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Trends in biomass and abundance estimates of yellowtail flounder (Limanda ferruginea) from USSR surveys in Div. 3LNO

by

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Introduction

Although the yellowtail flounder resource area covers the entire Grand Bank area of Div. 3LNØ, the major component is located in Div. 3N. Within Div. 3N a large proportion of the stock lies in the NAFO Regulatory Area, particularly the juveniles (ages). This stock has, therefore, been exploited heavily in recent years since it has been subjected to a very high degree of unregulated fishing effort. Many countries comprising this effort do not report their catches to NAFO and as a result the database from the commercial fishery in recent years is largely deficient. In order to assess the status of this stock the NAFO Scientific Council has, therefore, relied mainly on the results of independent research vessel surveys, particularly Canadian groundfish surveys and juvenile flatfish surveys. The purpose of this paper is to provide an additional survey series collected by the USSR and analyzed in a similar fashion coincident with that of the Canadian groundfish surveys.

Materials and Methods

The USSR has been conducting regular groundfish surveys in NAFO Divisions 3K, 3L, 3M, 3N, and 3Ø annually since 1972 during the spring-summer period. From 1972 to 1983 the surveys were conducted according to a fixed-station design and sets were of 1 hour duration. From 1984, for consistency, the USSR adopted the stratified random survey used by Canada and limited survey sets to 30 minutes duration. For the purpose of this paper no differentiation was made between vessels used (all were large high-powered vessels with similar fishing capability). The fishing gear has remained essentially the same.

The data analysis was conducted by first post-stratifying the surveys in the earlier years when they were conducted using fixed-station design. The data were then analyzed using the Canadian "stratified analysis program" (STRAP) in order to obtain mean numbers and weights per set, stratum and year and calculate estimates of biomass and abundance. For strata that were not surveyed in certain years, estimates were obtained using a multiplicative analysis model. For yellowtail flounder only the results of the surveys in Div. 3L, 3N, and 3Ø are presented.

Abundance estimates are shown in Tables 1-3 for Div. 3L, 3N, and 3Ø respectively and trends in abundance are presented in Fig. 1-3 for Div. 3L, 3N, and 3Ø respectively. Biomass estimates are available for Div. 3L, 3N, and 3Ø in Tables 4-6 and trends in biomass shown in Fig. 4-6 respectively.

Results and Discussion

Division 3L

Estimates of abundance (Table 1; Fig. 1) and biomass (Table 4; Fig. 4) fluctuated considerably on an annual basis in the earlier period (1972-81). From 1984 onward there was a dramatic but systematic decline from an estimated biomass of about 21,000 t to less than 1,000 t in 1989 (Table 4; Fig. 4). The major decline occurred between 1984 and 1985 where the 1985 biomass was estimated to be about 4500 t (Table 4). Since then the decline has been more gradual as would be expected at such low levels. Nevertheless, the estimates of the last 5 years would indicate that stock size in Div. 3L is at extremely low levels.

Division 3N

Estimates of abundance (Table 2; Fig. 2) and biomass (Table 5; Fig. 5) show somewhat similar trends as that of Div. 3L. From 1972 to 1982, however, most estimates (7 of 11) are in the vicinity of 175 million fish (Table 2) and 75,000 t of biomass (Table 5). A declining trend began in 1982 and continued to 1988 where estimated biomass went from 82,000 t in 1982 to 14,000 t in 1988 (Table 5). The 1989 estimate went back up to near 35,000 t (Table 5) the highest estimate since 1985 although still low compared to historic levels.

Division 3Ø

Again estimates of abundance (Table 3; Fig. 3) and biomass (Table 6; Fig. 6) fluctuated considerably from relatively low to considerably high levels up to 1984. From 1984 the estimated biomass (Table 6; Fig. 6) declined systematically from 56,000 t to a level of 6,500 t in 1988. The 1989 estimate increased again to 8,400 t, however, was still well below previous levels. For all three divisions the trends are similar. The earlier years showed large fluctuations which may largely be an artifact of sampling design and sampling intensity. Nevertheless, the lower levels of the oscillations are still higher than the more recent estimates of stock size. The declines in size stock for all divisions occurred at about the same time in the early 1980's and persisted to 1988 with some marginal sign of improvement in 1989. However, it seems evident that despite the 1989 estimates the stock size appears to be at its lowest since the surveys began in the early 1970's.

Table 1. Mean number per 30 minute set of yellowtail flounder from USSR spring-summer surveys in Division 3L with number of successful sets in brackets (*strata included in MM analysis).

