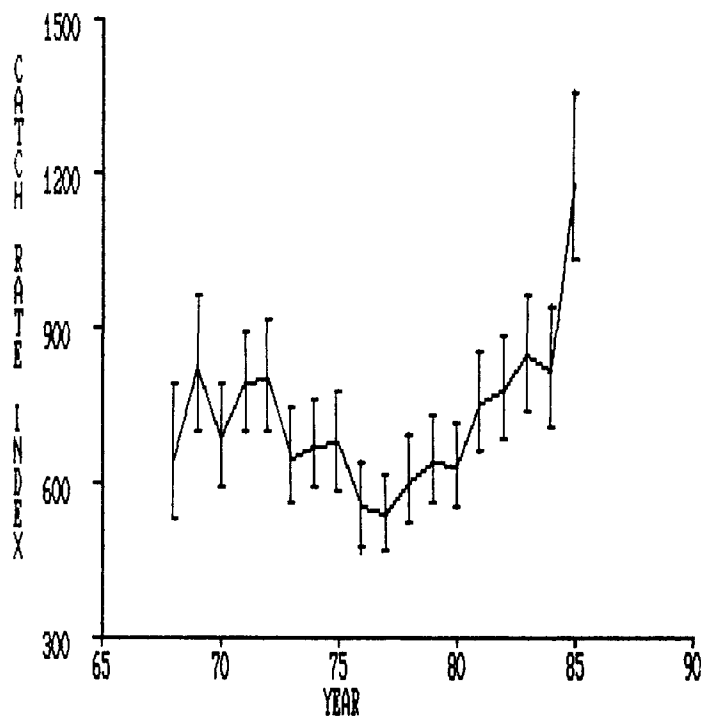


Figure 6. Composite redfish catch rate index estimated by STANDARD. See text for details. Points shown are the calculated index \pm 95% confidence interval.

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R..... .339
 MULTIPLE R SQUARED..... .115

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	8.707E0004	8.707E0004	
REGRESSION	28	1.898E0002	6.780E0000	10.662
TYPE 1	1	1.816E0001	1.816E0001	28.558
TYPE 2	3	5.439E0001	1.813E0001	28.509
TYPE 3	4	4.327E0001	1.082E0001	17.011
TYPE 4	3	1.693E0001	5.644E0000	8.876
TYPE 5	17	6.773E0001	3.984E0000	6.266
RESIDUALS	2302	1.464E0003	6.359E-0001	
TOTAL	2331	8.872E0004		

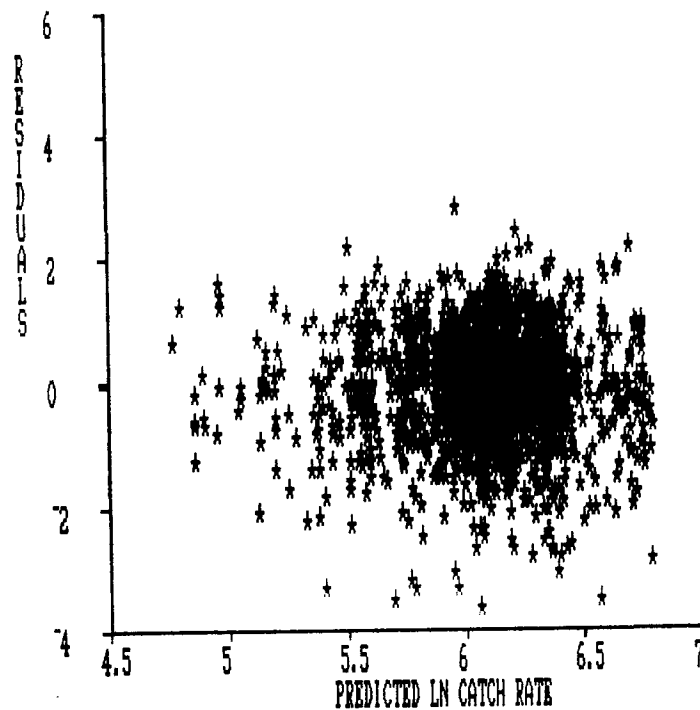


Figure 6. (Continued).

REGRESSION COEFFICIENTS

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
1	1	INTERCEPT	6.159	0.121	2331
2	4				
3	115				
4	7				
5	68				
1	3	1	0.511	0.096	82
2	2	2	-0.574	0.093	97
	3	3	-0.581	0.080	124
	5	4	0.028	0.038	726
3	100	5	-0.050	0.057	401
	104	6	-0.021	0.049	735
	118	7	-0.613	0.079	139
	122	8	0.008	0.052	568
4	1	9	-0.260	0.060	224
	4	10	-0.032	0.041	656
	10	11	-0.156	0.044	521
5	69	12	0.240	0.143	86
	70	13	0.055	0.135	121
	71	14	0.196	0.131	163
	72	15	0.214	0.134	135
	73	16	-0.001	0.138	113
	74	17	0.036	0.132	156
	75	18	0.039	0.135	128
	76	19	-0.163	0.139	110
	77	20	-0.189	0.135	137
	78	21	-0.074	0.135	135
	79	22	-0.017	0.134	135
	80	23	-0.030	0.131	170
	81	24	0.146	0.132	160
	82	25	0.183	0.134	139
	83	26	0.263	0.133	144
	84	27	0.229	0.139	116
	85	28	0.600	0.136	134

Figure 6. (Continued).

