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Interim Monitoring Report for the Assessment of Northern Shortfin Squid (*Illex illecebrosus*) in Subareas 3+4 during 2002

by

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Abstract

This document is an interim monitoring report that describes the status of Northern shortfin squid in Subareas 3+4 during 2002. Total landings of *Illex* in 2002 in Subareas 3+4 were 248 t, higher than in 2001 (57 tons), but well below the 1982-2002 average (3 550 tons). *Illex* abundance and biomass indices in the July 2002 Division 4VWX survey were below average. The mean weight of squid caught in the Div. 4VWX survey increased slightly between 2001 and 2002 (from 70 g to 85 g), but remained below the 1970-2002 average (95 g). Based on below average abundance and biomass indices and squid size, the Subareas 3+4 stock components remained in a state of low productivity in 2002.

1.0 Introduction

Northern shortfin squid (*Illex illecebrosus*), a species with a lifespan of about one year (Dawe and Beck, 1997), is considered to constitute a unit stock throughout its distributional range in the Northwest Atlantic Ocean; from Newfoundland to Cape Hatteras, North Carolina (Dawe and Hendrickson, 1998).

The onset and duration of the fisheries in each Subarea generally reflect the timing of squid migrations through each area. Subarea 3 catches are primarily from a small-boat jig fishery that occurs in shallow, nearshore waters of Newfoundland. Since 1987, Subarea 4 catches have been primarily from an international bottom trawl fishery for silver hake, squid and argentine that occurs on the Scotian Shelf (Dawe and Hendrickson, 1998). International fleets, composed of midwater and bottom trawlers, began fishing for Northern shortfin squid in Subareas 5+6 in 1968 (Dawe and Hendrickson, 1998). Since 1987, landings from Subareas 5+6 have been from a directed bottom trawl fishery that occurs primarily in the Mid-Atlantic Bight (NEFSC, 1999).

Two general levels of productivity, since 1970, were previously identified for the Subareas 3+4 component of the Northern shortfin squid (*Illex illecebrosus*) population based on trends in survey relative biomass indices and squid

mean weight, as well as nominal catches (Rivard *et al.*, 1998; Hendrickson, 1999). A period of high productivity (1976-1981) occurred between two low productivity periods (1970-1975 and 1982-2002).

Management of the stock component in Subarea 3 (Newfoundland) and Subarea 4 (Scotian Shelf and Gulf of St. Lawrence) is based on a Total Allowable Catch (TAC) established annually by the Northwest Atlantic Fisheries Organization (NAFO) and was set at 34 000 tons for 2002. Since 1977, the United States has managed the *Illex* stock component in its Exclusive Economic Zone (EEZ) (Subareas 5+6). The TAC for the Subareas 5+6 stock component was 24 000 tons in 2002. This document provides an evaluation of the status of the Subareas 3+4 component in 2002, based on trends in commercial fishery data, survey relative abundance and biomass indices, and fishing mortality indices, with an emphasis on the present low productivity period (1982-2002).

2.0 Materials and Methods

2.1 Commercial Fishery Data

Historically, catches have been recorded from the Subarea 3 fishery since 1911 (Dawe, 1981) and from the Subarea 4 fishery since 1920 (ICNAF, 1973). Catches from Subareas 5+6 have been recorded since 1963 (Lange and Sissenwine, 1980). Fisheries data evaluated herein include nominal catches from Subarea 3 and Subarea 4 during 1953-2002. Landings from Subareas 5+6, during 1963-2002 are also presented.

Subarea 4 catches during 1987-2002 represent the sum of catches (kept fraction only) of Northern shortfin squid by distant water fleets involved in the Scotian Shelf silver hake fishery plus Canadian catches recorded in the Canadian Zonal Interchange Format (ZIF) Database. The ZIF database contains catches by Canadian vessels and international vessels with Canadian allocations. Squid catches in the silver hake fishery were obtained from the Maritimes Observer Program Database. Since observer coverage in the SA 4 silver hake fishery has been 100% since 1987, and data are collected on a tow-by-tow basis (Showell and Fanning, 1999), catches from this source are considered the most accurate.

2.2 Research Survey Data

Fishery-independent indices of relative abundance (stratified mean number per tow) and biomass (stratified mean kg per tow) were available from stratified, random, multi-species bottom trawl surveys conducted by Canada in Div. 4T (southern Gulf of St. Lawrence) during September since 1971, Div. 4VWX (Scotian Shelf) during July since 1970, and by the United States of America in Subareas 5+6 during September-October since 1967. All strata were included in computations of the Div. 4T survey indices (Halliday and Koeller, 1981; Koeller, 1980) and the Div. 4VWX survey indices (Fanning, 1985). There were no gear or vessel conversion coefficients applied to indices from either of these two surveys. All offshore strata, between depths of 27-366 m (Grosslein, 1969), were included in the computations of survey indices for Subareas 5+6 and gear and vessel standardization coefficients were applied to these indices (NEFSC 1999). With the exception of the Div. 4T survey, which occurred during daylight hours during 1971-1984, sampling was conducted around the clock.