Stratum	Depth (m)	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
328	93-183	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-
341	"	-	-	-	-	-	-	-	-	-	-	-		0.00(3)	-	0.00(4)	0.00(3)	0.00(4)	0.00(3)
342	"	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-
343	"	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-
344	185-274	0.00(2)	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-
345	275-366	0.00(2)	-	-	-	0.00(2)	-	-	-	-	-	-		0.00(2)	0.00(3)	0.00(4)	0.00(3)	0.00(4)	0.00(4)
346*	"	-	-	-	0.00(2)	-	-	0.00(2)	0.00(2)	-	-	-		0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(4)	0.00(3)
347	185-274	0.00(2)	0.00(3)	0.00(3)	0.00(4)	0.00(3)	0.00(4)	0.00(3)	0.00(2)	0.00(3)	0.00(2)	0.00(2)		0.00(3)	0.00(3)	0.00(3)	0.00(4)	0.00(4)	0.00(6)
348	93-183	0.00(2)	0.00(2)	0.00(3)	0.00(2)	-	0.00(2)	0.00(2)	0.00(3)	0.00(2)	-	0.00(2)		0.00(3)	0.00(3)	0.00(4)	0.00(5)	0.00(6)	0.00(8)
349	"	-	-	-	-	0.00(2)	-	-	0.00(2)	-	-	0.00(2)		5.25(4)	0.00(4)	0.00(4)	0.00(5)	0.00(5)	0.00(6)
*350	57-91	30.00(2)	71.74(2)	-	0.00(2)	0.00(2)	3.86(2)	-	-	3.09(2)	14.91(2)	-		29.75(4)	0.00(3)	0.00(4)	8.25(4)	0.00(5)	0.80(5)
*363	"	-	-	-	185.66(2)	9.51(2)	294.37(2)	-	59.66(2)	83.83(2)	214.20(2)	33.69(2)		129.00(3)	3.00(3)	5.25(4)	2.83(6)	2.25(4)	0.25(4)
364	93-183	-	0.51(3)	0.00(3)	0.00(3)	0.00(4)	0.00(4)	0.00(2)	0.00(2)	0.00(2)	0.00(2)	0.00(2)		0.00(4)	0.00(4)	0.00(5)	0.00(6)	0.00(7)	0.14(7)
365	"	0.00(2)	0.00(2)	0.00(2)	0.00(3)	-	-	0.00(2)	-	-	-	-	E	0.00(3)	0.00(3)	0.00(3)	0.00(4)	0.00(4)	0.00(3)
366	185-274	0.00(3)	0.00(5)	0.00(5)	0.00(3)	0.00(4)	0.00(5)	0.00(2)	0.00(3)	0.00(4)	0.00(4)	0.00(5)	O	0.00(4)	0.00(3)	0.00(4)	0.00(4)	0.00(4)	0.00(5)
368	275-366	-	0.00(2)	0.00(3)	0.00(3)	-	0.00(3)	0.00(2)	0.00(3)	0.00(3)	0.00(3)	-		0.00(4)	0.00(3)	0.00(3)	0.00(3)	0.00(4)	0.00(4)
369	185-274	0.00(3)	0.00(3)	-	0.00(3)	0.00(3)	0.00(3)	0.00(4)	0.00(4)	0.00(2)	0.00(2)	0.00(5)	D	0.00(4)	0.00(3)	0.00(4)	0.00(3)	0.00(3)	0.00(3)
370	93-183	0.00(3)	0.00(3)	0.00(2)	0.00(3)	0.00(3)	0.62(5)	0.00(5)	0.13(4)	0.00(4)	0.00(4)	0.00(2)	A	0.00(3)	0.00(3)	0.00(4)	0.00(5)	0.00(3)	0.00(5)
*371	57-91	-	4.37(2)	0.00(2)	4.63(2)	0.00(2)	-	-	-	-	-	-	T	37.33(3)	1.00(3)	0.00(4)	0.50(4)	0.00(4)	0.00(3)
*372	"	55.85(5)	77.45(5)	0.00(4)	34.71(4)	34.71(4)	50.14(4)	108.00(2)	44.49(4)	64.46(3)	55.03(4)	147.21(4)	A	118.67(3)	36.25(4)	39.40(5)	38.20(5)	31.50(4)	5.60(5)
*384	"	110.40(3)	18.34(3)	0.00(3)	0.00(3)	0.00(2)	16.20(2)	7.71(2)	13.37(2)	66.86(3)	15.94(2)	32.66(2)		0.00(3)	28.33(3)	0.00(4)	0.25(4)	0.00(3)	0.75(4)
385	93-183	0.00(3)	0.00(2)	0.00(2)	0.00(2)	0.00(2)	0.00(2)	0.00(3)	0.00(2)	0.00(2)	-	0.00(2)	A	0.00(4)	0.00(3)	0.00(5)	0.00(5)	0.00(5)	0.00(5)
386	185-274	0.00(2)	0.00(4)	0.00(4)	0.00(4)	0.00(4)	0.00(4)	0.00(2)	0.00(3)	0.00(3)	0.00(2)	-	V	0.00(4)	0.00(3)	0.00(4)	0.00(4)	0.00(4)	0.00(4)
387	275-366	0.00(2)	0.00(2)	0.00(2)	0.00(2)	0.00(3)	-	-	-	-	0.00(3)	-	A	0.00(4)	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(5)
388	"	-	0.00(3)	0.00(2)	0.00(3)	0.00(2)	-	0.00(2)	-	-	0.00(2)	-	I	0.00(3)	0.00(4)	0.00(3)	0.00(3)	0.00(3)	0.00(4)
389	185-274	0.00(3)	0.00(2)	0.00(3)	0.00(2)	0.00(3)	0.00(4)	0.00(4)	0.00(5)	0.00(3)	0.00(4)	0.00(4)	L	0.00(3)	0.00(3)	0.00(4)	0.00(4)	0.00(4)	0.00(4)
390	93-183	0.00(2)	1.93(4)	0.00(3)	0.00(4)	0.00(4)	0.00(3)	0.00(3)	0.00(3)	0.00(3)	-	-	A	0.00(3)	0.00(4)	0.00(4)	0.00(5)	0.00(4)	0.00(5)
391	185-274	0.00(4)	0.00(3)	0.00(3)	0.00(3)	0.00(3)	-	-	-	-	0.00(3)	0.00(5)	B	0.00(3)	0.00(4)	0.00(3)	0.00(3)	0.00(3)	0.00(3)
392	275-366	-	-	-	-	-	0.00(2)	0.00(2)	0.00(2)	-	-	0.00(2)	L	0.00(3)	0.00(4)	0.00(4)	0.00(3)	0.00(3)	0.00(3)
729	367-549	-	-	-	-	-	-	-	-	-	-	0.00(2)	E	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(3)
730	550-731	-	-	-	-	-	0.00(2)	-	0.00(2)	-	-	-		0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(3)
731	367-549	-	-	-	-	-	-	-	-	-	-	-		0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(3)
732	550-731	-	-	-	-	-	0.00(2)	-	-	-	-	-		0.00(2)	0.00(2)	0.00(3)	0.00(3)	0.00(3)	0.00(3)
733	367-549	-	-	-	-	-	0.00(2)	0.00(2)	-	0.00(2)	-	0.00(5)		0.00(2)	0.00(3)	0.00(3)	0.00(4)	0.00(3)	0.00(4)
734	550-731	-	-	-	-	-	0.00(2)	0.00(2)	0.00(3)	0.00(2)	-	-		0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(3)
735	367-549	-	-	-	-	-	-	0.00(2)	-	0.00(2)	-	0.00(2)		0.00(3)	0.00(3)	0.00(3)	0.00(4)	0.00(4)	0.00(4)
736	550-731	-	-	-	-	-	0.00(2)	-	-	-	-	-		0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(3)
Abundance (000s) (area surveyed)		23239	26510	0	30261	7355	48460	19715	16585	27961	40635	32966		45717	9154	7638	8405	5857	1230
Abundance (000s) (MM analysis)		35148	41332	0	30261	7353	48572	19847	16700	27963	40634	33042		44919	9154	7638	8404	5857	1202

Table 2. Mean number per 30 minute set of yellowtail flounder from USSR spring-summer surveys in Division 3N with number of successful sets in brackets (*strata included in MM analysis).