PREDICTED RELATIVE POWER

YEAR	TOTAL CATCH	PROP.	RELATIVE POWER		
----	-----	-----	MEAN	S. E.	EFFORT
			----	-----	-----
68	13103000	0.224	1.000	0.000	13103000
69	22053000	0.349	1.729	0.246	12756954
70	31579000	0.288	1.438	0.194	21956327
71	62381000	0.328	1.658	0.216	37619632
72	50300000	0.215	1.687	0.225	29819619
73	40173000	0.180	1.360	0.186	29547408
74	32837000	0.287	1.412	0.185	23250440
75	27983000	0.243	1.416	0.191	19762660
76	18459000	0.245	1.156	0.159	15964771
77	17845000	0.453	1.127	0.151	15830857
78	16094000	0.441	1.265	0.170	12726005
79	13154000	0.471	1.339	0.179	9824535
80	14116000	0.576	1.323	0.173	10669446
81	18944000	0.660	1.577	0.207	12010776
82	16091000	0.516	1.637	0.218	9831914
83	12881000	0.671	1.772	0.235	7267149
84	10224000	0.580	1.712	0.237	5970404
85	13900000	0.615	2.481	0.335	5602681

AVERAGE C.V. FOR THE MEAN: .127

Figure 6. (Continued).

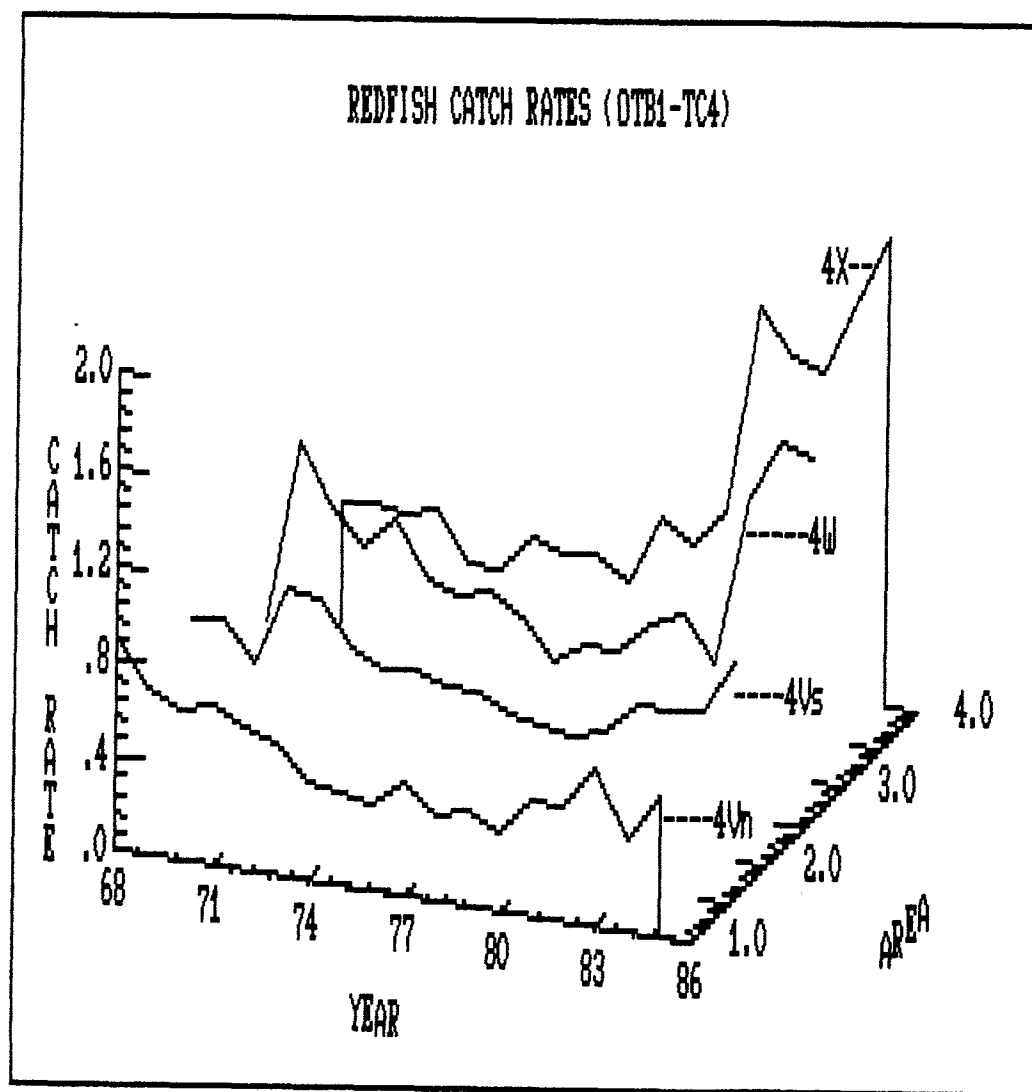


Figure 7. Side-trawler catch rates by division and sub-division (1968 - 1985).

