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Assessment of Northern Shortfin Squid (*Illex illecebrosus*) in Subareas 3+4 for 2003

by

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Abstract

Two general levels of productivity have been identified for the Subareas 3+4 component of the northern shortfin squid (*Illex illecebrosus*) population based on trends in nominal catches, research vessel survey relative biomass indices, and squid mean weight (Rivard *et al*., 1998; Hendrickson, 1999). A period of high productivity (1976-1981) occurred between two low productivity periods (1970-1975 and 1982-2002). During 2003, relative abundance and biomass indices from the Canadian Div. 4VWX July survey were well below the 1982-2002 average. The mean size of squid in the 2003 survey was small (71 g) and comparable to the 1982-2002 average (75 g). Nominal catches in Subareas 3+4 were also low relative to the 1982-2002 average. Based on these trends, the Subareas 3+4 stock component remained in a state of low productivity in 2003.

Introduction

Northern shortfin squid (*Illex illecebrosus*), a species with a lifespan of about one year (Dawe and Beck, 1997; Hendrickson, 2004), is considered to constitute a unit stock throughout its range of exploitation 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. During 1987-2001, squid were harvested from Subarea 4 by an international bottom trawl fishery for silver hake (*Merluccius bilinearis*), *I. illecebrosus* and argentine (*Argentina* sp.) that occurred on the Scotian Shelf (Hendrickson *et al*., 2002). International fleets, comprised 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).

Although the resource is continuously distributed between Cape Hatteras and inshore Newfoundland during summer through autumn, it is considered, for management purposes, to be comprised of two components. Management of the northern component, in Subarea 3 (Newfoundland) and Subarea 4 (Scotian Shelf and Gulf of St. Lawrence), is based on an annual Total Allowable Catch (TAC) established by the Northwest Atlantic Fisheries Organization (NAFO). The TAC has been set at 34 000 tons since 2000. The southern component (Subareas 5+6) is located within the Exclusive Economic Zone (EEZ) of the United States and has been managed by the Mid-Atlantic Fishery Management Council since 1977. The annual TAC for the Subareas 5+6 component has been set at 24 000 tons since 2000. This

document provides an evaluation of the status of the Subareas 3+4 component in 2003 based on trends in commercial fishery data, research vessel survey relative abundance and biomass indices, and fishing mortality indices.

Materials and Methods

Commercial Fishery Data

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 1953-2003. Landings from Subareas 5+6 during 1963-2003 are also presented.

Subarea 4 catches during 1987-2003 represent the sum of catches (kept fraction only) of northern shortfin squid in the Scotian Shelf international fishery (for silver hake, *I. illecebrosus* and argentine) plus catches from 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 international fishery were obtained from the Maritimes Observer Program Database. Catch data from the Observer Database are considered the most accurate because there has been 100% observer coverage in the Subarea 4 international fishery since 1987 and the data are collected on a tow-by-tow basis (Showell and Fanning, 1999).

Research Survey Data

Fishery-independent indices of relative abundance (stratified mean number per tow) and biomass (stratified mean kg per tow) were derived for Subarea 4 and Subareas 5+6 from stratified random bottom trawl surveys conducted by Canada in Div. 4T (southern Gulf of St. Lawrence) during September since 1971, in 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 indices from the Div. 4T survey and the Div. 4VWX survey. Survey sampling design and methods used in the Div. 4T survey are provided in Halliday and Koeller (1981) and Koeller (1980). Different vessels were used in the Div. 4VWX survey during the periods of 1970-1981, 1982 and 1983-2003 (Fanning, 1985). However, there are no gear or vessel conversion coefficients available with which to standardize the survey indices. Indices from the 2003 Div. 4T survey are not included here because conversion coefficients are not available for the replacement vessel used in the survey and there was a reduction in the number of strata sampled (Doug Swain, per. comm.). In the computations of survey indices for Subareas 5+6, all offshore strata between depths of 27-366 m (Grosslein, 1969) were included 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 during 1971-1984, sampling in all surveys was conducted around the clock. The Div. 4T survey indices for 1985-2002 have been corrected for diel and vessel catchability differences (Benoit and Swain, 2003).

Data from three research survey series were used to derive survey abundance and biomass indices for *I. illecebrosus* in Subarea 3. Swept area estimates of absolute abundance and biomass were derived, from all strata sampled during 1988-2002 in the July EU bottom trawl survey of the Flemish Cap in Div. 3M (Saborido-Rey and Vazquez, 2001). The 2003 EU survey indices are not included herein because a conversion factor for the vessel used in 2003 is not yet available (Antonio Vazquez, per. comm.). Stratified mean number per tow and weight per tow indices were derived for all strata sampled by the Canada Division of Fisheries and Oceans (DFO) in autumn bottom trawl surveys in Div. 2J+3KLNO conducted during September-December and in spring bottom trawl surveys conducted by the DFO in Div. 3LNO+Subdiv. 3Ps in April-June during 1995-2003 (Doubleday, 1981). The survey trawl was changed in 1995 from an Engels Hi-rise trawl to a Campelen 1800 shrimp trawl, which is smaller in overall size and contains smaller mesh. Prior to 1995, *I. illecebrosus* catches were not consistently recorded during either of these surveys.

Fishing Mortality

Annual fishing mortality indices for Subareas 3+4, during 1970-2003, were computed by dividing the annual catches from Subareas 3+4 by the annual biomass indices from the July Div. 4VWX surveys.