Stratum	Depth (m)	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
357	275-366	0.00(2)	0.00(5)	0.00(3)	0.00(4)	0.00(4)	-	0.00(2)	0.00(3)	0.26(2)	0.00(2)	0.00(2)		0.00(4)	0.00(4)	0.00(4)	0.00(4)	0.00(3)	0.00(6)
358	185-274	0.00(4)	0.00(2)	0.00(3)	0.00(4)	0.00(2)	0.00(5)	0.00(2)	-	-	0.00(3)	0.00(4)		0.00(5)	0.00(4)	0.00(5)	0.00(5)	0.00(3)	0.00(9)
359	93-183	0.00(4)	0.00(5)	0.00(6)	0.00(4)	0.00(5)	0.00(4)	0.00(6)	0.00(5)	0.00(3)	0.00(3)	0.00(4)		0.00(5)	0.00(4)	0.00(4)	0.00(4)	0.00(4)	0.00(5)
*360	57-91	189.84(8)	42.23(9)	120.94(6)	79.64(7)	107.34(7)	112.63(2)	-	117.26(6)	29.31(3)	161.23(4)	162.26(4)		28.60(5)	71.00(7)	0.00(5)	39.60(5)	0.00(5)	85.09(11)
*361	"	126.26(2)	1102.97(3)	151.71(2)	402.34(6)	666.17(3)	255.09(2)	274.20(6)	140.14(2)	742.97(3)	118.03(2)	251.23(2)		179.00(4)	53.67(3)	177.50(4)	124.00(4)	116.00(4)	288.50(4)
*362	"	-	144.26(4)	609.81(4)	159.61(8)	333.13(4)	200.06(2)	84.86(2)	198.26(2)	665.74(2)	333.77(2)	103.63(2)		247.00(4)	148.25(4)	48.25(4)	71.40(5)	46.00(4)	67.50(4)
*373	"	120.51(3)	32.27(4)	12.73(4)	109.93(4)	91.03(4)	277.89(3)	84.00(3)	181.20(3)	193.20(3)	236.70(4)	62.06(3)	N	61.75(4)	63.00(4)	27.60(5)	17.80(5)	1.75(4)	3.00(5)
*374	"	129.86(2)	25.89(3)	13.63(2)	-	14.40(2)	-	44.49(2)	-	-	-	-	O	28.33(3)	175.33(3)	47.50(4)	5.25(4)	0.00(3)	0.00(4)
*375	<56	291.26(3)	91.95(5)	219.09(4)	389.02(7)	103.68(5)	54.39(4)	-	84.17(3)	117.26(3)	134.23(3)	259.97(4)		141.00(5)	44.33(3)	93.50(4)	57.25(4)	40.67(3)	111.75(4)
*376	"	-	316.63(9)	210.09(6)	95.76(5)	667.03(2)	95.14(2)	-	320.74(3)	77.91(2)	81.77(2)	252.21(5)	D	226.60(5)	487.50(4)	15.50(4)	0.50(4)	1.75(4)	223.75(4)
377	93-183	0.00(3)	-	-	-	-	0.00(5)	-	-	0.00(4)	0.00(3)	0.51(3)	A	2.33(3)	17.00(4)	0.00(3)	0.00(3)	0.00(3)	0.00(4)
378	185-276	0.00(2)	-	0.00(2)	-	0.00(2)	-	2.06(3)	0.00(3)	0.00(2)	-	0.00(3)	T	0.00(3)	0.00(4)	0.00(3)	0.00(3)	0.00(3)	0.00(4)
379	275-366	0.00(2)	-	-	0.00(2)	-	0.00(2)	0.00(4)	0.00(2)	-	0.00(2)	-	A	0.00(4)	0.00(4)	0.00(3)	0.00(3)	0.00(3)	0.00(4)
380	"	-	-	0.00(3)	0.00(2)	0.00(3)	0.00(2)	0.77(2)	0.00(3)	0.00(2)	0.00(2)	0.00(3)		0.00(4)	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(5)
381	185-274	0.00(7)	0.00(6)	0.00(5)	0.00(6)	0.00(6)	0.00(3)	0.00(3)	0.00(2)	0.39(4)	-	0.00(4)	A	0.00(3)	0.00(5)	0.00(3)	0.00(2)	0.00(3)	0.00(4)
382	93-183	9.92(7)	0.00(6)	0.00(5)	0.00(5)	0.00(4)	1.37(3)	0.51(3)	0.00(3)	0.00(3)	0.00(4)	86.79(4)	V	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(4)	0.00(7)
*383	57-91	-	-	-	-	-	-	-	-	-	-	-	A	1.00(3)	3.33(3)	0.00(3)	0.00(4)	0.00(4)	0.00(3)
723	367-549	-	-	-	-	-	0.00(2)	-	-	0.00(2)	-	-	I	0.00(3)	0.00(5)	0.00(3)	0.00(4)	0.00(3)	0.00(5)
724	550-731	-	-	-	-	-	-	-	-	-	-	-	L	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(4)
725	367-549	-	-	-	-	-	-	-	-	-	-	-	A	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(4)
726	550-731	-	-	-	-	-	-	-	-	-	-	-	N	0.00(3)	0.00(2)	0.00(3)	0.00(3)	0.00(3)	0.00(3)
727	367-549	-	-	-	-	-	0.00(3)	0.00(2)	-	-	0.00(3)	-	L	0.00(4)	0.00(3)	0.00(3)	0.00(3)	0.00(4)	0.00(6)
728	550-731	-	-	-	-	-	-	-	-	-	-	-	E	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(5)
Abundance (000s) (area surveyed)		121958	234312	207590	174416	273314	161292	70126	156794	282641	177885	159330		128423	130285	52929	48144	28941	106386
Abundance (000s) (MM analysis)		174534	234312	207589	176652	273315	163301	98158	160753	284875	180575	157296		128406	135943	52929	48144	28941	106386

Table 3. Mean number per 30 minute set of yellowtail flounder from USSR spring-summer surveys in Division 3O with number of successful sets in brackets (*strata included in MM analysis).

Stratum	Depth (m)	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
329	93-183	0.00(3)	5.04(5)	0.00(3)	0.00(2)	0.00(3)	0.00(3)	1.20(3)	0.00(3)	0.13(4)	0.17(3)	0.00(2)		0.00(3)	0.00(3)	0.00(4)	0.00(4)	0.00(4)	0.00(4)
*330	57-91	0.86(3)	30.34(6)	4.24(4)	29.83(4)	0.00(6)	20.57(3)	0.69(3)	1.37(3)	1.03(2)	0.51(2)	3.09(3)		25.00(4)	0.00(3)	2.80(5)	1.00(5)	4.20(5)	0.00(5)
*331	"	-	47.06(2)	-	-	-	-	-	-	-	4.37(2)	-		238.00(3)	5.67(3)	9.67(3)	8.33(3)	16.67(3)	6.33(3)
332	93-183	7.14(8)	2.88(10)	7.39(8)	10.34(9)	8.34(9)	5.40(6)	2.23(6)	4.83(5)	0.72(5)	0.00(4)	0.07(7)		1.75(4)	0.20(5)	0.00(4)	1.50(4)	1.00(4)	0.00(4)
333	185-274	0.26(4)	0.00(2)	0.00(4)	0.00(4)	0.00(4)	0.00(4)	0.00(3)	0.00(2)	0.00(4)	0.00(2)	0.00(3)		0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(5)
334	275-366	0.00(2)	0.00(3)	-	-	-	-	-	0.00(2)	-	0.00(2)	-		0.00(3)	0.00(4)	0.00(3)	0.00(3)	0.00(3)	0.00(4)
335	"	-	-	-	-	-	-	-	-	-	0.00(2)	-		0.00(4)	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(3)
336	185-274	0.00(2)	0.00(3)	0.00(2)	0.00(2)	0.00(2)	0.00(2)	0.00(3)	0.00(2)	0.00(2)	0.00(2)	0.00(2)	W	0.00(4)	0.00(3)	0.00(3)	0.00(3)	0.00(4)	0.00(6)
337	93-183	0.00(3)	1.29(4)	0.00(4)	1.80(6)	0.00(4)	0.00(3)	14.74(3)	2.31(4)	0.00(4)	0.17(3)	0.00(4)	O	3.25(4)	0.00(3)	0.00(3)	0.00(3)	0.00(4)	0.00(4)
*338	57-91	80.10(4)	58.29(3)	57.60(3)	124.46(3)	16.63(3)	378.90(4)	52.33(4)	42.17(2)	4.29(3)	48.86(4)	7.03(3)		35.50(4)	28.67(3)	1.00(3)	9.33(3)	0.00(5)	34.60(5)
339	93-183	-	0.00(2)	-	59.66(3)	0.00(2)	-	-	-	-	-	-	D	3.00(3)	6.33(3)	0.00(3)	0.00(3)	12.33(3)	1.33(3)
*340	57-91	-	145.80(4)	-	-	124.20(2)	-	-	-	-	-	-	A	9.00(3)	21.67(3)	46.25(4)	1.25(4)	35.67(3)	12.57(7)
*351	"	185.66(2)	158.40(3)	178.71(2)	175.29(6)	-	221.49(3)	200.57(2)	24.69(2)	20.83(2)	129.34(2)	60.94(2)	T	101.80(5)	127.20(5)	92.75(4)	41.00(5)	26.80(5)	34.00(5)
*352	"	87.33(5)	415.97(6)	184.85(7)	235.89(6)	119.06(8)	438.48(5)	293.14(6)	91.23(5)	207.90(8)	234.21(5)	130.63(5)	A	442.80(5)	91.25(4)	44.25(4)	27.00(4)	19.33(6)	23.00(6)
*353	"	56.06(2)	67.89(2)	307.03(2)	-	-	167.14(2)	-	2.57(2)	-	-	93.60(2)		44.40(5)	23.00(4)	21.67(3)	4.67(3)	5.20(5)	12.00(4)
354	93-183	0.00(5)	0.00(4)	0.00(5)	0.00(5)	0.00(5)	0.00(4)	0.51(3)	0.00(4)	0.00(2)	1.89(3)	0.00(4)	A	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(4)
355	185-274	0.00(2)	0.00(3)	0.00(2)	-	-	0.00(2)	0.00(2)	0.00(2)	0.00(3)	-	-	V	0.00(3)	0.00(4)	0.00(3)	0.00(3)	0.00(4)	0.00(4)
356	275-366	-	-	-	0.00(2)	-	-	-	-	0.00(2)	-	-	A	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(4)
717	367-549	-	-	-	-	-	-	-	-	-	0.00(2)	0.00(2)	I	0.00(3)	0.00(3)	0.00(3)	0.00(4)	0.00(3)	0.00(3)
718	550-731	-	-	-	-	-	-	-	-	-	-	-	L	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(3)
719	367-549	-	-	-	-	-	0.00(3)	-	-	-	-	-	A	0.00(4)	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(3)
720	550-731	-	-	-	-	-	-	-	-	-	-	-	B	0.00(3)	0.00(3)	0.00(3)	0.00(2)	0.00(3)	0.00(3)
721	367-549	-	-	-	-	-	-	-	-	-	-	-	L	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(4)
722	550-731	-	-	-	-	-	-	-	-	-	-	-	E	0.00(3)	0.00(2)	0.00(3)	0.00(3)	0.00(3)	0.00(3)
Abundance (000s) (area surveyed)		66577	145032	103982	100350	40290	191999	99261	28105	43131	73835	45311		122619	49126	33577	14825	15087	18062
Abundance (000s) (MM analysis)		72860	144105	114209	115157	53256	219030	115735	30229	48872	133345	52921		122140	48846	33577	14712	14493	18006