2.3 Fishing Mortality

Annual fishing mortality indices for Subareas 3+4, during 1970-2002, were computed by dividing annual catches in Subareas 3+4 by the annual biomass indices from the July Div. 4VWX surveys.

3.0 Results

3.1 Subareas 3+4 Fisheries

During 1992-1999, squid catches in the Subarea 4 silver hake fishery were predominantly from the Cuban fleet. However, effort in this fishery has markedly declined during recent years. The sole Russian trawler in the Subarea 4 silver hake fishery did not catch *Illex* during 2001 or 2002 (Rikhter and Sigaev, 2003, Rikhter and Sigaev, 2002).

The total catch of *Illex* in Subarea 4 (24 tons) in 2002 was the lowest since 1960 (Table 1). In Subarea 3, *Illex* catches increased from 23 tons in 2001 to 224 tons in 2002.

Catches in Subareas 3+4 increased during the 1970s and reached a peak of 162 092 tons in 1979 (Table 1, Fig. 1). During 1976-81, total catches (Subareas 3-6) were dominated by those from Subareas 3+4 (which averaged 80 645 tons while those in Subareas 5+6 averaged 19 661 tons). Following a 1979 peak, Subarea 3+4 catches declined sharply to less than 1 000 tons during 1983-88. In 1997, Subareas 3+4 catches (15 614 tons) reached their highest level since 1981 due primarily to the Subarea 3 jig fishery (12 748 tons). Annual catches in Subareas 3+4 have been less than 1 000 tons since 1999 and totaled 248 tons in 2002.

3.2 Subareas 5+6 Fishery

Catches in Subareas 5+6 reached a peak of 24 936 tons in 1976 and afterwards have ranged between 1 958 tons and 23 597 tons (Table 1). Since 1987, the Subareas 5+6 fishery has consisted solely of domestic (USA) bottom trawlers. During 1987-97, catches were generally in the range of 10 000-18 000 t. Catches during 1998 reached 23 597 tons (the highest since 1977) but the fishery was closed in August for the remainder of the year because the TAC (19 000 tons) was attained. Subsequently, annual catches in Subareas 5+6 have been much lower and were only 2 700 tons in 2002, the lowest since 1988.

3.3 Catches from Subareas 3-6

The timing and duration of fisheries varies by Subarea. Since 1992, fisheries in Subareas 4 and 5+6 have generally occurred during June-October, with a peak in catches during July. The Subarea 3 fishery has generally occurred during July-November with a September peak in catch (Hendrickson *et al*.. 2002).

Combined catches from Subareas 3-6 declined from about 25 500 tons in 1998 to about 3 000 tons in 2002, the lowest level since 1988 (Table 1, Fig. 1). This was primarily due to a decrease in catches from Subareas 5+6.

3.4 Survey Abundance and Biomass Indices

Annual survey trends in relative abundance (stratified mean number per tow) and biomass (stratified mean kg per tow) are shown in Fig. 2 and Table 2. The Div. 4VWX July survey generally occurs prior to the Subarea 3 fishery and during the early phase of the Subarea 4 fishery, so it can be considered to provide pre-fishery abundance and biomass indices. This survey encompasses a larger expanse of *Illex* habitat in Subarea 4 than does the Div. 4T survey. Relative biomass indices from the Div. 4VWX survey indicate a period of high productivity during 1976-1981, averaging 12.6 kg/tow, followed by a low productivity period during 1982-2002, averaging 2.4 kg/tow (Figure 2, Table 2). Indices of relative abundance (13.0 squid per tow) and biomass (1.1 kg per tow) from the 2002 Division 4VWX survey were below average (35.3 squid per tow and 2.4 kg per tow, respectively).

Surveys in Subareas 5+6 and Div. 4T occur during autumn and can be considered to provide post-fishery abundance and biomass indices. However, the Div. 4T survey appears to capture squid only during periods of high abundance. During 1999-2002, biomass and abundance indices from both surveys remained below their time-series averages (Table 2).

3.5 Body Size

Mean body weights of squid caught in the Div. 4VWX survey indicate that squid were larger during the high productivity period and smaller during the low productivity period (Fig. 3). The mean weight of squid caught in the Div. 4VWX survey increased slightly between 2001 and 2002 (from 70 g to 85 g) but remained below the 1970-2002 average (95 g). During 2000-2002, the mean weight of squid from the Subareas 5+6 autumn survey declined from 90 g to 70 g, the lowest value in the time series.