Results and Discussion

Subareas 3+4 Fisheries

During 1992-1999, squid catches in the SA 4 international fishery ranged between 286 tons (in 1999) and 3 997 tons (in 1994) and were predominantly from the Cuban fleet. However, there has been no Cuban fishery since 1999 (NAFO 2003). Since 2000, Subarea 4 catches have been primarily from bycatch in Canadian fisheries and have been less than 45 tons (Table 1). Catches by international vessels were solely Russian and totalled 12 tons in 2000 and 4 tons in 2003 (NAFO 2003). During 1992-1999, annual catches in Subarea 3 from the Canadian inshore jig fishery were highly variable and ranged between 48 tons (in 1995) and 12,748 tons (in 1997) (Table 1). Since 2000, Subarea 3 catches have ranged between 23 t in 2001 and 1 084 tons in 2003.

Catches in Subareas 3+4 increased during the 1970s and reached a peak of 162 092 tons in 1979 (Table 1, Fig. 1). During 1976-1981, total catches (Subareas 3-6) were dominated by those from Subareas 3+4; averaging 80 645 tons in Subareas 3+4 and 19 661 tons in Subareas 5+6. Following a 1979 peak, Subarea 3+4 annual catches declined sharply, to less than 1 000 tons during 1983-1988. During 1997, Subareas 3+4 catches (15 614 tons) reached their highest level since 1981 and were primarily from the Subarea 3 inshore jig fishery (12 748 tons). After 1998, catches from Subareas 3+4 were less than 1 200 tons, varying between 57 tons (in 2001) and 1 128 tons (in 2003).

Subareas 5+6 Fishery

Catches in Subareas 5+6 reached a peak of 24 936 tons in 1976 when an international fishery existed on the eastern USA shelf (Table 1, Fig. 1). Since 1987, the Subareas 5+6 fishery has consisted solely of domestic bottom trawlers. During 1987-1997, catches were generally in the range of 10 000-18 000 tons. USA catches peaked in 1998 (23 597 tons), but the fishery was closed beginning in August because the TAC (19 000 tons) had been exceeded. After 1998, catches from Subareas 5+6 were below the 1982-2002 average (11 512 tons) and varied between 2 750 tons (in 2002) and 9 011 tons (in 2000). In 2003, catches were 6 389 tons.

Catches from Subareas 3-6

The timing and duration of the northern shortfin squid fisheries vary by Subarea. Since 1992, the Subarea 4 and 5+6 fisheries have occurred during June-October, with peak catches in July. The Subarea 3 fishery has occurred during July-November with peak catches in September (Fig.1).

Total catches from Subareas 3-6 declined by 70% between 1998 and 1999 and have been below the 1982-2002 average (15 064) since then, ranging between about 3 000 tons and 9 400 tons (Table 1, Fig. 1). This decline occurred across all Subareas, but was primarily due to insignificant landings in Subarea 4 and low catches in Subareas 5+6. During 2003, total catches were 7 517 tons.

Survey Abundance and Biomass Indices

Annual trends in relative abundance (stratified mean number per tow) and biomass (stratified mean kg per tow) are shown in Fig. 2 and presented in Table 2 for the three surveys with the longest time series. The Div. 4VWX survey generally occurs prior to the fishery in Subarea 3 and during the early phase of the Subarea 4 fishery. The Div. 4VWX survey is considered as a survey of pre-fishery biomass. 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). Since 1997, relative abundance and biomass indices have been below the averages observed for the low productivity period but have increased since reaching a time series low in 2000, to 13.0 squid per tow and 1.1 kg per tow, respectively in 2002. Abundance (12.1 squid per tow) and biomass (0.9 kg per tow) indices changed little in 2003.

Abundance indices from the Subarea 3 pre-fishery EU survey conducted in July on the Flemish Cap (Div. 3M) does not appear to track the same trends as the Div. 4VWX July survey (Table 3, Fig. 3). The Canadian spring survey in Div. 3LNO+Subdiv. 3Ps tracks abundance from the Div. 4VWX survey more closely (Table 3, Fig. 3). The Flemish Cap likely represents marginal habitat for *I. illecebrosus* and the Canadian survey is conducted during April-June, a

time when squid may not have completed their migration onto the continental shelf during some years (Dawe and Warren, 1993). The Div. 3LNO+Subdiv. 3Ps spring survey indices are of much lower magnitude than the Div. 4VWX indices (Fig. 3, Table 3) because they occur earlier and the entire survey area does not consistently represent suitable *I. illecebrosus* habitat during the time that the survey is conducted.

The survey in Subareas 5+6 occurs late in the fishing season and reflects post-fishery biomass. Other late-season surveys include the September Div. 4T survey and the September-December 2J+3KLNO survey. Indices from the latter survey are much lower in magnitude than the Subareas 5+6 indices (Table 3), but appear to track similar trends (Fig. 4).

In 2003, the Subareas 5+6 survey abundance index was the highest value in the survey time series (28.5 squid/tow) (Table 2). However, unlike the previous period with high abundance indices (*i.e.* 1976-1981), the relative biomass index in 2003 was low (1.95 kg/tow), reflecting much smaller mean body size of squid in 2003 than during 1976-1981. Despite the record high abundance index in 2003, squid were not caught in large numbers at multiple stations. During 1981, when the abundance index (27.1 squid per tow) was similar to that of 2003 (Table 2), catch rates were high at multiple stations (Fig. 5). During 2003, a large catch (3 574 squid) occurred at a single station (Fig. 6).

