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Estimates of Abundance and Biomass of Witch Flounder (*Glyptocephalus cynoglossus*) in Div. 3NO and Greenland Halibut (*Reinhardtius hippoglossoides*) in Div. 3KL from USSR Groundfish Surveys During 1987-89

by

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Introduction

Both witch flounder and Greenland halibut are major deep water groundfish resources in the Northwest Atlantic. The witch flounder stock in Div. 3NØ and the Greenland halibut stock in Subarea 2 and Div. 3KL are assessed under the auspices of the NAFO Scientific Council using mainly data from research vessel surveys. One of the more serious drawbacks in evaluating the status of these resources has been the lack of adequate survey coverage in deep water zones where these species are distributed in abundance. This has been of particular concern for Greenland halibut in Div. 3L and more significantly a concern for witch flounder in Div. 3NØ where survey data used from Canadian sources do not cover depths beyond 366 m (200 fath). The presented data here cover more of the deeper zones up to 1000 m in depth.

Materials and Methods

Groundfish surveys by the USSR have been conducted in Div. 3K, 3L, 3N, and 3Ø since 1972. However, for the purpose of this paper only data from 1987 to 1989 have been analyzed for Greenland halibut in Div. 3K and 3L and witch flounder in Div. 3N and 3Ø. The surveys during this period were conducted with stratification schemes and survey designs used in Canadian surveys for the same areas. The analyses were performed using the Canadian stratified analysis program (STRAP) in order to obtain mean numbers and weights (kg) per set, stratum and year to calculate estimates of abundance and biomass.

Abundance and biomass estimates are presented in Tables 1-4 for Greenland halibut in Div. 3K and 3L respectively and in Tables 5-8 for witch in Div. 3N and 3Ø respectively.

Results and Discussion

Greenland halibut

- Division 3K

Estimates of abundance (Table 1) and biomass (Table 2) increased from 1987 to 1988 then declined from 1988 to 1989 to levels still higher than those of 1987. Average biomass over the 3 year period was about 82,000 t. This compares to an average of about 75,000 t from Canadian fall surveys over the same period where coverage was about the same. A comparison of Canadian results and those here indicate similar patterns in distribution with strata of high and low abundance being similar despite the fact that the Canadian surveys are conducted in late fall and the USSR surveys are conducted in early spring.

- Division 3L

Estimates of abundance (Table 3) and biomass (Table 4) declined from 1987 to 1988, then increased again in 1989 to a biomass level of 6400 t with an average of 4500 t for the

3 years. These values are considerably lower than estimates from the Canadian surveys. A comparison of strata fished suggests a somewhat similar pattern although the Canadian surveys tended to catch higher numbers in strata where fish were more plentiful. These differences may imply some seasonal variation.

Witch flounder

- Division 3N

Estimates of abundance (Table 5) and biomass (Table 6) show stability over the 3 year period with an average estimated biomass of about 1200 t. The estimates are well below reported commercial catches despite the fact that survey coverage is conducted in depths up to 731 m. These estimates are not greatly different than those reported for Canadian surveys although Canadian surveys do not survey deeper zones. It is evident from the results that the deeper strata are quite significant since the larger catches throughout the survey occur there. However, because the area of the deep strata is so small the impact on the overall biomass estimates from catches in these strata is greatly reduced through the areal expansion calculations.

- Division 3Ø

The abundance (Table 7) and biomass (Table 8) estimates are highly variable. Biomass varied between 2900 t in 1989 and 6600 t in 1988. These estimates are not inconsistent with the type of variation and levels of estimation occurring in Canadian surveys although the deep strata are surveyed by the USSR. Except for stratum 721 it does not appear that catches in deep strata are particularly high and, therefore, would not be expected to vary greatly from Canadian results. It is also apparent that strata 332 and 353 (being large) would impact considerably on large fluctuations since they are important strata for witch flounder. Clearly, their proximity to the slope area would explain high fluctuations when fish tend to move somewhat from the slope area to higher parts of the Grand Bank.

Table 1. Mean number per set of Greenland halibut from USSR spring-summer surveys in Division 3K (number of successful sets in brackets).