3.6 Fishing Mortality Indices

Annual fishing mortality indices for Subareas 3+4 were high during 1977-81, reached a peak of 4.09 in 1978 (Table 3, Fig. 4) and averaged 1.67 during the high productivity period (1976-81). High values during 1976-81 are attributed to increased catches and low survey indices (Fig. 5). Since 1982, relative fishing mortality rates have been much lower and averaged 0.18 during 1982-2002.

4.0 Discussion

Based on below average abundance and biomass indices and squid size, the Subareas 3+4 stock component remained in a state of low productivity in 2002.

Acknowledgements

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References

Dawe, E. G. 1981. Development of the Newfoundland squid (*Illex illecebrosus*) fishery and management of the resource. J. Shellfish Res. 1: 137-142.

Dawe, E. G. and P. C. Beck. 1997. Population structure, growth and sexual maturation of short-finned squid at Newfoundland, Canada, based on statolith analysis. Can. J. Fish. Aquat. Sci. 54: 137-146.

Dawe, E. G. and L. C. Hendrickson. 1998. A review of the biology, population dynamics, and exploitation of short-finned squid in the northwest Atlantic Ocean, in relation to assessment and management of the resource. NAFO SCR Doc. 98/59, Ser. No. N3051, 33 p.

Dawe, E. G., and Warren, W. G. 1993. Recruitment of short-finned squid in the Northwest Atlantic Ocean and some environmental relationships. Journal of Cephalopod Biology, 2: 1-21.

Doubleday, W.G. 1981. Manual on groundfish surveys in the northwest Atlantic. NAFO Sci. Coun. Studies. 2: 55 p.

Fanning, L. P. 1985. Intercalibration of research survey results obtained by different vessels. CAFSAC Res. Doc. 85-83. 43 p.

Grosslein, M.D. 1969. Groundfish survey program of BCF Woods Hole. Commer. Fish. Rev. 31(8-9): 22-35.

Halliday, R. G. and A. C. Kohler. 1971. Groundfish survey programmes of the St. Andrews Biological Station, Fisheries Research Board of Canada – objectives and characteristics. ICNAF Res. Doc. 71/35, Ser. No. 2520. 25 p.

Hendrickson, L.C. 1999. Fishery effects on spawner escapement in the Northwest Atlantic *Illex illecebrosus* stock. NAFO SCR Doc. 99/66, Ser. No. N4125. 8 p.

Hendrickson, L.C., E.G. Dawe and M.A. Showell. 2002. Assessment of Northern shortfin squid (*Illex illecebrosus*) in Subareas 3+4 for 2001. NAFO SCR Doc. 02/56. Ser. No. N4668. 17 p.

ICNAF. 1973. Nominal catch of squid in Canadian Atlantic waters (Subareas 2-4), 1920-68. ICNAF Redbook 1973, Part III: 154-161.

Koeller, P. A. 1980. Distribution, biomass and length frequencies of squid (*Illex illecebrosus*) in Divisions 4TVWX from Canadian research vessel surveys: an update for 1979. NAFO SCR Doc. 80/II/17. Ser. No. N049.

Lange, A. M. T. and M. Sissenwine. 1980. Biological considerations relevant to the management of squid *Loligo pealeii* and *Illex illecebrosus* of the Northwest Atlantic. Mar. Fish. Rev. 42(7-8): 23-38.

Northwest Atlantic Fisheries Organization [NAFO]. 2002a. List of biological sampling data for 2001. NAFO SCS Doc. 02/8. Ser. No. N620. 18 p.

Northeast Fisheries Science Center [NEFSC]. 1999. Report of the 29th Northeast Regional Stock Assessment Workshop (29th SAW): Stock Assessment Review Committee SARC) Consensus Summary of Assessments. Northeast Fisheries Science Center Ref. Doc. 99-14 347 p.

Rikhter V. A. and I. K. Sigaev. 2003. Russian Research Report for 2002, Part I, Research carried out by AtlantNIRO in NAFO Subarea 4. NAFO SCS Doc. 03/6, Ser. No. N4807. 32 p.

Rikhter, V. A. and I. K. Sigaev. 2002. Russian Research Report for 2001. PART 1. Research carried out by AtlantNIRO in NAFO Subarea 4. NAFO SCS Doc. 02/4, Ser. No. N4597. 2 p.

Rikhter, V. A., and I. K. Sigaev. 2001. Russian Research Report for 2000. PART 1. Research carried out by AtlantNIRO in NAFO Subarea 4. NAFO SCS Doc. 01/11, Ser. No. N4372. 3 p.

Rivard, D., L. C. Hendrickson and F. M. Serchuk. 1998. Yield estimates for short-finned squid (*Illex illecebrosus*) in SA 3-4 from research vessel survey relative biomass indices. NAFO SCR Doc. 98/75, Ser. No. N3068. 4 p.