Body Size

Mean body weights of squid were largest during the high productivity period (1976-1981) and lower during the low productivity periods in both the Div. 4VWX July survey and the Subareas 5+6 autumn survey (Fig. 7). Mean weights were much larger in the Subareas 5+6 survey than in the Div. 4VWX survey during the high productivity period. However, this size disparity subsequently decreased due to a gradual decline in the mean size of squid from the Subareas 5+6 survey, such that squid from both surveys were of similar size (about 70-85g) during 2001-2003. This size range is similar to the 1982-2002 average size (75 g) of squid caught in the Div. 4VWX surveys (Fig. 7).

Mean mantle lengths of squid caught at New Bonaventure in the Newfoundland inshore fishery were much smaller in 2003 than in 2002 (Dawe *et al.*, 2004). Decreases in average size were associated with a reduction in length mode and a change in the predominant male maturity stage between the two years. During 2002, squid were comprised almost exclusively of large maturing individuals, whereas they were predominantly comprised of small immature squid in 2003. This unusual predominance of small squid in Newfoundland inshore waters coincides with the record high relative abundance index and record small size of squid observed in the Subareas 5+6 autumn survey during 2003.

Fishing Mortality Indices

Annual fishing mortality indices for Subareas 3+4 were high during 1977-1981, reached a peak of 4.09 in 1978 (Table 4, Fig. 8) and averaged 1.67 during the high productivity period (1976-1981). High levels during 1976-1981 were attributed to large catches and low survey indices. During 1982-2002, relative fishing mortality indices were much lower and averaged 0.18. The fishing mortality index for 2003 (0.7) was below the average for the low productivity period (Table 4).

Summary

In 2003, relative abundance and biomass indices from the Div. 4VWX July survey were well below the 1982-2002 average. The fishing mortality index was also low. The mean size of squid in the 2003 survey (71 g) was small and similar to the 1982-2002 average (75 g). Based on these trends, the Subareas 3+4 stock components remained in a state of low productivity in 2003.

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Table 1. Nominal catches (t) of *Illex illecebrosus* in NAFO Subareas 3 and 4 during 1953-2003 and Subareas 5+6 (U.S. EEZ) during 1963-2003, 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

	Subarea 3[2]	Subarea 4[3]	Total Subarea 3+4	Subareas 5+6[4,5]	Total Subareas (3-6)[6]	TAC (t)[1] 3+4	TAC (t)[1] 5+6
1996	8,285	457	8,742	16,969	25,711	150,000	21,000
Year	**(t)**	**(t)**	**(t)**	**(t)**	**(t)**		
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	228	30	258	2,750	3,008	34,000	24,000
2003	1,084	44	1,128	6,389	7,517	34,000	24,000
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	724	3,081	10,064	13,145		
1982-2002	2,254	1,297	3,551	11,512	15,063		

[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 1987-2003 were updated based on catches in the Canadian Observer and ZIF Databases

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

[5] Subareas 5+6 catches during 1994-2003 are provisional

[6] Catches during 2003 are provisional for all Subareas

Table 2. Indices of relative abundance (stratified mean number/tow) and biomass (stratified mean kg/tow) from research vessel bottom trawl surveys conducted in Subareas 5+6 (Sept-Oct, 1967-2003), Div. 4VWX (July, 1970-2003), and Div. 4T (Sept, 1971-2002).

	Subareas 5+6		Div. 4VWX		Div. 4T[1]	
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	0.20
1972	2.2	0.3	6.6	0.7	0.05	0.02
1973	1.5	0.4	10.9	1.5	0.08	0.03
1974	2.8	0.4	13.4	1.8	0.06	0.02
1975	8.7	1.4	44.8	5.0	2.47	0.54
1976	20.6	7.0	231.2	42.7	30.77	8.29
1977	12.6	3.7	50.9	9.5	25.74	7.62
1978	19.3	4.5	16.4	2.3	52.83	15.04
1979	19.4	6.1	91.4	14.2	28.47	8.19
1980	13.8	3.3	23.3	2.2	18.05	4.61
1981	27.1	9.3	35.5	4.9	5.76	1.70
1982	3.9	0.6	26.0	2.1	0.39	0.13
1983	1.7	0.2	76.9	2.1	0.09	0.02
1984	4.5	0.5	14.1	1.5	0.04	0.02
1985	2.4	0.4	80.2	2.7	0.32	0.12
1986	2.1	0.3	7.7	0.4	0.12	0.01
1987	15.8	1.5	4.9	0.4	0.22	0.05
1988	23.2	3.0	47.3	2.7	1.33	0.42
1989	22.4	3.3	26.3	2.7	0.97	0.24
1990	16.6	2.4	40.6	4.8	1.37	0.29
1991	5.2	0.7	27.1	1.8	0.17	0.03
1992	8.2	0.8	121.7	7.3	0.65	0.11
1993	10.4	1.6	79.0	5.4	0.83	0.13
1994	6.8	0.9	45.3	4.2	0.79	0.18
1995	8.0	0.7	33.9	2.4	0.32	0.03
1996	10.8	0.9	11.9	0.9	1.09	0.19
1997	5.8	0.5	52.0	4.8	0.89	0.14
1998	14.6	1.4	10.0	0.9	1.34	0.30
1999	1.4	0.2	16.7	2.0	0.47	0.11
2000	7.4	0.7	4.0	0.1	0.27	0.03
2001	4.5	0.3	4.1	0.3	0.08	0.01
2002	6.4	0.4	13.0	1.1	0.11	0.02
2003	28.5	1.9	12.1	0.9		
Average 1982-2002	8.7	1.0	35.3	2.4	0.56	0.12

[1] Indices not computed for 2003 due to lack of vessel conversion factor and reduced sampling intensity.