Stratum	Depth range (m)	Stratum area (sq. n. mi.)	1987	1988	1989
618	101-200	1455	-	-	-
619	101-200	1588	-	-	-
620	201-300	2709	10.33(6)	66.00(6)	2.00(6)
621	201-300	2859	45.83(6)	33.14(7)	5.33(6)
622	401-500	632	236.33(3)	745.67(3)	559.67(3)
623	301-400	1027	116.50(4)	236.00(3)	186.33(3)
624	201-300	668	1.67(3)	18.33(3)	21.67(3)
625	301-400	850	20.50(4)	333.75(4)	16.00(6)
626	301-400	919	123.67(3)	333.75(4)	295.20(5)
627	401-500	1194	348.20(5)	756.20(5)	735.00(5)
628	301-400	1085	91.75(4)	105.00(4)	85.00(5)
629	301-400	495	177.33(3)	115.00(4)	98.50(4)
630	301-400	544	77.00(3)	195.67(3)	60.33(3)
631	401-500	1202	214.33(3)	515.00(3)	301.67(3)
632	201-300	447	1.00(3)	6.33(3)	6.00(3)
633	301-400	2179	7.86(7)	31.25(8)	19.00(4)
634	201-300	1618	2.00(6)	5.00(4)	5.25(4)
635	201-300	1274	7.50(4)	7.60(5)	8.60(5)
636	201-300	1455	5.60(5)	13.60(5)	7.00(5)
637	201-300	1132	3.67(3)	6.83(6)	6.17(6)
638	301-400	2059	19.11(9)	30.20(5)	18.57(7)
639	301-400	1463	7.20(5)	12.00(5)	15.83(6)
640	401-500	198	28.25(4)	15.00(3)	13.50(4)
641	501-750	584	79.00(3)	20.33(3)	0.00(3)
642	751-1000	931	134.67(3)	256.00(3)	33.67(3)
643	1001-1250	1266	-	-	-
644	1251-1500	954	-	-	-
645	401-500	204	5.00(3)	9.00(3)	2.00(3)
646	501-750	333	11.00(3)	25.00(3)	3.33(3)
647	751-1000	409	35.33(3)	48.25(4)	20.33(3)
648	1001-1250	232	-	-	-
649	1251-1500	263	-	-	-
Total abundance (000s)			125,688	277,489	176,663

Table 2. Mean weight (kg) per set of Greenland halibut from USSR spring-summer surveys in Division 3K (number of successful sets in brackets).

Stratum	Depth range (m)	Stratum area (sq. n. mi.)	1987	1988	1989
618	101-200	1455	-	-	-
619	101-200	1588	-	-	-
620	201-300	2709	2.73(6)	4.88(6)	0.07(6)
621	201-300	2859	12.93(6)	8.20(7)	0.43(6)
622	401-500	632	81.00(3)	310.07(3)	245.00(3)
623	301-400	1027	30.00(4)	60.97(3)	41.43(3)
624	201-300	668	0.17(3)	2.13(3)	1.63(3)
625	301-400	850	10.50(4)	61.45(4)	3.93(6)
626	301-400	919	60.00(3)	71.45(4)	140.32(5)
627	401-500	1194	164.60(5)	305.42(5)	356.56(5)
628	301-400	1085	31.75(4)	38.85(4)	23.28(5)
629	301-400	495	80.00(3)	39.20(4)	21.85(4)
630	301-400	544	22.93(3)	50.87(3)	15.97(3)
631	401-500	1202	76.33(3)	198.33(3)	150.47(3)
632	201-300	447	0.07(3)	1.00(3)	0.60(3)
633	301-400	2179	3.74(7)	9.06(8)	4.10(4)
634	201-300	1618	2.18(6)	2.10(4)	0.65(4)
635	201-300	1274	1.52(4)	2.36(5)	1.38(5)
636	201-300	1455	1.48(5)	2.90(5)	1.04(5)
637	201-300	1132	1.40(3)	2.85(6)	2.50(6)
638	301-400	2059	12.20(9)	8.04(5)	9.00(7)
639	301-400	1463	7.26(5)	4.04(5)	5.80(6)
640	401-500	198	32.10(4)	11.07(3)	11.75(4)
641	501-750	584	89.00(3)	15.67(3)	0.00(3)
642	751-1000	931	219.67(3)	276.30(3)	54.43(3)
643	1001-1250	1266	-	-	-
644	1251-1500	954	-	-	-
645	401-500	204	4.67(3)	4.10(3)	2.17(3)
646	501-750	333	12.23(3)	5.53(3)	4.03(3)
647	751-1000	409	42.67(3)	36.30(4)	21.07(3)
648	1001-1250	232	-	-	-
649	1251-1500	263	-	-	-
Biomass (t)			64862	103965	78112

Table 3. Mean number of Greenland halibut per 30 minute set from USSR spring-summer surveys in Division 3L (number of successful sets in brackets).