Showell, M.A. and L.P. Fanning. 1999. Assessment of the Scotian Shelf silver hake population in 1998. Canadian Stock Assessment Research Document. 99/148. 41 p.

Table 1. Nominal catches (t) of *Illex illecebrosus* in NAFO Subareas 3 and 4, during 1953-2002, and Subareas 5+6 (U.S. EEZ), during 1963-2002, and TACs in Subareas 3+4 and Subareas 5+6.

			Total		Total		
	Subarea 3[2]	Subarea 4[3]	Subarea 3+4	Subareas 5+6[4,5]	Subareas (3-6)[6]	TAC (t)[1]	
Year	(t)	(t)	(t)	(t)	(t)	3+4	5+6
1953	4,460	51	4,511		4,511		
1954	6,700	115	6,815		6,815		
1955	7,019	269	7,288		7,288		
1956	7,779	450	8,229		8,229		
1957	2,634	335	2,969		2,969		
1958	718	84	802		802		
1959	2,853	258	3,111		3,111		
1960	5,067	24	5,091		5,091		
1961	8,971	50	9,021		9,021		
1962	482	587	1,069		1,069		
1963	2,119	103	2,222	810	3,032		
1964	10,408	369	10,777	360	11,137		
1965	7,831	433	8,264	522	8,786		
1966	5,017	201	5,218	570	5,788		
1967	6,907	126	7,033	995	8,028		
1968	9	47	56	3,271	3,327		
1969	21	65	86	1,537	1,623		
1970	111	1,274	1,385	2,826	4,211		
1971	1,607	7,299	8,906	6,614	15,520		
1972	26	1,842	1,868	17,641	19,509		
1973	622	9,255	9,877	19,155	29,032		
1974	48	389	437	20,628	21,065		71,000
1975	3,751	13,945	17,696	17,926	35,622	25,000	71,000
1976	11,257	30,510	41,767	24,936	66,703	25,000	30,000
1977	32,754	50,726	83,480	24,795	108,275	25,000	35,000
1978	41,376	52,688	94,064	17,592	111,656	100,000	30,000
1979	88,833	73,259	162,092	17,241	179,333	120,000	30,000
1980	34,780	34,826	69,606	17,828	87,434	150,000	30,000
1981	18,061	14,801	32,862	15,571	48,433	150,000	30,000
1982	11,164	1,744	12,908	18,633	31,541	150,000	30,000
1983	5	421	426	11,584	12,010	150,000	30,000
1984	397	318	715	9,919	10,634	150,000	30,000
1985	404	269	673	6,115	6,788	150,000	30,000
1986	1	110	111	7,470	7,581	150,000	30,000
1987	194	368	562	10,102	10,664	150,000	30,000
1988	272	539	811	1,958	2,769	150,000	30,000
1989	3,101	2, 870	5,971	6,801	12,772	150,000	30,000
1990	4,440	6,535	10,975	11,670	22,645	150,000	30,000
1991	1,719	1,194	2,913	11,908	14,821	150,000	30,000
1992	924	654	1,578	17,827	19,405	150,000	30,000
1993	276	2,410	2,686	18,012	20,698	150,000	30,000
1994	1,954	3,997	5,951	18,350	24,301	150,000	30,000
1995	48	1,007	1,055	14,058	15,113	150,000	30,000
1996	8,285	457	8,742	16,969	25,711	150,000	21,000
1997	12,748	2,866	15,614	13,629	29,243	150,000	19,000
1998	815	1,087	1,902	23,597	25,499	150,000	19,000
1999	19	286	305	7,388	7,693	75,000	19,000
2000	328	38	366	9,011	9,377	34,000	24,000
2001	23	34	57	3,939	3,996	34,000	24,000
2002	224	24	248	2,723	2,971	34,000	24,000

Table 1. (Continued).

AVERAGES					
1976-1981	37,844	42,802	80,645	19,661	100,306
1982-1986	2,028	538	2,566	10,637	13,203
1987-1991	1,945	2,301	4,246	8,488	12,734
1992-1996	2,297	1,705	4,002	17,043	21,046
1997-2002	2,357	723	3,079	10,060	13,139
1982-2002	2,254	1,297	3,551	11,511	15,062

[1]TACs during 1974 and 1975 for Subareas 5+6 include *Loligo pealeii* and, during 1975-1977, countries without allocations were permitted to land 3,000 t in Subareas 3+4

[2] SA 3 catches include a small amount from Subarea 2

[3] SA 4 catches during 1987-2001 were updated based on catches in the Canadian Observer and ZIF Databases

[4] Subareas 5+6 catches during 1963-1978 not reported by species and are proration-based estimates by Lange and Sissenwine (1980)

[5] Subareas 5+6 catches during 1994-2002 are provisional

[6] Catches during 2002 are provisional for all Subareas

Table 2. Indices of relative abundance (stratified mean number/tow) and biomass (stratified mean kg/tow) from bottom trawl surveys conducted in Subareas 5+6 (Sept-Oct, 1967-2002), Division 4VWX (July, 1970-2002), and Division 4T (Sept, 1971-2002).