Table 4. Mean weight (kg) per 30 minute set of yellowtail flounder from USSR spring-summer surveys in Division 3L with number of successful sets in brackets (*strata included in MM analysis).

Stratum	Depth (m)	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
328	93-183	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-
341	"	-	-	-	-	-	-	-	-	-	-	-		0.00(3)	-	0.00(4)	0.00(3)	0.00(4)	0.00(3)
342	"	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-
343	"	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-
344	185-274	0.00(2)	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-
345	275-366	0.00(2)	-	-	-	0.00(2)	-	-	-	-	-	-		0.00(2)	0.00(3)	0.00(4)	0.00(3)	0.00(4)	0.00(4)
346	"	-	-	-	0.00(2)	-	-	0.00(2)	0.00(2)	-	-	-		0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(4)	0.00(3)
347	185-274	0.00(2)	0.00(3)	0.00(3)	0.00(4)	0.00(3)	0.00(4)	0.00(3)	0.00(2)	0.00(3)	0.00(2)	0.00(2)		0.00(3)	0.00(3)	0.00(3)	0.00(4)	0.00(4)	0.00(6)
348	93-183	0.00(2)	0.00(3)	0.00(3)	0.00(2)	-	0.00(2)	0.00(2)	0.00(3)	0.00(2)	-	0.00(2)		0.00(3)	0.00(3)	0.00(4)	0.00(5)	0.00(6)	0.00(8)
349	"	-	-	-	-	0.00(2)	-	-	0.00(2)	-	-	0.00(2)		2.38(4)	0.00(4)	0.00(4)	0.00(5)	0.00(5)	0.00(6)
*350	57-91	13.65(2)	30.57(2)	-	0.00(2)	0.00(2)	1.65(2)	-	-	1.54(2)	7.28(2)	-		13.75(4)	0.00(3)	0.00(4)	3.75(4)	0.00(5)	0.36(5)
*363	"	-	-	-	75.63(2)	2.60(2)	133.12(2)	-	28.62(2)	37.90(2)	112.47(2)	16.43(2)		59.37(3)	1.70(3)	2.75(4)	1.67(6)	1.13(4)	0.10(4)
364	93-183	-	0.26(3)	0.00(3)	0.00(3)	0.00(4)	0.00(4)	0.00(2)	0.00(2)	0.00(2)	0.00(2)	0.00(2)		0.00(4)	0.00(4)	0.00(5)	0.00(6)	0.00(7)	0.07(7)
365	"	0.00(2)	0.00(2)	0.00(2)	0.00(3)	-	-	0.00(2)	-	-	-	-	M	0.00(3)	0.00(3)	0.00(3)	0.00(4)	0.00(4)	0.00(3)
366	185-274	0.00(3)	0.00(5)	0.00(5)	0.00(3)	0.00(4)	0.00(5)	0.00(2)	0.00(3)	0.00(4)	0.00(4)	0.00(5)	O	0.00(4)	0.00(3)	0.00(4)	0.00(4)	0.00(4)	0.00(5)
368	275-366	-	0.00(2)	0.00(3)	0.00(3)	-	0.00(3)	0.00(2)	0.00(3)	0.00(3)	0.00(3)	-		0.00(4)	0.00(3)	0.00(3)	0.00(3)	0.00(4)	0.00(4)
369	185-274	0.00(3)	0.00(3)	-	0.00(3)	0.00(3)	0.00(3)	0.00(4)	0.00(4)	0.00(2)	0.00(2)	0.00(5)	D	0.00(4)	0.00(3)	0.00(4)	0.00(3)	0.00(3)	0.00(3)
370	93-183	0.00(3)	0.00(3)	0.00(2)	0.00(3)	0.00(3)	0.28(5)	0.00(5)	0.05(4)	0.00(4)	0.00(4)	0.00(2)	A	0.00(3)	0.00(3)	0.00(4)	0.00(5)	0.00(3)	0.00(5)
*371	57-91	-	2.08(2)	0.00(2)	2.24(2)	0.00(2)	-	-	-	-	-	-	T	18.83(3)	0.53(3)	0.00(4)	0.28(4)	0.00(4)	0.00(3)
*372	"	25.35(5)	32.59(5)	0.00(4)	15.57(4)	15.54(4)	20.57(4)	42.61(2)	21.20(4)	32.23(3)	26.50(4)	73.48(4)	A	57.17(3)	16.98(4)	17.42(5)	16.20(5)	14.10(4)	2.54(5)
*384	"	50.13(3)	8.01(3)	0.00(3)	0.00(3)	0.00(2)	7.55(2)	3.83(2)	7.84(2)	35.54(3)	8.28(2)	17.33(2)		0.00(3)	14.50(3)	0.00(4)	0.15(4)	0.00(3)	0.45(4)
385	93-183	0.00(3)	0.00(2)	0.00(2)	0.00(2)	0.00(2)	0.00(2)	0.00(3)	0.00(2)	0.00(2)	-	0.00(2)	A	0.00(4)	0.00(3)	0.00(5)	0.00(5)	0.00(5)	0.00(5)
386	185-274	0.00(2)	0.00(4)	0.00(4)	0.00(4)	0.00(4)	0.00(4)	0.00(2)	0.00(3)	0.00(3)	0.00(2)	-	V	0.00(4)	0.00(3)	0.00(4)	0.00(4)	0.00(4)	0.00(4)
387	275-366	0.00(2)	0.00(2)	0.00(2)	0.00(2)	0.00(3)	-	-	-	-	0.00(3)	-	A	0.00(4)	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(5)
388	"	-	0.00(3)	0.00(2)	0.00(3)	0.00(2)	-	0.00(2)	-	-	0.00(2)	-	I	0.00(3)	0.00(4)	0.00(3)	0.00(3)	0.00(3)	0.00(4)
389	185-274	0.00(3)	0.00(2)	0.00(3)	0.00(2)	0.00(3)	0.00(4)	0.00(4)	0.00(5)	0.00(3)	0.00(4)	0.00(4)	L	0.00(3)	0.00(3)	0.00(4)	0.00(4)	0.00(4)	0.00(4)
390	93-183	0.00(2)	0.68(4)	0.00(3)	0.00(4)	0.00(4)	0.00(3)	0.00(3)	0.00(3)	0.00(3)	-	-	A	0.00(3)	0.00(4)	0.00(4)	0.00(5)	0.00(4)	0.00(5)
391	185-274	0.00(4)	0.00(3)	0.00(3)	0.00(3)	0.00(3)	-	-	-	-	0.00(3)	0.00(5)	B	0.00(3)	0.00(4)	0.00(3)	0.00(3)	0.00(3)	0.00(3)
392	275-366	-	-	-	-	-	0.00(2)	0.00(2)	0.00(2)	-	-	0.00(2)	L	0.00(3)	0.00(4)	0.00(4)	0.00(3)	0.00(3)	0.00(3)
729	367-549	-	-	-	-	-	-	-	-	-	-	0.00(2)	E	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(3)
730	550-731	-	-	-	-	-	0.00(2)	-	0.00(2)	-	-	-		0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(3)
731	367-549	-	-	-	-	-	-	-	-	-	-	-		0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(3)
732	550-731	-	-	-	-	-	0.00(2)	-	-	-	-	-		0.00(2)	0.00(2)	0.00(3)	0.00(3)	0.00(3)	0.00(3)
733	367-549	-	-	-	-	-	0.00(2)	0.00(2)	-	0.00(2)	-	0.00(5)		0.00(2)	0.00(3)	0.00(3)	0.00(4)	0.00(3)	0.00(4)
734	550-731	-	-	-	-	-	0.00(2)	0.00(2)	0.00(3)	0.00(2)	-	-		0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(3)
735	367-549	-	-	-	-	-	-	0.00(2)	-	0.00(2)	-	0.00(2)		0.00(3)	0.00(3)	0.00(3)	0.00(4)	0.00(4)	0.00(4)
736	550-731	-	-	-	-	-	0.00(2)	-	-	-	-	-		0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(3)
Biomass (t) (area surveyed)		10550	11249	0	12608	3080	21545	7842	8046	13637	20823	16488		21627	4429	3432	3670	2637	566
Biomass (t) (MM analysis)		15956	18125	0	12608	3080	21628	7934	8117	13637	20823	16534		21266	4429	3432	3671	2637	552