Stratum	Depth range (m)	Stratum area (sq. n. mi.)	1987	1988	1989
328	93-183	1519	-	-	-
341	93-183	1574	2.00(3)	0.00(4)	2.00(3)
342	93-183	585	-	-	-
343	93-183	525	-	-	-
344	184-274	1494	-	-	-
345	275-366	1432	75.33(3)	7.75(4)	44.00(4)
346	275-366	865	8.00(3)	24.00(4)	12.00(3)
347	184-274	983	14.25(4)	0.50(4)	2.17(6)
348	93-183	2120	0.60(5)	0.33(6)	2.13(8)
349	93-183	2114	0.80(5)	0.00(5)	0.17(6)
350	57-91	2071	0.00(4)	0.00(5)	0.00(5)
363	57-91	1780	0.00(6)	0.00(4)	0.00(4)
364	93-183	2817	0.50(6)	0.14(7)	1.00(7)
365	93-183	1041	0.25(4)	0.00(4)	1.33(3)
366	184-274	1394	4.75(4)	0.50(4)	0.20(5)
368	275-366	334	1.33(3)	2.75(4)	17.50(4)
369	184-274	961	3.67(3)	0.00(3)	4.67(3)
370	93-183	1320	0.20(5)	0.33(3)	0.20(5)
371	57-91	1121	0.00(4)	0.00(4)	0.00(3)
372	57-91	2460	0.00(5)	0.00(4)	0.00(5)
384	57-91	1120	0.00(4)	0.00(3)	0.00(4)
385	93-183	2356	0.00(5)	0.00(5)	0.60(5)
386	185-274	983	4.75(4)	4.50(4)	15.50(4)
387	275-366	718	3.33(3)	2.67(3)	17.20(5)
388	275-366	361	5.33(3)	12.33(3)	22.25(4)
389	185-274	821	6.00(4)	5.75(4)	27.75(4)
390	93-183	1481	0.00(5)	0.25(4)	1.20(5)
391	185-274	282	15.33(3)	16.33(3)	20.67(3)
392	275-366	145	13.00(3)	30.67(3)	60.33(3)
729	367-549	186	24.67(3)	13.67(3)	14.33(3)
730	550-731	170	4.67(3)	3.33(3)	3.00(3)
731	367-549	216	7.00(3)	1.67(3)	11.67(3)
732	550-721	231	16.33(3)	11.67(3)	7.00(3)
733	367-549	468	2.75(4)	0.67(3)	13.00(4)
734	550-731	228	48.00(3)	3.00(3)	0.00(3)
735	367-549	272	11.75(4)	9.50(4)	20.00(4)
736	550-731	175	23.00(3)	21.00(3)	23.00(3)
Total abundance (000s)			14207	5309	14204

Table 4. Mean weight (kg) of Greenland halibut per 30 minute set from USSR spring-summer surveys in Division 3L (number of successful sets in brackets).

Stratum	Depth range (m)	Stratum area (sq. n. mi.)	1987	1988	1989
328	93-183	1519	-	-	-
341	93-183	1574	1.00(3)	0.00(4)	0.60(3)
342	93-183	585	-	-	-
343	93-183	525	-	-	-
344	184-274	1494	-	-	-
345	275-366	1432	14.33(3)	1.93(4)	21.90(4)
346	275-366	865	4.33(3)	8.93(4)	6.87(3)
347	184-274	983	1.80(4)	0.08(4)	0.45(6)
348	93-183	2120	0.02(5)	0.02(6)	0.44(8)
349	93-183	2114	0.24(5)	0.00(5)	0.02(6)
350	57-91	2071	0.00(4)	0.00(5)	0.00(5)
363	57-91	1780	0.00(6)	0.00(4)	0.00(4)
364	93-183	2817	0.03(6)	0.07(7)	0.19(7)
365	93-183	1041	0.03(4)	0.00(4)	0.07(3)
366	184-274	1394	2.53(4)	0.43(4)	0.12(5)
368	275-366	334	0.67(3)	2.03(4)	10.83(4)
369	184-274	961	1.03(3)	0.00(3)	3.27(3)
370	93-183	1320	0.12(5)	0.37(3)	0.16(5)
371	57-91	1121	0.00(4)	0.00(4)	0.00(3)
372	57-91	2460	0.00(5)	0.00(4)	0.00(5)
384	57-91	1120	0.00(4)	0.00(3)	0.00(4)
385	93-183	2356	0.00(5)	0.00(5)	0.04(5)
386	185-274	983	0.73(4)	1.22(4)	7.30(4)
387	275-366	718	1.57(3)	1.30(3)	6.20(5)
388	275-366	361	1.53(3)	4.63(3)	8.20(4)
389	185-274	821	1.67(4)	1.83(4)	12.48(4)
390	93-183	1481	0.00(5)	0.05(4)	0.40(5)
391	185-274	282	5.33(3)	4.70(3)	6.67(3)
392	275-366	145	5.33(3)	7.40(3)	17.97(3)
729	367-549	186	16.67(3)	12.37(3)	5.83(3)
730	550-731	170	2.67(3)	3.20(3)	2.57(3)
731	367-549	216	5.67(3)	1.03(3)	6.27(3)
732	550-721	231	12.33(3)	6.73(3)	3.17(3)
733	367-549	468	1.48(4)	0.17(3)	4.60(4)
734	550-731	228	68.00(3)	1.43(3)	0.00(3)
735	367-549	272	11.75(4)	7.50(4)	11.68(4)
736	550-731	175	20.00(3)	16.07(3)	12.77(3)
Biomass (t)			5012	2170	6364