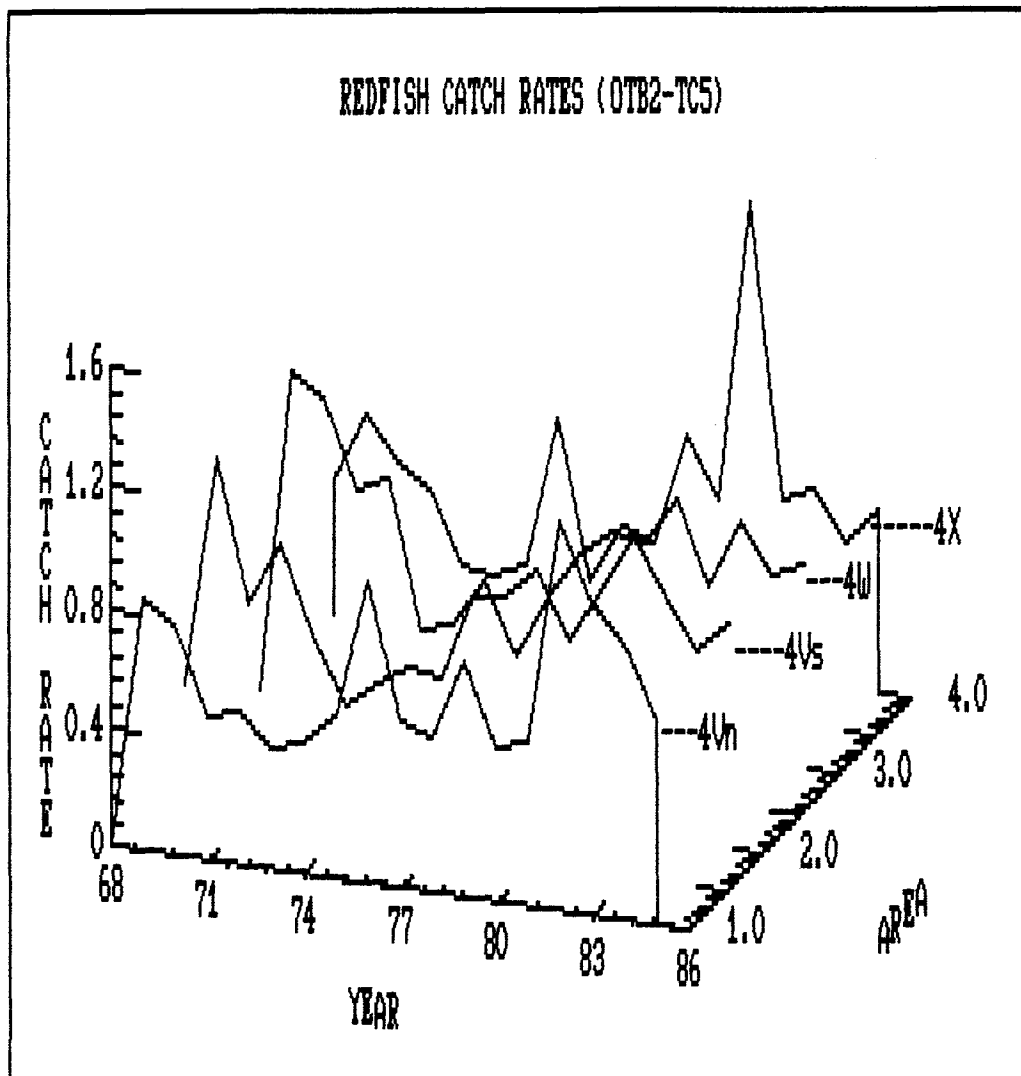


Figure 8. Stern-trawler catch rates by division and sub-division (1968 - 1985).