	Subareas 5+6		Division 4VWX		Division 4T	
Year	(number/tow)	(kg/tow)	(number/tow)	(kg/tow)	(number/tow)	(kg/tow)
1967	1.6	0.2				
1968	1.6	0.3				
1969	0.6	0.1				
1970	2.3	0.3	5.6	0.4		
1971	1.7	0.3	28.5	2.8	0.72	0.16
1972	2.2	0.3	6.6	0.7	0.05	0.01
1973	1.5	0.4	10.9	1.5	0.08	0.02
1974	2.8	0.4	13.4	1.8	0.06	0.00
1975	8.7	1.4	44.8	5.0	2.47	0.51
1976	20.6	7.0	231.2	42.7	30.76	8.04
1977	12.6	3.7	50.9	9.5	25.73	7.61
1978	19.3	4.5	16.4	2.3	55.95	15.87
1979	19.4	6.1	91.4	14.2	28.47	8.14
1980	13.8	3.3	23.3	2.2	18.04	4.58
1981	27.1	9.3	35.5	4.9	5.76	1.67
1982	3.9	0.6	26.0	2.1	0.38	0.08
1983	1.7	0.2	76.9	2.1	0.09	0.00
1984	4.5	0.5	14.1	1.5	0.03	0.00
1985	2.4	0.4	80.2	2.7	0.48	0.11
1986	2.1	0.3	7.7	0.4	0.08	0.01
1987	15.8	1.5	4.9	0.4	0.16	0.02
1988	23.2	3.0	47.3	2.7	1.33	0.40
1989	22.4	3.3	26.3	2.7	0.30	0.04
1990	16.6	2.4	40.6	4.8	0.88	0.14
1991	5.2	0.7	27.1	1.8	0.12	0.03
1992	8.2	0.8	121.7	7.3	0.28	0.05
1993	10.4	1.6	79.0	5.4	0.58	0.10
1994	6.8	0.9	45.3	4.2	0.26	0.10
1995	8.0	0.7	33.9	2.4	0.16	0.02
1996	10.8	0.9	11.9	0.9	0.70	0.11
1997	5.8	0.5	52.0	4.8	0.96	0.17
1998	14.6	1.4	10.0	0.9	0.96	0.21
1999	1.4	0.2	16.7	2.0	0.23	0.05
2000	7.4	0.7	4.0	0.1	0.19	0.02
2001	4.5	0.3	3.3	0.2	0.08	0.01
2002	6.4	0.4	13.0	1.1	0.09	0.01
Time Series Average	8.8	1.6	39.4	4.2	5.51	1.51

Table 3. Fishing mortality indices (SA 3+4 nominal catch/Div. 4VWX July survey biomass index) of Northern shortfin squid (*Illex illecebrosus*) in Subareas 3+4 during 1970-2002. Fishing mortality indices were divided by 10,000 to scale the values.

Year	SA 3+4 Nominal Catch (t)	Division 4VWX July Survey Biomass Index (kg/tow)	Fishing Mortality Indices
1970	1,385	0.4	0.35
1971	8,906	2.8	0.32
1972	1,868	0.7	0.27
1973	9,877	1.5	0.66
1974	437	1.8	0.02
1975	17,696	5.0	0.35
1976	41,767	42.7	0.10
1977	83,480	9.5	0.88
1978	94,064	2.3	4.09
1979	162,092	14.2	1.14
1980	69,606	2.2	3.16
1981	32,862	4.9	0.67
1982	12,908	2.1	0.61
1983	426	2.1	0.02
1984	715	1.5	0.05
1985	673	2.7	0.02
1986	111	0.4	0.03
1987	562	0.4	0.14
1988	811	2.7	0.03
1989	5,971	2.7	0.22
1990	10,975	4.8	0.23
1991	2,913	1.8	0.16
1992	1,578	7.3	0.02
1993	2,686	5.4	0.05
1994	5,951	4.2	0.14
1995	1,055	2.4	0.04
1996	8,742	0.9	0.97
1997	15,614	4.8	0.33
1998	1,902	0.9	0.20
1999	305	2.0	0.02
2000	366	0.1	0.37
2001	57	0.3	0.02
2002	248	1.1	0.02
Average			
1976-1981	80,645	12.6	1.67
1982-2002	3,551	2.4	0.18