Table 3. Indices of *Illex illecebrosus* relative abundance (stratified mean number/tow) and biomass (stratified mean kg/tow) from Canadian bottom trawl surveys conducted in Div. 2J+3KLNO (Sept-Dec) and in Div. 3LNO+Subdiv. 3Ps (April-June) during 1995-2003, and swept areas estimates of total biomass (tons) and abundance ('000s of squid) from EU bottom trawl surveys conducted in July in Div. 3M during 1988-2002.

Year	Div. 3M Survey[1] July		Div. 2J+3KLNO Survey Sept-Dec		Div. 3LNO+Subdiv. 3Ps Survey April-June	
	Total Abundance ('000s of squid)	Total Biomass (t)	(number/tow)	(kg/tow)	(number/tow)	(kg/tow)
1988	46	5				
1989	86	8				
1990	18,698	1,647				
1991	14,454	1,159				
1992	897	66				
1993	27	1				
1994	3,002	211				
1995	57	1	<0.01	<0.01	0.04	<0.01
1996	1,286	87	0.08	<0.01	0.24	0.04
1997	956	64	0.14	0.01	0.30	0.04
1998	1,178	71	0.84	0.05	0.12	0.02
1999	701	18	0.03	<0.01	0.03	0.01
2000	175	3	<0.01	<0.01	0.09	0.01
2001	469	7	<0.01	<0.01	0.04	0.01
2002	432	7	<0.01	<0.01	0.25	0.02
2003			0.48	0.02	0.19	0.03

[1] Indices not computed for 2003 due to lack of vessel conversion factor.

Table 4. 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 1970-2003. Fishing mortality indices were divided by 10,000 to scale the values.

Year	SA 3+4 Nominal Catch (t)	Div. 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	258	1.1	0.02
2003	662	0.9	0.07
Average			
1976-1981	80,645	12.6	1.67
1982-2002	3,551	2.4	0.18