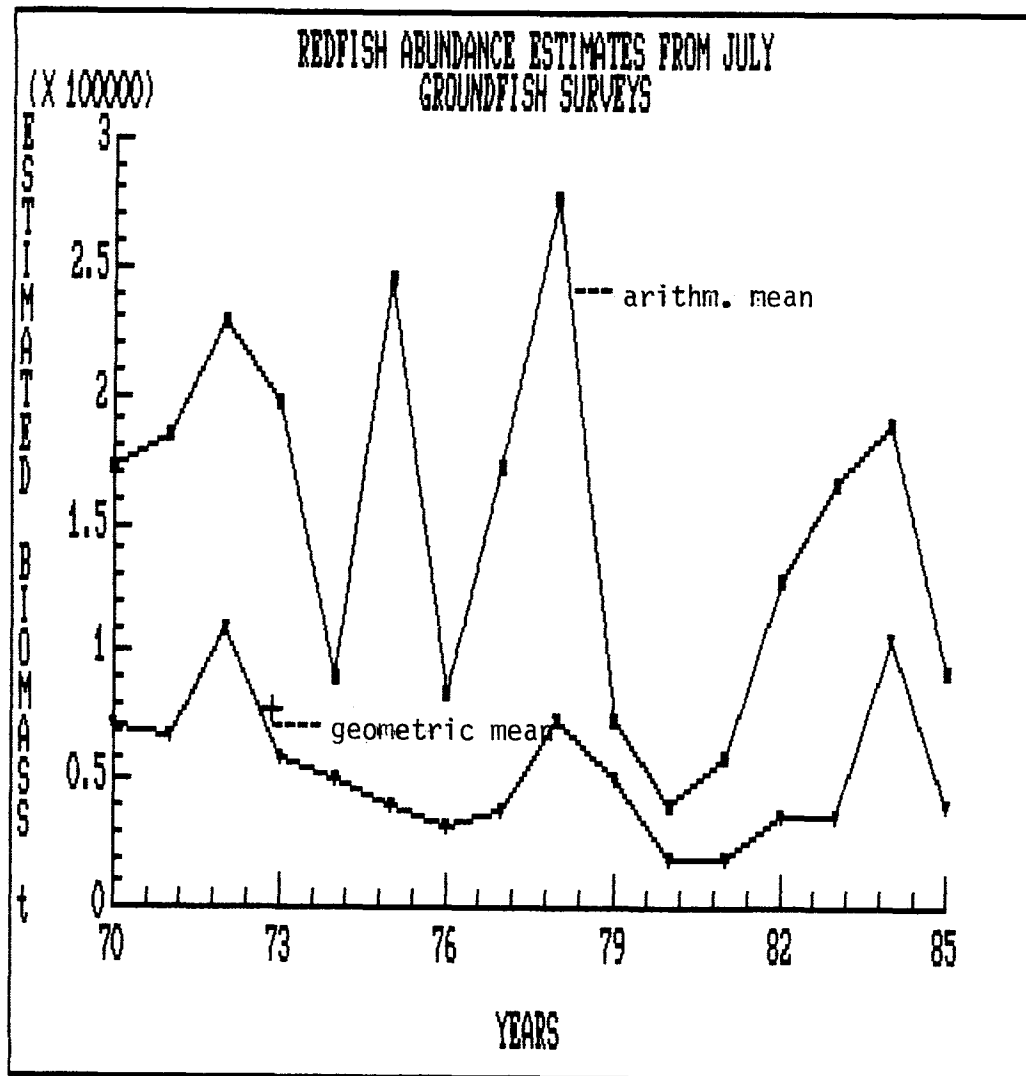


Figure 9. Annual estimates of redfish biomass in management unit 4VWX for 1970 - 1985.

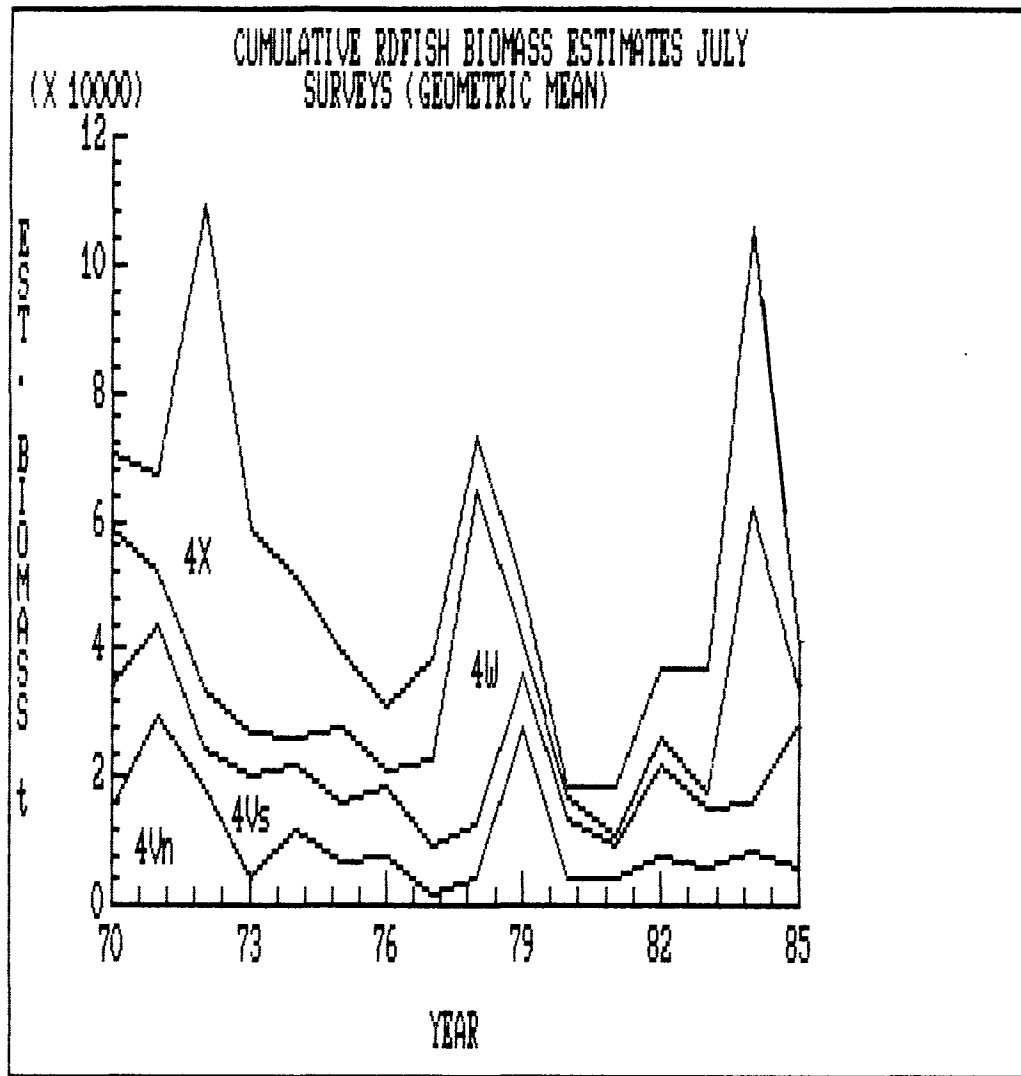


Figure 10. Annual estimates of redfish biomass by division and sub-division for 1970 - 1985.