Table 5. Mean weight (kg) per 30 minute set of yellowtail flounder from USSR spring-summer surveys in Division 3N with number of successful sets in brackets (*strata included in MM analysis).

Stratum	Depth (m)	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
357	275-366	0.00(2)	0.00(5)	0.00(3)	0.00(4)	0.00(4)	-	0.00(2)	0.00(3)	0.15(2)	0.00(2)	0.00(2)		0.00(4)	0.00(4)	0.00(4)	0.00(4)	0.00(3)	0.00(6)
358	185-274	0.00(4)	0.00(2)	0.00(3)	0.00(4)	0.00(2)	0.00(5)	0.00(2)	-	-	0.00(3)	0.00(4)		0.00(5)	0.00(4)	0.00(5)	0.00(5)	0.00(3)	0.00(9)
359	93-183	0.00(4)	0.00(5)	0.00(6)	0.00(4)	0.00(5)	0.00(4)	0.00(6)	0.00(5)	0.00(3)	0.00(3)	0.00(4)		0.00(5)	0.00(4)	0.00(4)	0.00(4)	0.00(4)	0.00(5)
*360	57-91	69.86(8)	18.19(9)	51.93(6)	42.19(7)	51.87(7)	56.90(2)	-	56.51(6)	15.29(3)	51.48(4)	89.28(4)		13.76(5)	27.20(7)	0.00(5)	6.66(5)	0.00(5)	7.70(11)
*361	"	46.47(2)	646.51(3)	66.91(2)	157.32(6)	301.51(3)	105.27(2)	117.95(6)	75.52(2)	329.59(3)	60.81(2)	141.04(2)		82.28(4)	29.93(3)	76.83(4)	58.25(4)	54.58(4)	135.35(4)
*362	"	-	63.28(4)	217.31(4)	65.35(8)	106.95(4)	75.52(2)	37.75(2)	88.92(2)	274.04(2)	139.89(2)	51.02(2)		107.18(4)	66.65(4)	20.58(4)	28.20(5)	17.98(4)	32.98(4)
*373	"	44.35(3)	12.70(4)	7.35(4)	8.10(4)	43.16(4)	102.25(3)	34.47(3)	102.75(3)	92.67(3)	106.71(4)	31.25(3)	N	28.98(4)	25.25(4)	12.32(5)	7.80(5)	1.08(4)	1.76(5)
*374	"	47.78(2)	13.25(3)	5.84(2)	-	6.35(2)	-	17.92(2)	-	-	-	-	O	15.80(3)	98.13(3)	23.10(4)	2.50(4)	0.00(3)	0.00(4)
*375	<56	107.18(3)	41.81(5)	72.84(4)	152.15(7)	39.90(5)	24.48(4)	-	37.05(3)	62.40(3)	55.44(3)	152.52(4)		74.10(5)	26.80(3)	46.78(4)	29.53(4)	23.77(3)	47.33(4)
*376	"	-	113.96(9)	56.19(6)	41.02(5)	189.03(2)	32.46(2)	-	114.29(3)	26.38(2)	9.54(2)	94.87(5)	D	89.46(5)	172.35(4)	7.85(4)	0.13(4)	0.30(4)	25.33(4)
377	93-183	0.00(3)	-	-	-	-	0.00(5)	-	-	0.00(4)	0.00(3)	0.15(3)	A	0.80(3)	5.70(4)	0.00(3)	0.00(3)	0.00(3)	0.00(4)
378	185-276	0.00(2)	-	0.00(2)	-	0.00(2)	-	0.98(3)	0.00(3)	0.00(2)	-	0.00(3)	T	0.00(3)	0.00(4)	0.00(3)	0.00(3)	0.00(3)	0.00(4)
379	275-366	0.00(2)	-	-	0.00(2)	-	0.00(2)	0.00(4)	0.00(2)	-	0.00(2)	-	A	0.00(4)	0.00(4)	0.00(3)	0.00(3)	0.00(3)	0.00(4)
380	"	-	-	0.00(3)	0.00(2)	0.00(3)	0.00(2)	0.28(2)	0.00(3)	0.00(2)	0.00(2)	0.00(3)		0.00(4)	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(5)
381	185-274	0.00(7)	0.00(6)	0.00(5)	0.00(6)	0.00(6)	0.00(3)	0.00(3)	0.00(2)	0.21(4)	-	0.00(4)	A	0.00(3)	0.00(5)	0.00(3)	0.00(2)	0.00(3)	0.00(4)
382	93-183	3.65(7)	0.00(6)	0.00(5)	0.00(5)	0.00(4)	0.94(3)	0.15(3)	0.00(3)	0.00(3)	0.00(4)	39.90(4)	V	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(4)	0.00(7)
*383	57-91	-	-	-	-	-	-	-	-	-	-	-	A	0.33(3)	2.23(3)	0.00(3)	0.00(4)	0.00(4)	0.00(3)
723	367-549	-	-	-	-	-	0.00(2)	-	-	0.00(2)	-	-	I	0.00(3)	0.00(5)	0.00(3)	0.00(4)	0.00(3)	0.00(5)
724	550-731	-	-	-	-	-	-	-	-	-	-	-	L	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(4)
725	367-549	-	-	-	-	-	-	-	-	-	-	-	A	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(4)
726	550-731	-	-	-	-	-	-	-	-	-	-	-	B	0.00(3)	0.00(2)	0.00(3)	0.00(3)	0.00(3)	0.00(3)
727	367-549	-	-	-	-	-	0.00(3)	0.00(2)	-	-	0.00(3)	-	L	0.00(4)	0.00(3)	0.00(3)	0.00(3)	0.00(4)	0.00(6)
728	550-731	-	-	-	-	-	-	-	-	-	-	-	E	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(5)
Biomass (t) (area surveyed)		44880	121723	75549	65163	103851	64794	30007	73479	123588	71206	82420		57775	54831	23935	19271	13472	34118
Biomass (t) (MM analysis)		64234	121722	75550	66390	103852	65820	43077	75480	124881	71683	81863		57771	57307	23936	19272	13474	34120