Table 5. Mean number of witch flounder per 30 minute set from USSR spring-summer surveys in Division 3N (number of successful sets in brackets).

Stratum	Depth range (m)	Stratum area (sq. n. mi.)	1987	1988	1989
357	275-366	164	20.50(4)	15.00(3)	20.17(6)
358	185-274	225	4.60(5)	4.67(3)	15.44(9)
359	93-183	421	0.00(4)	0.00(4)	0.00(5)
360	57-91	2992	0.00(5)	0.00(5)	0.09(11)
361	57-91	1853	0.00(4)	0.00(4)	0.00(4)
362	57-91	2520	0.00(5)	0.00(4)	0.00(4)
373	57-91	2520	0.00(5)	0.00(4)	0.00(5)
374	57-91	931	0.00(4)	0.00(3)	0.00(4)
375	<56	1593	0.00(4)	0.00(3)	0.00(4)
376	<56	1499	0.00(4)	0.00(4)	0.00(4)
377	93-183	100	0.00(3)	0.00(3)	0.00(4)
378	185-274	139	6.00(3)	1.33(3)	0.00(4)
379	275-366	106	13.00(3)	6.33(3)	5.75(4)
380	275-366	116	1.00(3)	1.33(3)	4.80(5)
381	185-274	182	0.00(2)	0.00(3)	0.25(4)
382	93-183	647	0.00(3)	0.00(4)	0.00(7)
383	57-91	674	0.00(4)	0.00(4)	0.00(3)
723	367-549	155	58.50(4)	15.33(3)	15.20(5)
724	550-731	124	9.33(3)	25.00(3)	17.75(4)
725	367-549	105	29.00(3)	54.67(3)	57.25(4)
726	550-731	72	47.00(3)	18.33(3)	29.67(3)
727	367-549	160	14.33(3)	24.25(4)	42.83(6)
728	550-731	156	19.00(3)	40.00(3)	31.20(5)
Total abundance (000s)			2058	1953	2349

Table 6. Mean weight (kg) of witch flounder per 30 minute set from USSR spring-summer surveys in Division 3N (number of successful sets in brackets).

Stratum	Depth range (m)	Stratum area (sq. n. mi.)	1987	1988	1989
357	275-366	164	18.90(4)	9.07(3)	11.70(6)
358	185-274	225	3.20(5)	3.43(3)	7.73(9)
359	93-183	421	0.00(4)	0.00(4)	0.00(5)
360	57-91	2992	0.00(5)	0.00(5)	0.06(11)
361	57-91	1853	0.00(4)	0.00(4)	0.00(4)
362	57-91	2520	0.00(5)	0.00(4)	0.00(4)
373	57-91	2520	0.00(5)	0.00(4)	0.00(5)
374	57-91	931	0.00(4)	0.00(3)	0.00(4)
375	<56	1593	0.00(4)	0.00(3)	0.00(4)
376	<56	1499	0.00(4)	0.00(4)	0.00(4)
377	93-183	100	0.00(3)	0.00(3)	0.00(4)
378	185-274	139	3.80(3)	0.50(3)	0.00(4)
379	275-366	106	8.67(3)	2.83(3)	3.55(4)
380	275-366	116	1.00(3)	0.87(3)	3.32(5)
381	185-274	182	0.00(2)	0.00(3)	0.13(4)
382	93-183	647	0.00(3)	0.00(4)	0.00(7)
383	57-91	674	0.00(4)	0.00(4)	0.00(3)
723	367-549	155	38.25(4)	9.03(3)	9.48(5)
724	550-731	124	3.00(3)	8.60(3)	6.03(4)
725	367-549	105	22.67(3)	24.03(3)	24.60(4)
726	550-731	72	20.00(3)	7.27(3)	12.70(3)
727	367-549	160	9.00(3)	15.85(4)	21.50(6)
728	550-731	156	11.00(3)	21.50(3)	16.64(5)
Biomass (t)			1341	1016	1177

Table 7. Mean number of witch flounder per 30 minute set from USSR spring-summer surveys in Division 3Ø (number of successful sets in brackets).