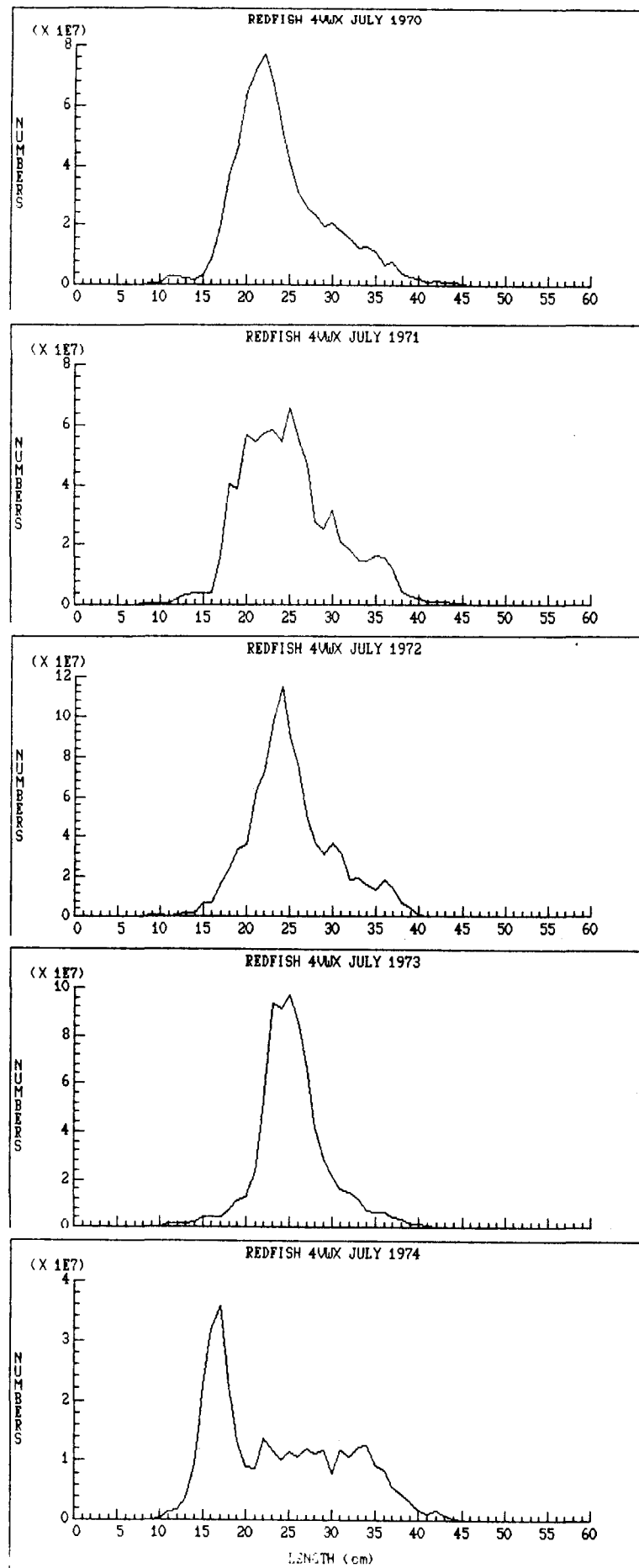


Figure 11. Estimated length-frequency distributions of redfish in management unit 4VWX (1970 - 1985).