Table 6. Mean weight (kg) per 30 minute set of yellowtail flounder from USSR spring-summer surveys in Division 3O with number of successful sets in brackets (*strata included in MM analysis).

Stratum	Depth (m)	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
329	93-183	0.00(3)	2.36(5)	0.00(3)	0.00(2)	0.00(3)	0.00(3)	0.60(3)	0.00(3)	0.08(4)	0.10(3)	0.00(2)		0.00(3)	0.00(3)	0.00(4)	0.00(4)	0.00(4)	0.00(4)
*330	57-91	0.48(3)	14.72(6)	1.65(4)	15.31(4)	0.00(6)	8.83(3)	0.36(3)	0.72(3)	0.64(2)	0.18(2)	1.73(3)		14.82(4)	0.00(3)	1.46(5)	0.40(5)	2.02(5)	0.00(5)
*331	"	-	17.07(2)	-	-	-	-	-	-	-	2.24(2)	-		116.47(3)	2.60(3)	4.70(3)	4.33(3)	8.93(3)	3.77(3)
332	93-183	3.39(8)	1.45(10)	4.15(8)	3.49(9)	3.55(9)	2.49(6)	1.06(6)	2.30(5)	0.45(5)	0.00(4)	0.04(7)		0.82(4)	0.22(5)	0.00(4)	0.75(4)	0.43(4)	0.00(4)
333	185-274	0.09(4)	0.00(2)	0.00(4)	0.00(4)	0.00(4)	0.00(4)	0.00(3)	0.00(2)	0.00(4)	0.00(2)	0.00(3)		0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(5)
334	275-366	0.00(2)	0.00(3)	-	-	-	-	-	0.00(2)	-	0.00(2)	-		0.00(3)	0.00(4)	0.00(3)	0.00(3)	0.00(3)	0.00(4)
335	"	-	-	-	-	-	-	-	-	-	0.00(2)	-		0.00(4)	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(3)
336	185-274	0.00(2)	0.00(3)	0.00(2)	0.00(2)	0.00(2)	0.00(2)	0.00(3)	0.00(2)	0.00(2)	0.00(2)	0.00(2)	M	0.00(4)	0.00(3)	0.00(3)	0.00(3)	0.00(4)	0.00(6)
337	93-183	0.00(3)	0.71(4)	0.00(4)	1.01(6)	0.00(4)	0.00(3)	7.85(3)	1.39(4)	0.00(4)	0.10(3)	0.00(4)	O	1.43(4)	0.00(3)	0.00(3)	0.00(3)	0.00(4)	0.00(4)
*338	57-91	39.36(4)	29.66(3)	28.87(3)	60.27(3)	7.44(3)	178.28(4)	24.11(4)	19.70(2)	2.61(3)	23.16(4)	3.69(3)		17.33(4)	14.60(3)	0.20(3)	4.67(3)	0.00(5)	15.66(5)
339	93-183	-	0.00(2)	-	26.64(3)	0.00(2)	-	-	-	-	-	-	D	1.83(3)	2.93(3)	0.00(3)	0.00(3)	5.40(3)	0.57(3)
*340	57-91	-	78.25(4)	-	-	53.13(2)	-	-	-	-	-	-	A	4.53(3)	10.20(3)	20.20(4)	0.50(4)	16.37(3)	6.11(7)
*351	"	71.46(2)	106.87(3)	75.39(2)	72.82(6)	-	99.12(3)	85.27(2)	11.70(2)	10.77(2)	60.58(2)	30.68(2)	T	45.76(5)	58.90(5)	37.05(4)	18.00(5)	11.08(5)	15.48(5)
*352	"	12.45(5)	203.17(6)	84.25(7)	91.06(6)	-	203.93(5)	132.06(6)	41.83(5)	110.24(8)	97.26(5)	64.49(5)	A	184.74(5)	44.68(4)	20.10(4)	11.25(4)	8.78(6)	10.75(6)
*353	"	33.56(2)	35.00(2)	163.54(2)	-	-	96.38(2)	-	1.34(2)	-	-	53.23(2)		22.24(5)	11.52(4)	11.13(3)	1.73(3)	2.58(5)	6.38(4)
354	93-183	0.00(5)	0.00(4)	0.00(5)	0.00(5)	0.00(5)	0.00(4)	0.31(3)	0.00(4)	0.00(2)	1.08(3)	0.00(4)	A	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(4)
355	185-274	0.00(2)	0.00(3)	0.00(2)	-	-	0.00(2)	0.00(2)	0.00(2)	0.00(3)	-	-	V	0.00(3)	0.00(4)	0.00(3)	0.00(3)	0.00(4)	0.00(4)
356	275-366	-	-	-	0.00(2)	-	-	-	-	0.00(2)	-	-	A	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(4)
717	367-549	-	-	-	-	-	-	-	-	-	0.00(2)	0.00(2)	I	0.00(3)	0.00(3)	0.00(3)	0.00(4)	0.00(3)	0.00(3)
718	550-731	-	-	-	-	-	-	-	-	-	-	-	L	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(3)
719	367-549	-	-	-	-	-	0.00(3)	-	-	-	-	-	A	0.00(4)	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(3)
720	550-731	-	-	-	-	-	-	-	-	-	-	-	B	0.00(3)	0.00(3)	0.00(3)	0.00(2)	0.00(3)	0.00(3)
721	367-549	-	-	-	-	-	-	-	-	-	-	-	L	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(4)
722	550-731	-	-	-	-	-	-	-	-	-	-	-	E	0.00(3)	0.00(2)	0.00(3)	0.00(3)	0.00(3)	0.00(3)
Biomass (t) (area surveyed)		24039	77165	48842	42047	17217	90477	43972	13062	22889	32323	23185		53793	23488	14355	6463	6747	8422
Biomass (t) (MM analysis)		26378	76719	53220	48955	23690	102412	60128	14065	25435	65070	26772		55558	23349	14354	6406	6487	8398