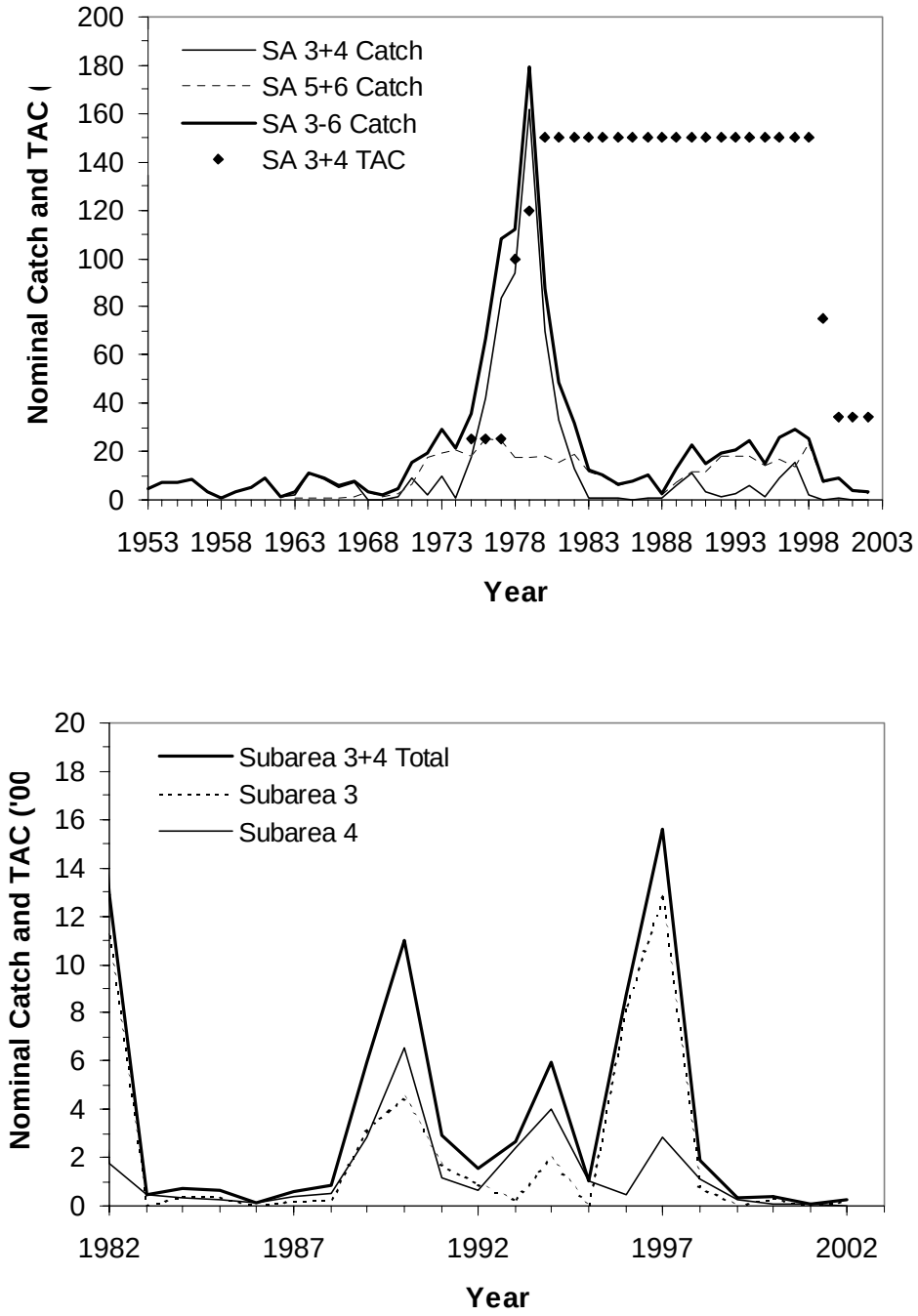

Fig. 1. Nominal catches ('000 t) of *Illex illecebrosus* and TACs in Subareas 3 and 4, during 1953-2002, and Subareas 5+6 during 1963-2002 (top) and nominal catches in Subarea 3 and Subarea 4 during 1982-2002 (bottom).