Stratum	Depth range (m)	Stratum area (sq. n. mi.)	1987	1988	1989
329	93-183	1721	0.25(4)	0.00(4)	0.00(4)
330	57-91	2089	0.00(5)	0.00(5)	0.00(5)
331	57-91	456	0.00(3)	3.33(3)	0.00(3)
332	93-183	1047	27.50(4)	17.75(4)	6.50(4)
333	185-274	151	4.67(3)	8.67(3)	2.20(5)
334	275-366	92	0.00(3)	5.33(3)	0.25(4)
335	275-366	58	3.33(3)	14.33(3)	9.67(3)
336	185-274	121	35.67(3)	44.50(4)	4.67(6)
337	93-183	948	14.33(3)	62.00(4)	15.25(4)
338	57-91	1898	8.33(3)	10.20(5)	7.00(5)
339	93-183	585	0.00(3)	0.00(3)	0.00(3)
340	57-91	1716	0.00(4)	0.00(3)	0.14(7)
351	57-91	2520	0.00(5)	0.00(5)	0.00(5)
352	57-91	2580	0.00(4)	1.17(6)	1.50(6)
353	57-91	1282	0.00(3)	13.20(5)	8.00(4)
354	93-183	474	5.00(3)	13.67(3)	3.75(4)
355	185-274	103	3.67(3)	10.75(4)	27.00(4)
356	275-366	61	37.67(3)	1.33(3)	91.25(4)
717	367-549	93	1.00(4)	0.67(3)	0.33(3)
718	550-731	111	7.00(3)	2.33(3)	4.67(3)
719	367-549	76	1.00(3)	14.67(3)	1.00(3)
720	550-731	105	5.50(2)	7.00(3)	1.33(3)
721	367-549	76	160.33(3)	37.00(3)	82.50(4)
722	550-731	93	5.33(3)	2.00(3)	7.67(3)
Total abundance (000s)			5972	9992	4907

Table 8. Mean weight (kg) of witch flounder per 30 minute set from USSR spring-summer surveys in Division 3Ø (number of successful sets in brackets).

Stratum	Depth range (m)	Stratum area (sq. n. mi.)	1987	1988	1989
329	93-183	1721	0.17(4)	0.00(4)	0.00(4)
330	57-91	2089	0.00(5)	0.00(5)	0.00(5)
331	57-91	456	0.00(3)	1.83(3)	0.00(3)
332	93-183	1047	18.25(4)	8.78(4)	3.65(4)
333	185-274	151	3.00(3)	4.83(3)	0.84(5)
334	275-366	92	0.00(3)	3.40(3)	0.08(4)
335	275-366	58	2.00(3)	9.13(3)	5.30(3)
336	185-274	121	23.67(3)	25.15(4)	1.72(6)
337	93-183	948	8.73(3)	38.97(4)	5.78(4)
338	57-91	1898	8.00(3)	8.82(5)	4.10(5)
339	93-183	585	0.00(3)	0.00(3)	0.00(3)
340	57-91	1716	0.00(4)	0.00(3)	0.07(7)
351	57-91	2520	0.00(5)	0.00(5)	0.00(5)
352	57-91	2580	0.00(4)	1.08(6)	1.53(6)
353	57-91	1282	0.00(3)	10.74(5)	6.40(4)
354	93-183	474	2.67(3)	7.73(3)	1.33(4)
355	185-274	103	2.00(3)	5.60(4)	14.10(4)
356	275-366	61	23.00(3)	0.97(3)	53.40(4)
717	367-549	93	0.75(4)	0.37(3)	0.10(3)
718	550-731	111	1.83(3)	0.53(3)	1.67(3)
719	367-549	76	0.90(3)	9.43(3)	0.77(3)
720	550-731	105	1.00(2)	3.23(3)	0.37(3)
721	367-549	76	143.00(3)	24.73(3)	52.35(4)
722	550-731	93	3.33(3)	1.20(3)	3.07(3)
Biomass (t)			4370	6636	2868