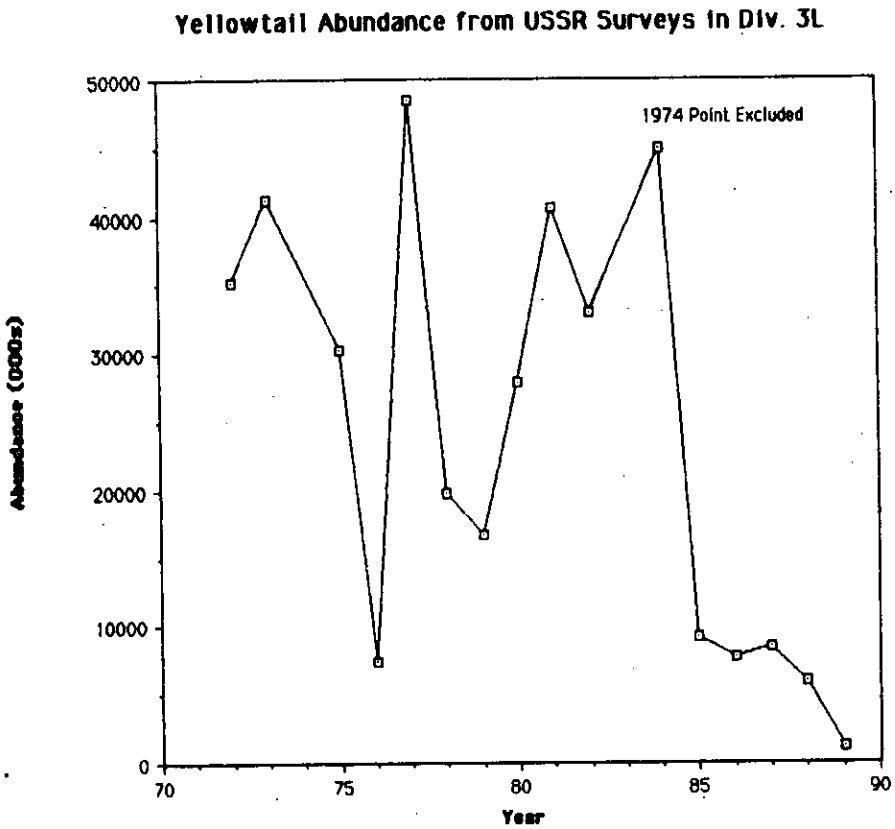

Fig. 1. Div. 3L abundance estimates of yellowtail flounder from USSR spring-summer surveys using a multiplicative model to estimate missing strata (no data were available for 1983).

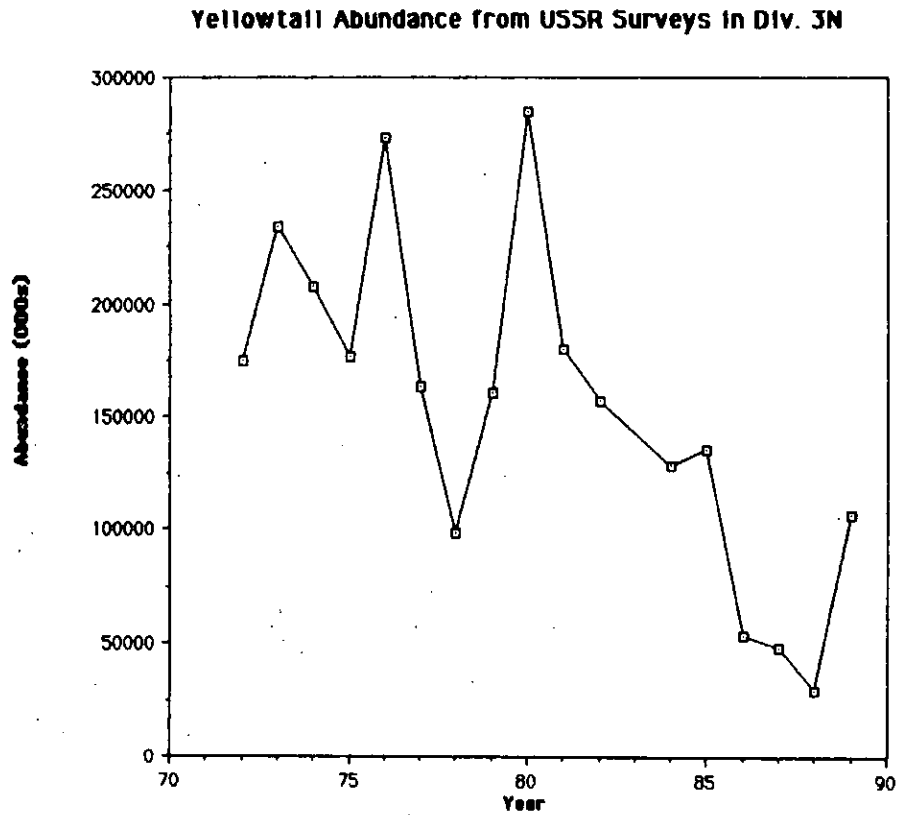

Fig. 2. Div. 3N abundance estimates of yellowtail flounder from USSR spring-summer surveys using a multiplicative model to estimate missing strata (no data were available for 1983).

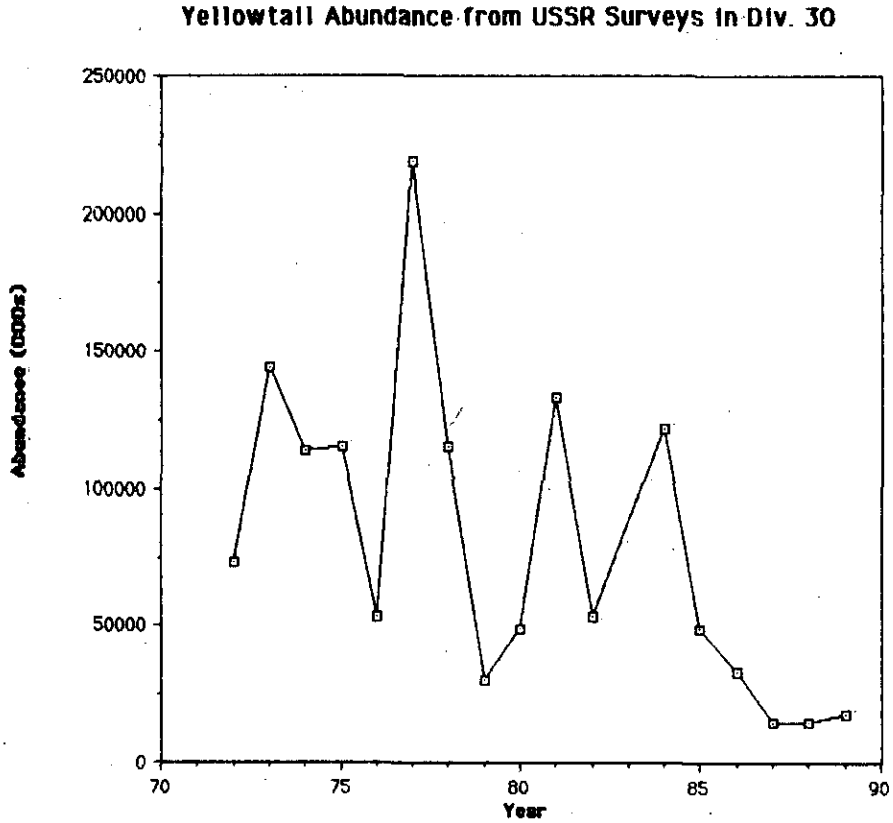

Fig. 3. Div. 3O abundance estimates of yellowtail flounder from USSR spring-summer surveys using a multiplicative model to estimate missing strata (no data were available for 1983).