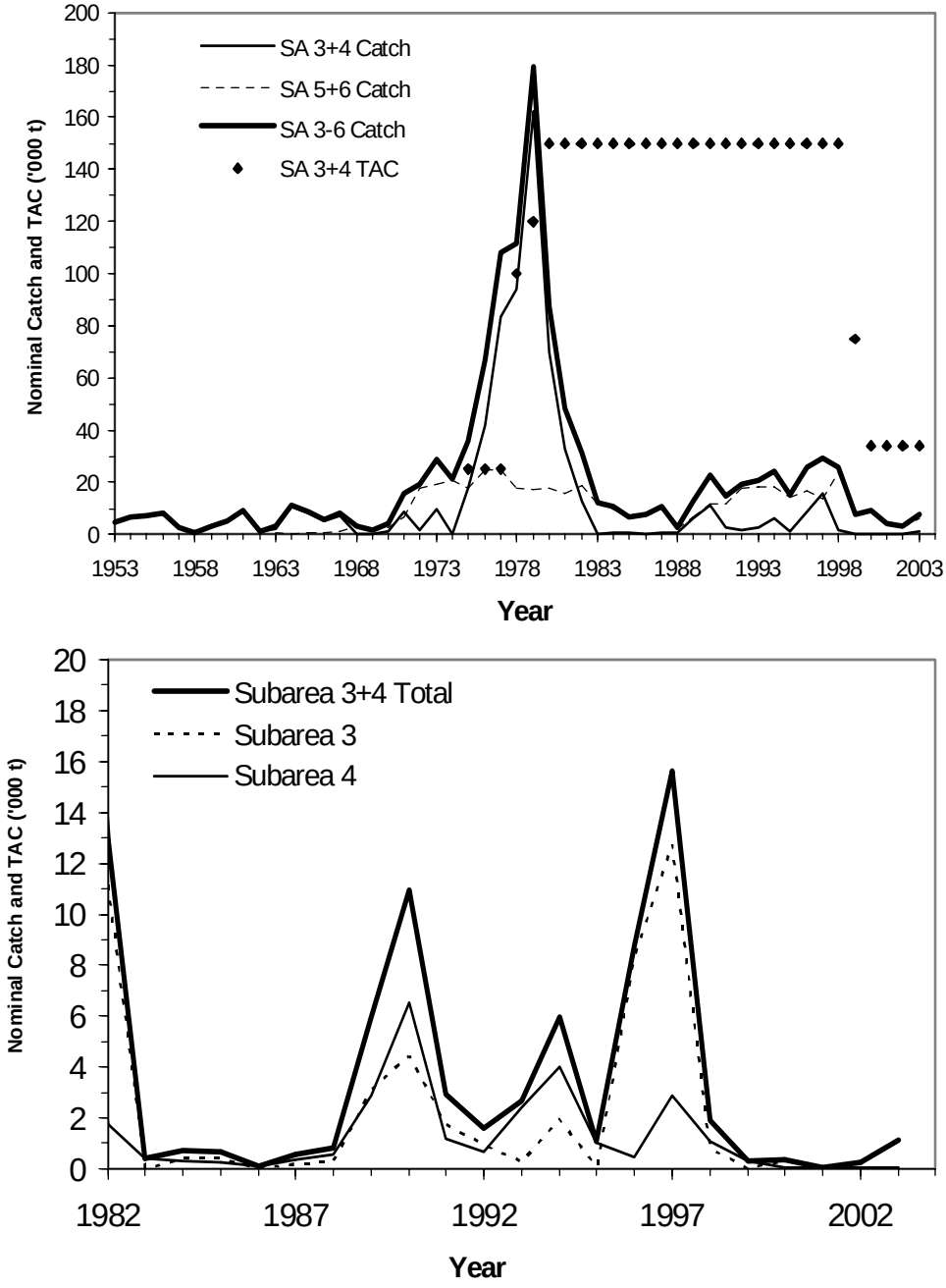

Fig. 1. Nominal catches ('000 t) of *Illex illecebrosus* and TACs in Subareas 3 and 4 during 1953-2003, and Subareas 5+6 during 1963-2003 (top) and nominal catches in Subarea 3 and Subarea 4 during 1982-2003 (bottom).

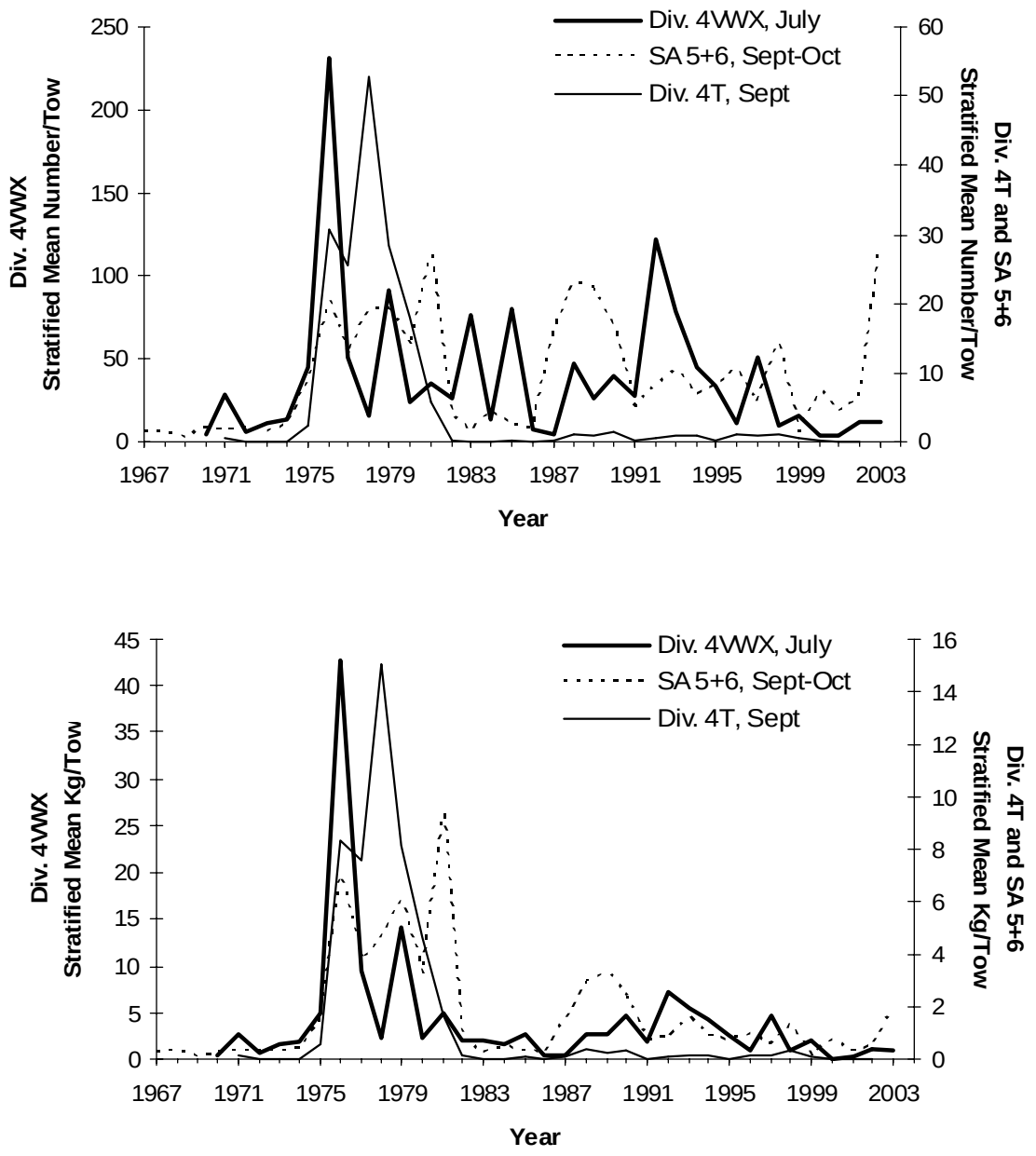

Fig. 2. *Illex illecebrosus* relative abundance (stratified mean number/tow) (top) and biomass indices (stratified mean kg/tow) (bottom) from the Canadian Div. 4VWX (July, 1970-2003) and Div. 4T surveys (September, 1971-2002), and the U.S. surveys in Subareas 5+6 (September-October, 1967-2003).