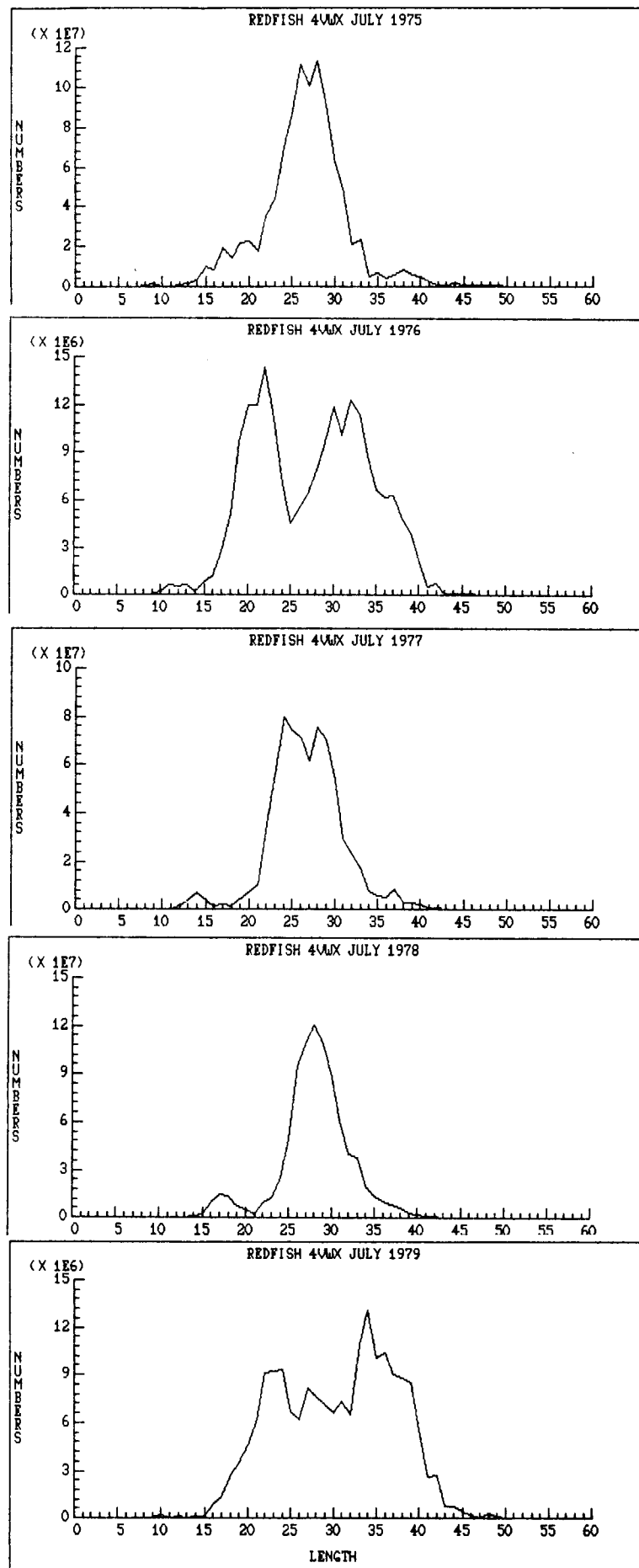


Figure 11. (Continued).

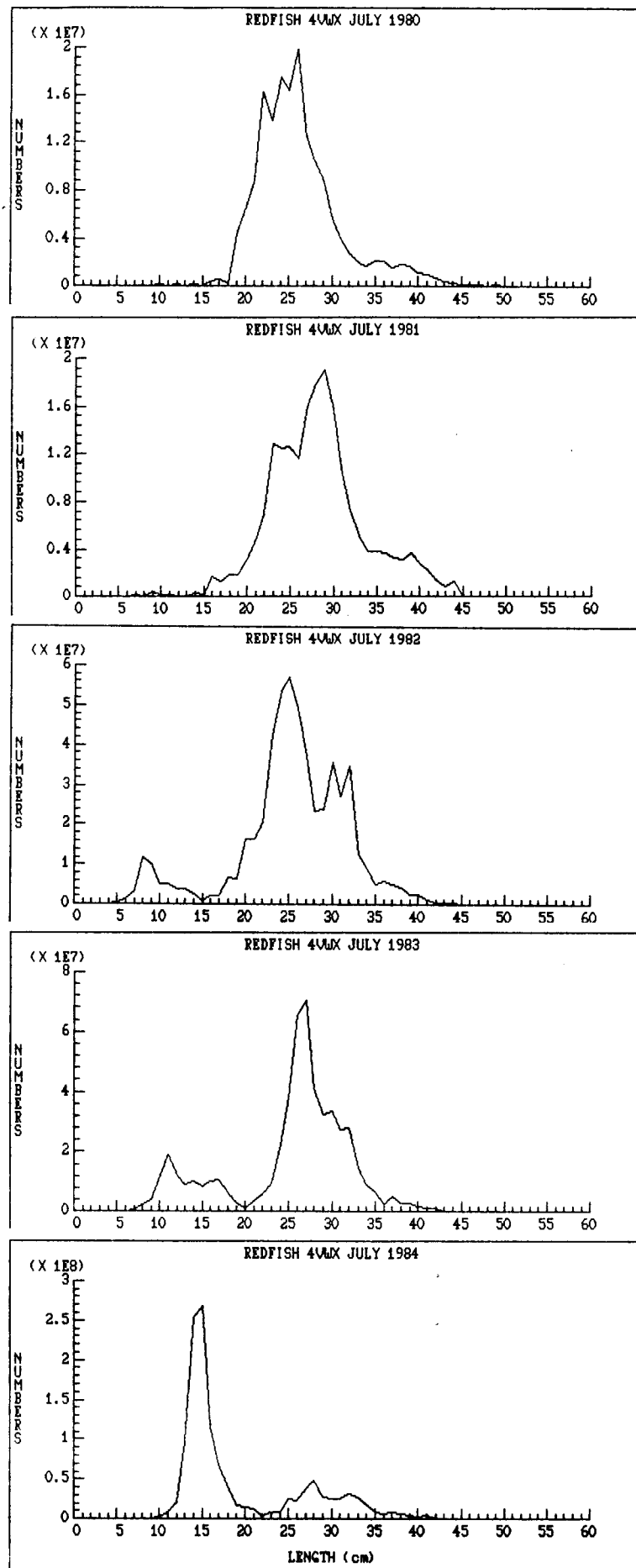


Figure 11. (Continued).