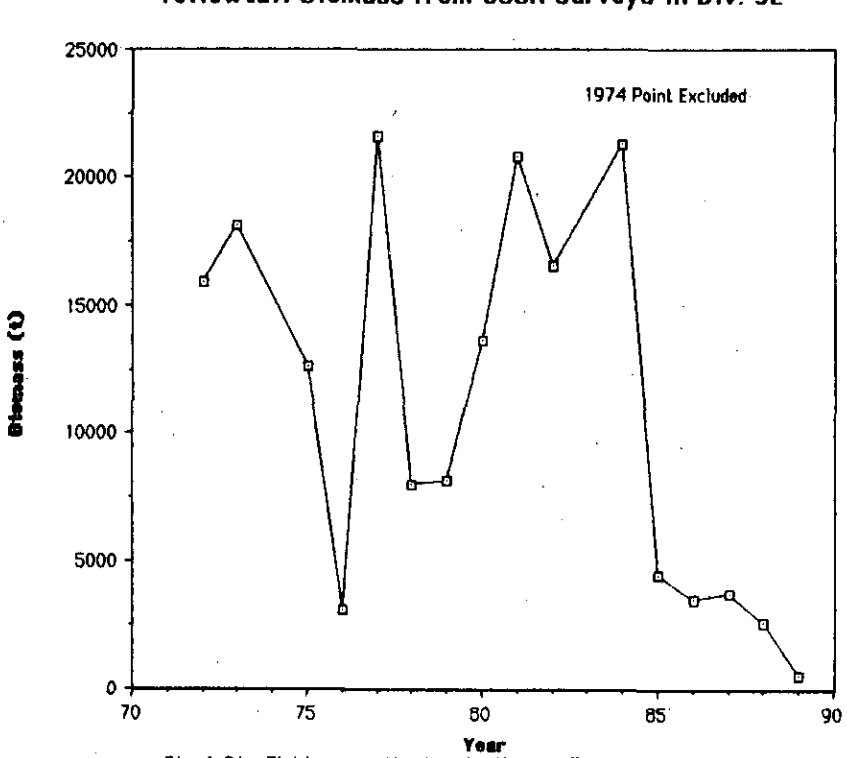

Fig. 4. Div. 3L biomass estimates of yellowtail flounder from USSR spring-summer surveys using a multiplicative model to estimate missing strata (no data were available for 1983).

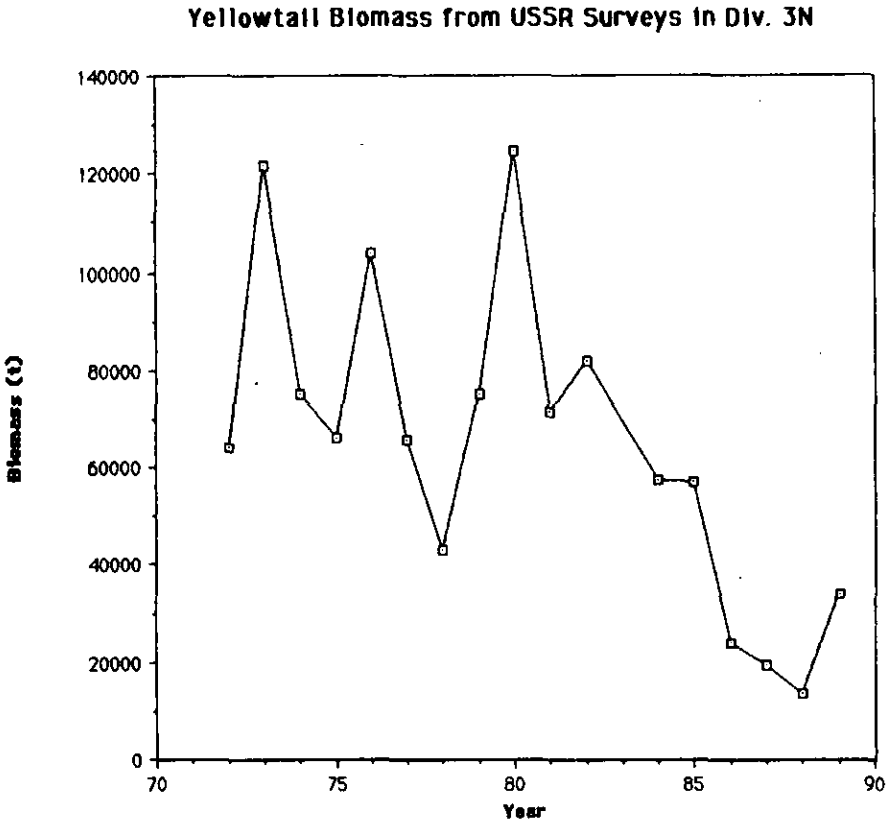

Fig. 5. Div. 3N biomass estimates of yellowtail flounder from USSR spring-summer surveys using a multiplicative model to estimate missing strata (no data were available for 1983).

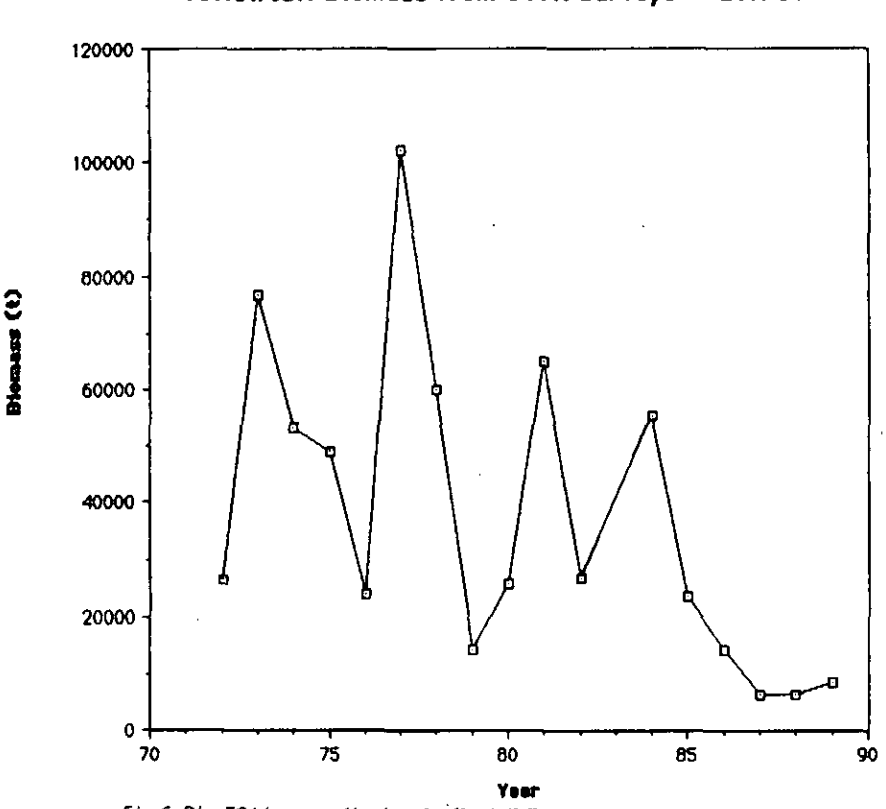

Fig. 6. Div. 3O biomass estimates of yellowtail flounder from USSR spring-summer surveys using a multiplicative model to estimate missing strata (no data were available for 1983).