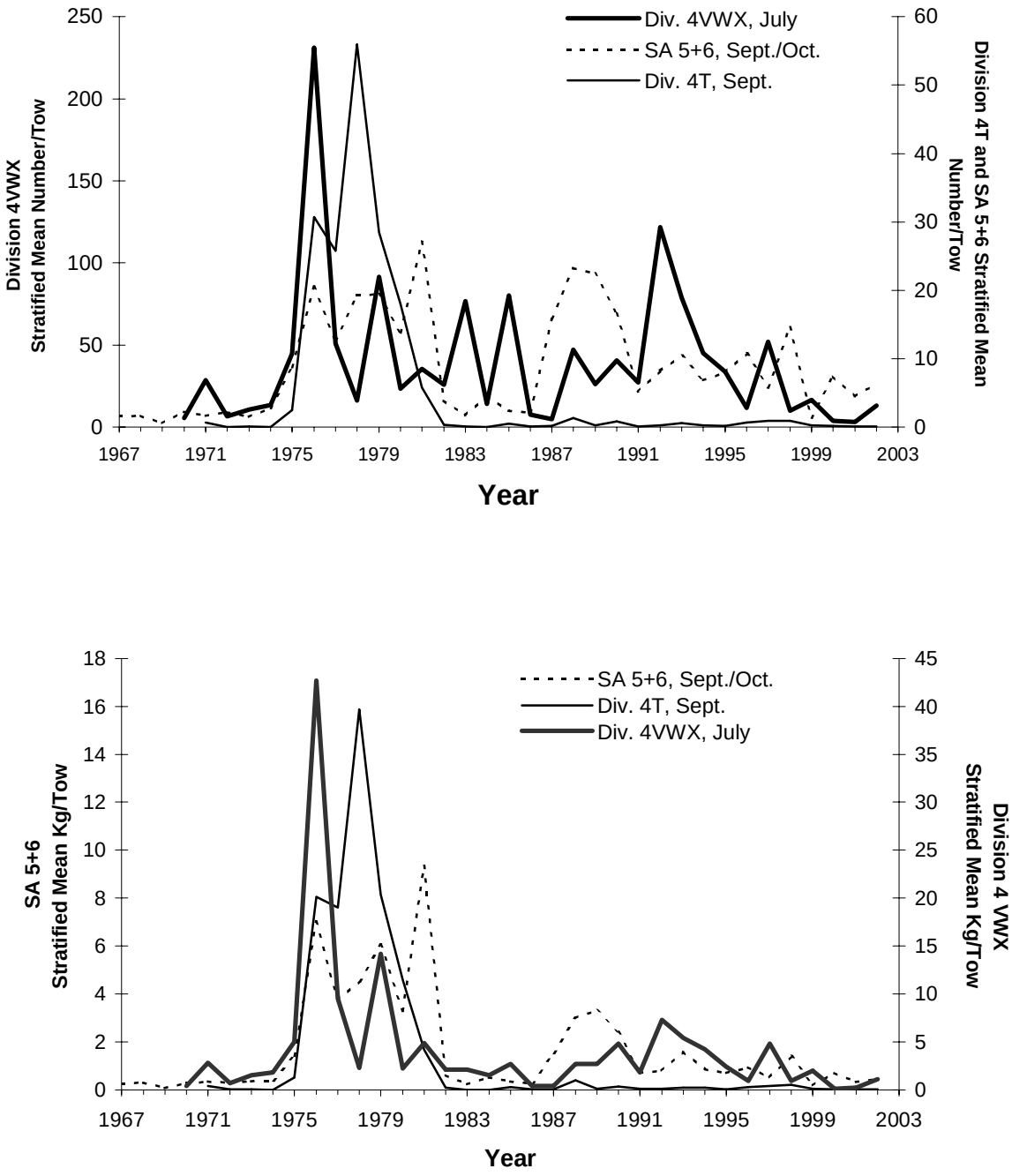

Fig. 2. *Illex illecebrosus* relative abundance (stratified mean number/tow) (top) and biomass indices (stratified mean kg/tow) (bottom) from the Division 4VWX surveys (July, 1970-2002), Division 4T surveys (September, 1971-2002), and Subareas 5+6 surveys (September-October, 1967-2002).