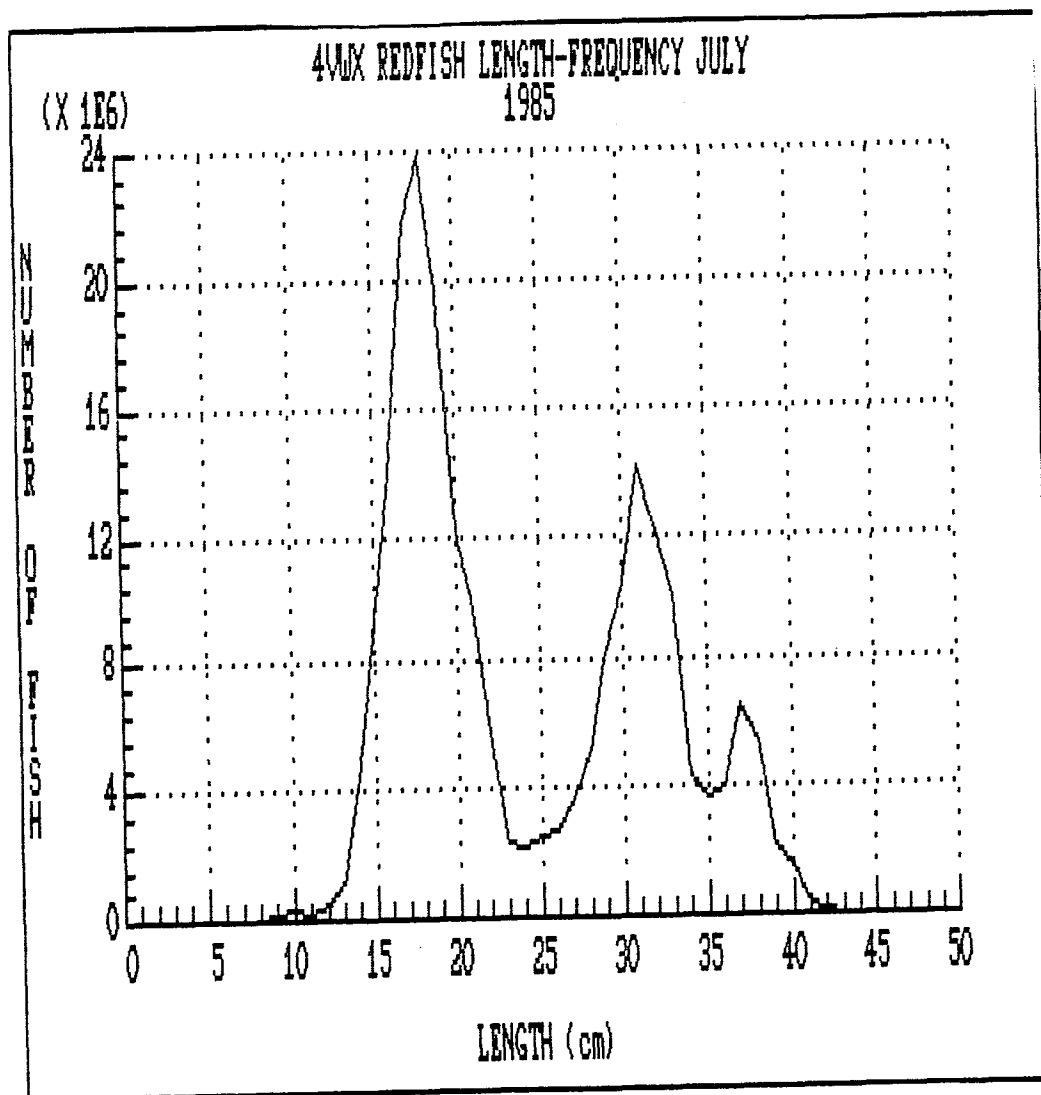


Figure 11. (Continued).