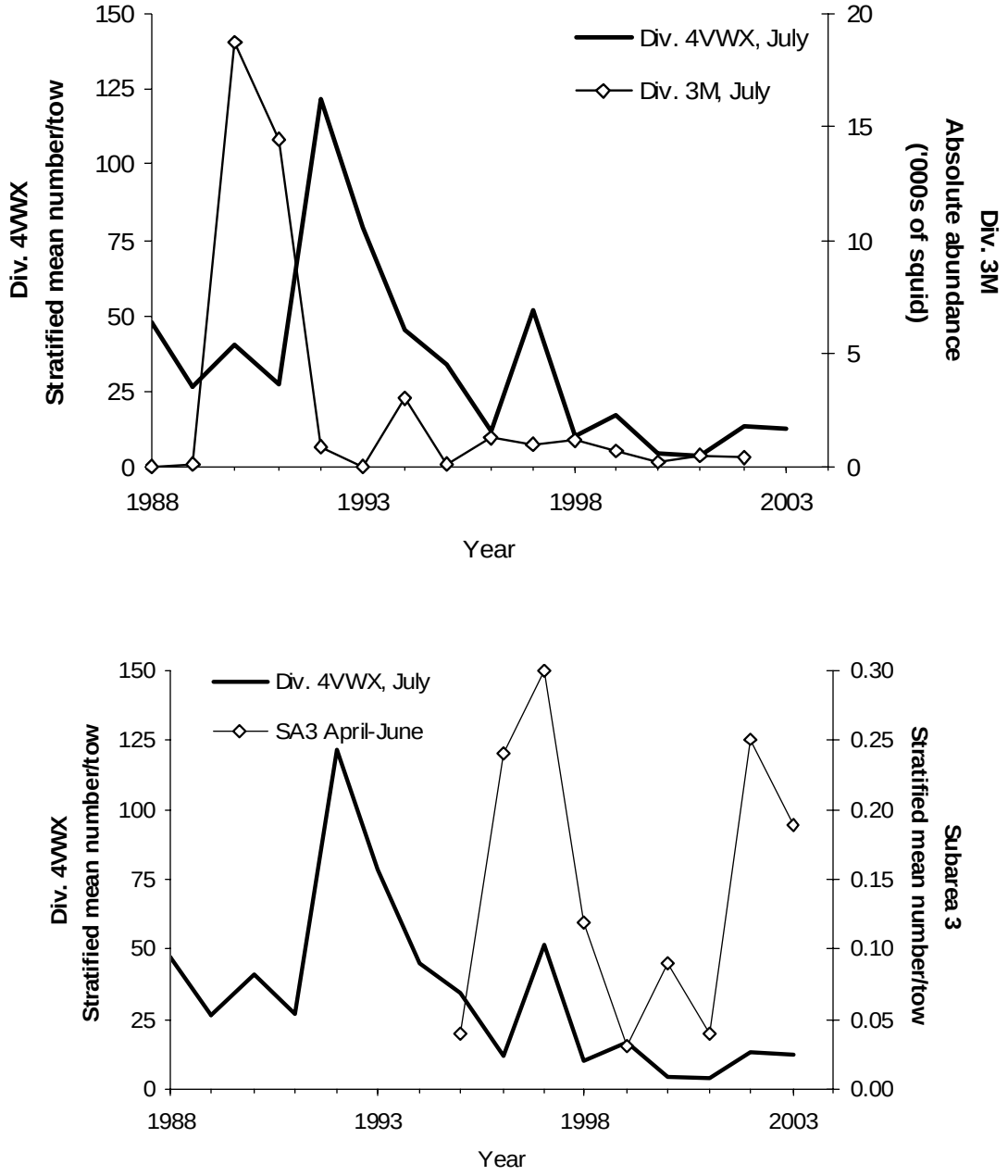

Fig. 3. Abundance indices (stratified mean number/tow) of *Illex illecebrosus*, during July of 1988-2003, in the Canadian bottom trawl surveys in Div. 4VWX (July) and the EU bottom trawl survey in Div. 3M (absolute abundance, '000 squid) (top) and the Canadian surveys in 3LNOPs (April-June) (bottom).