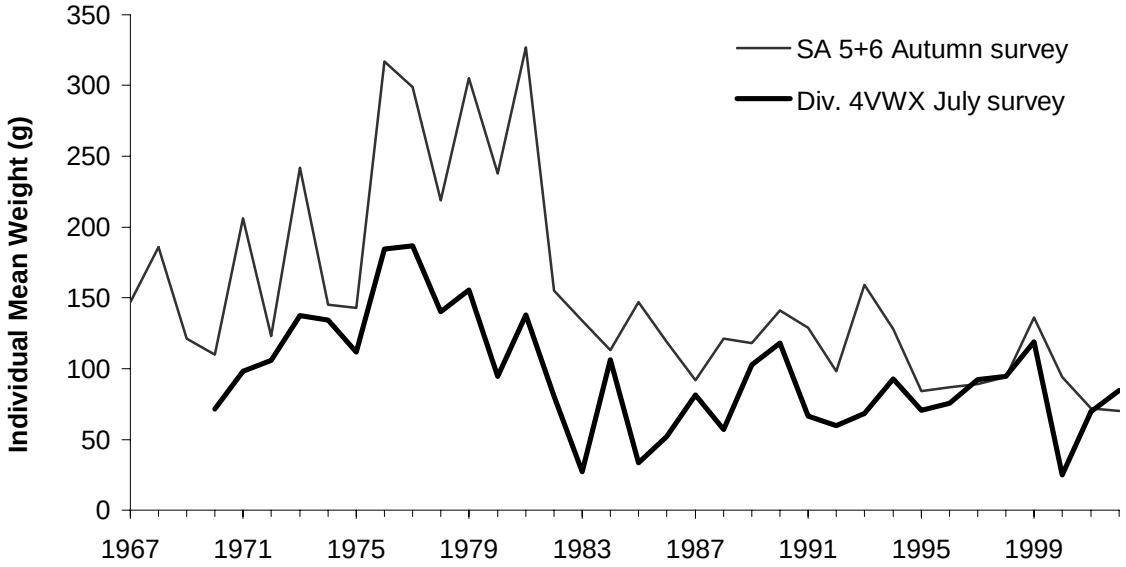

Fig. 3. Mean weight per individual (g) of *Illex illecebrosus* caught in the Subareas 5+6 autumn bottom trawl survey (1967-2002), Canadian Division 4VWX July bottom trawl surveys (1970-2002).

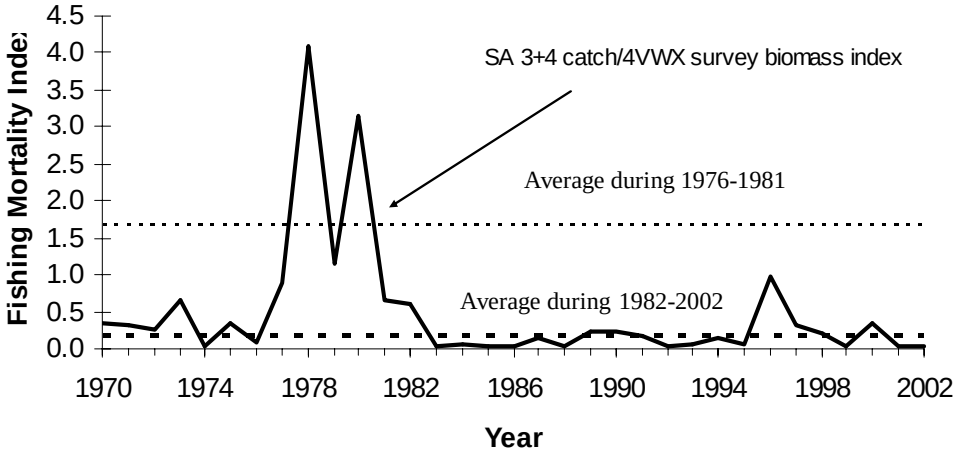

Fig.4. Fishing mortality indices (SA 3+4 nominal catch/Division 4VWX July survey biomass index) in Subareas 3+4, during 1970-2002, and averages during the high (1976-1981) and low (1982-2002) productivity periods. Fishing mortality indices were divided by 10,000 to scale the values.

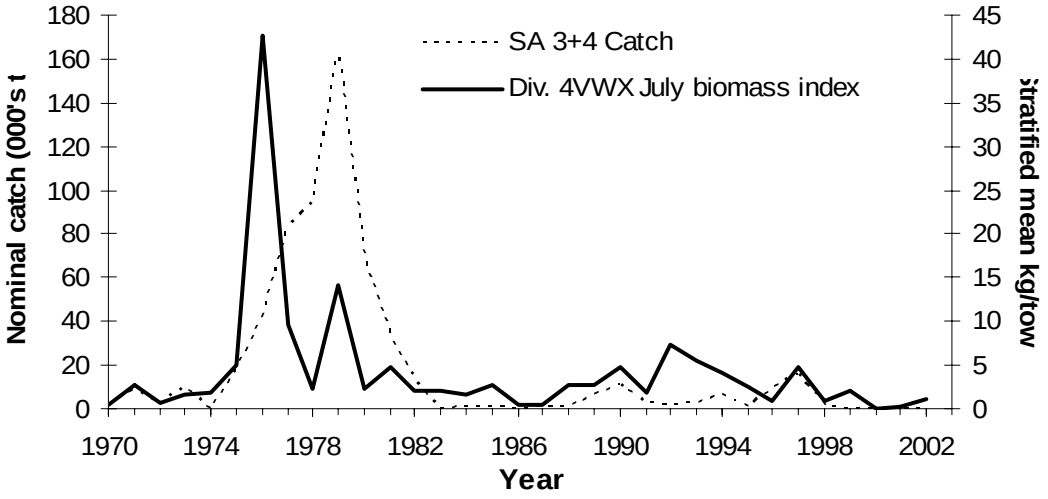

Fig. 5. Nominal catch (‘000 t) in SA 3+4 and Division 4VWX July survey biomass indices (kg/tow) during 1970-2002.