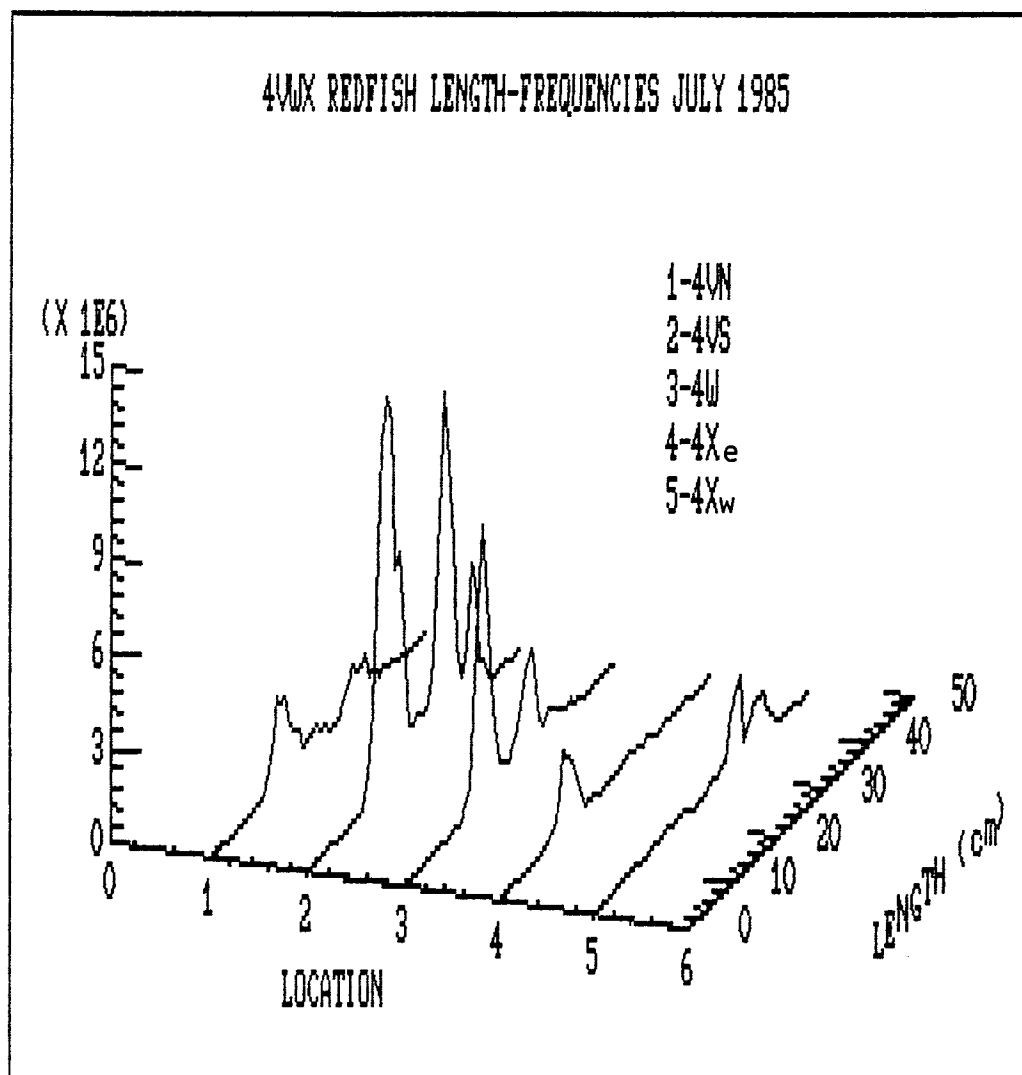


Figure 12. Estimated length-frequency distributions of redfish by division and sub-division for July 1985.

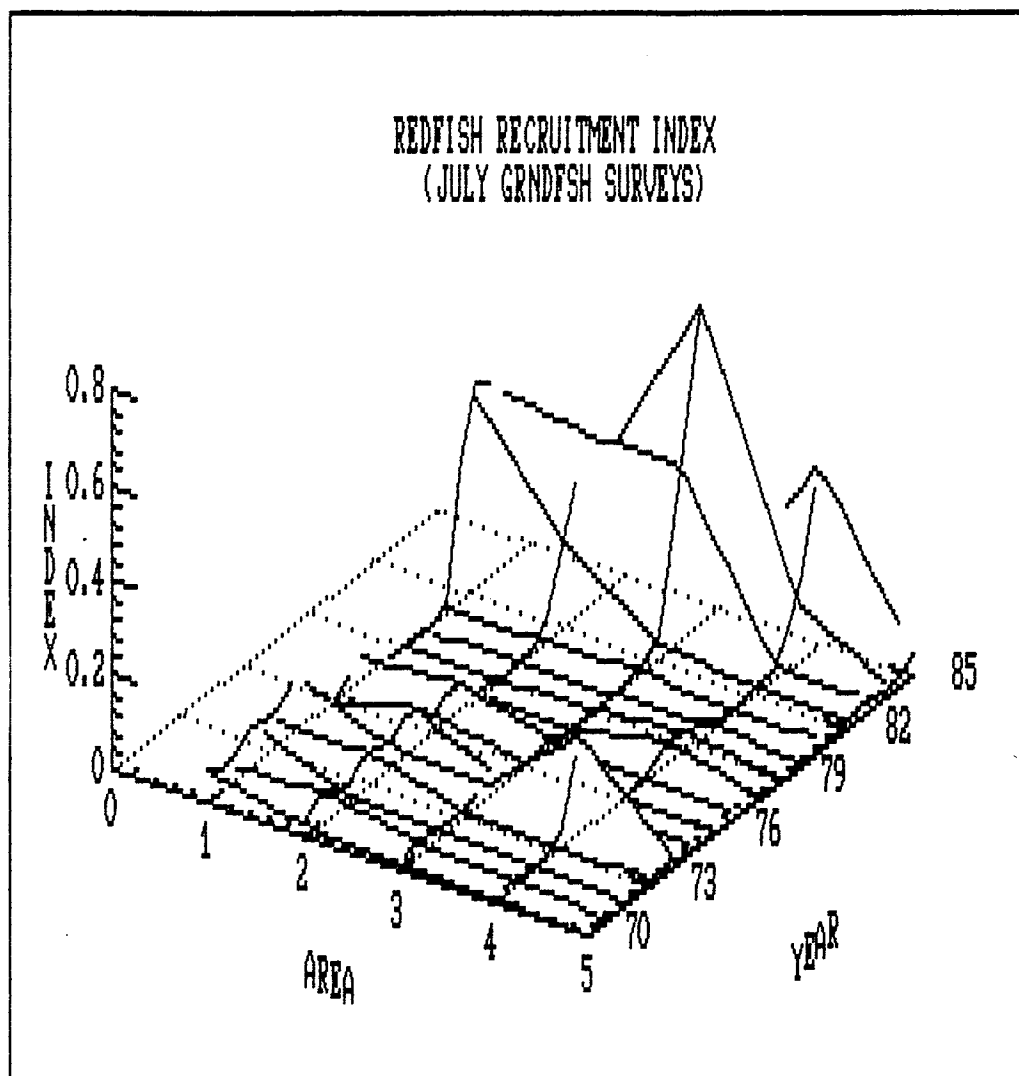


Figure 13. Recruitment index for redfish by division and sub-division (1970 - 1985). Area 1 = 4Vn, 2 = 4Vs, 3 = 4W, 4 = 4Xe, and 5 = 4Xw.