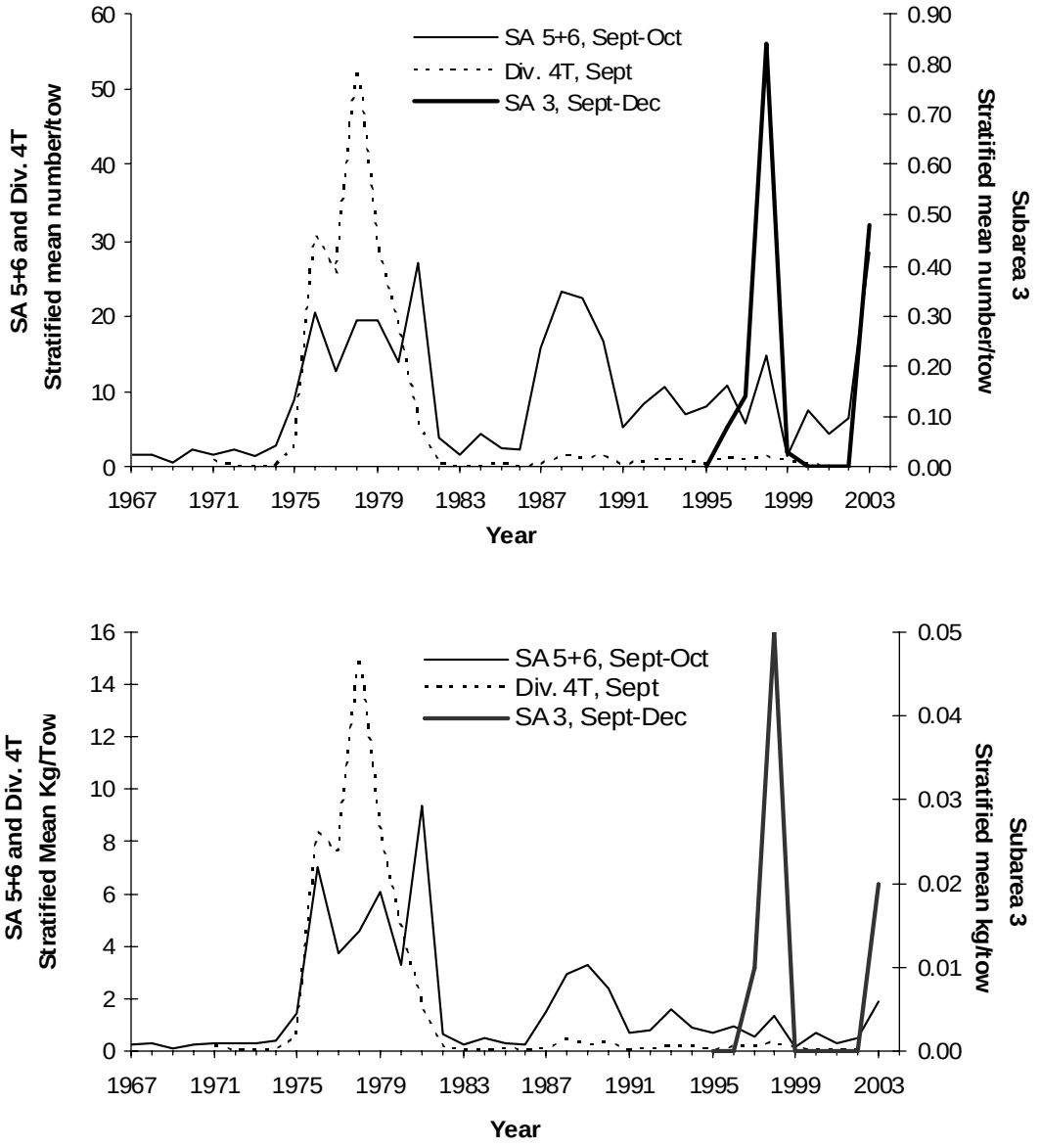

Fig. 4. *Illex illecebrosus* indices of relative abundance (stratified mean number/tow) (top) and biomass (stratified mean number/tow) (bottom), during autumn, from the Canadian bottom trawl survey in Div. 2J+3KLNO (1995-2003) and Div. 4T (1971-2002) and the U.S. bottom trawl surveys in Subareas 5+6 (1967-2003).

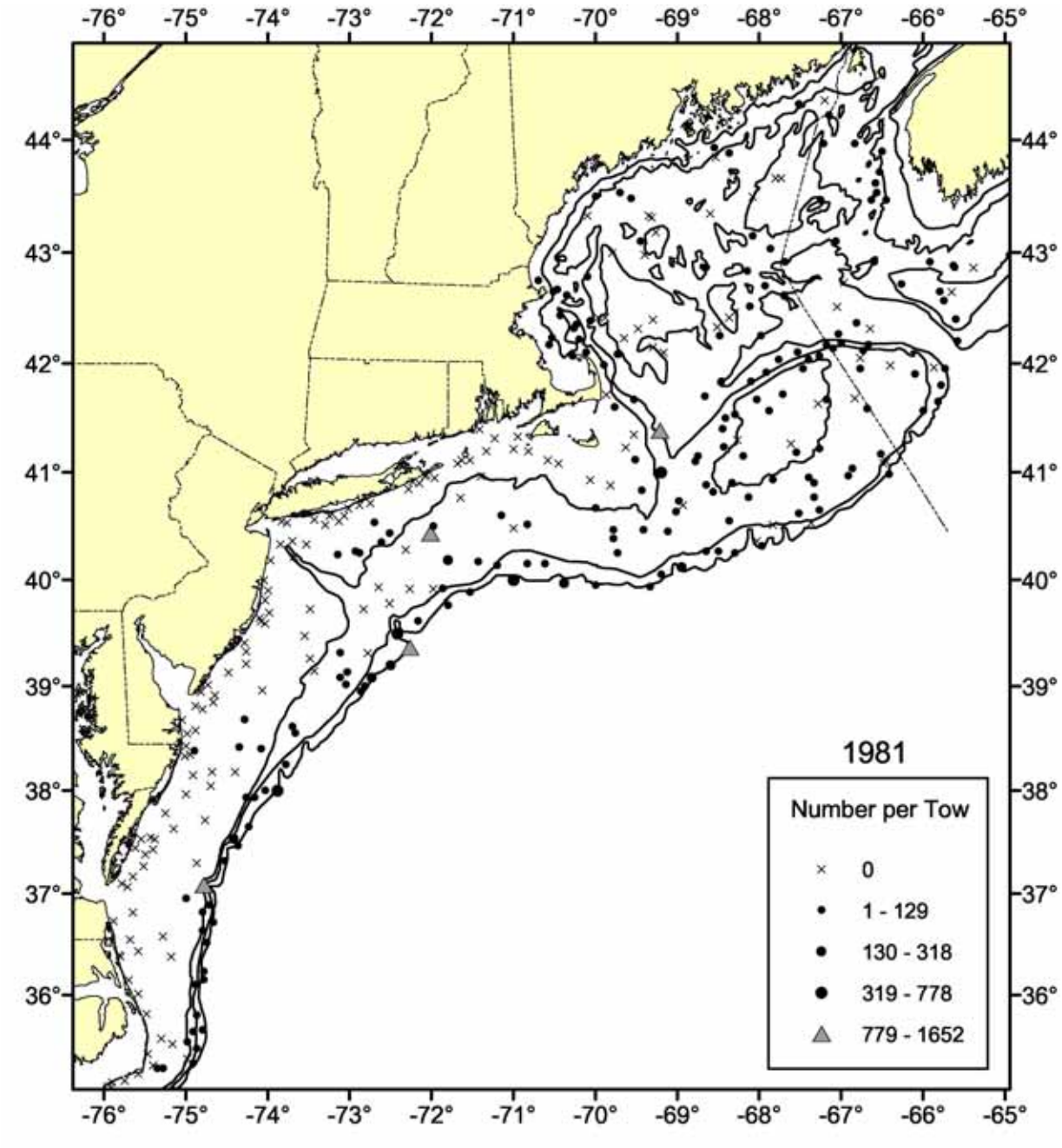

Fig. 5. Distribution of *Illex illecebrosus* during the 1981 NEFSC autumn bottom trawl survey. The 50, 100 and 200 m isobaths are shown.

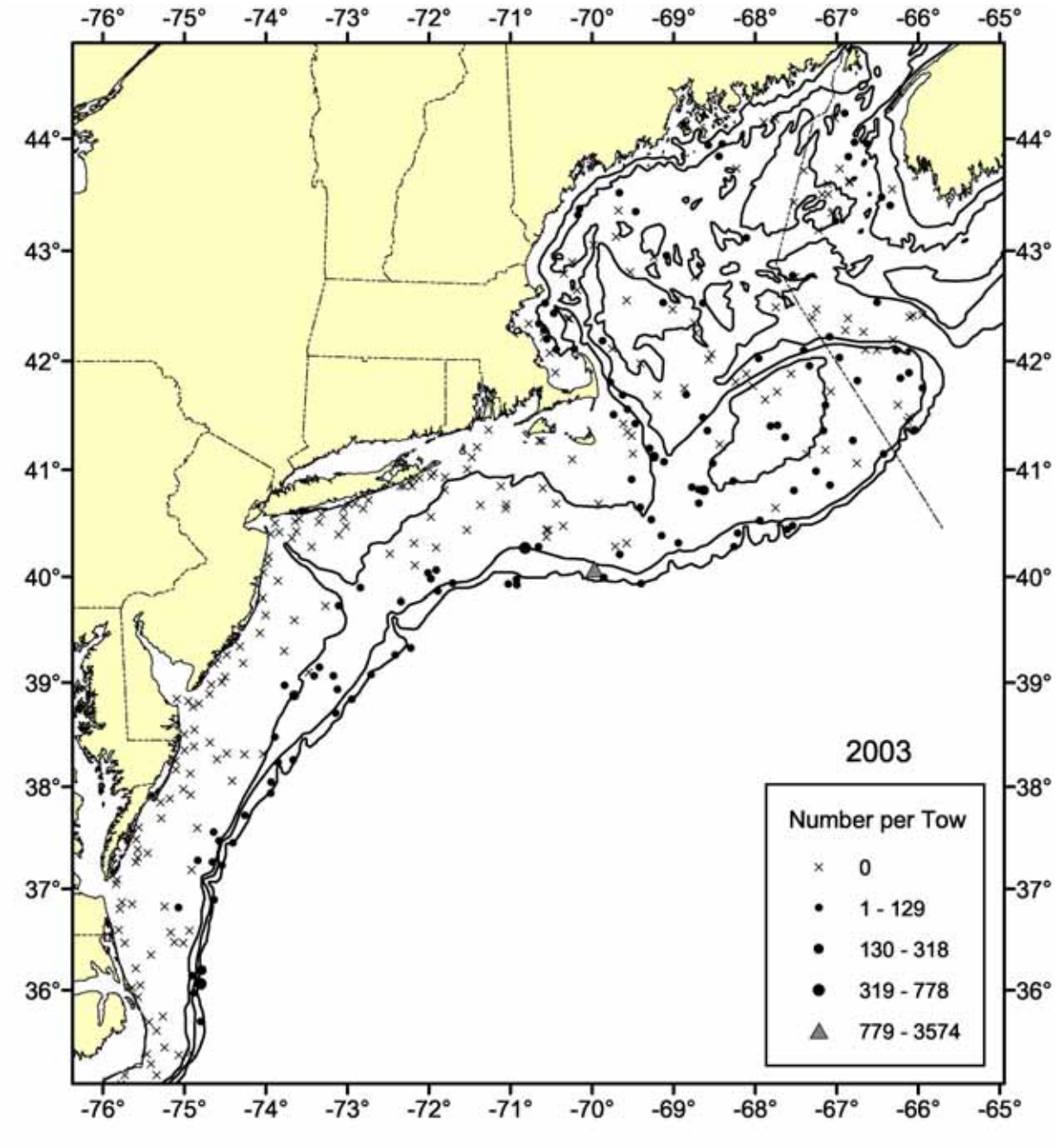

Fig. 6. Distribution of *Illex illecebrosus* during the 2003 NEFSC autumn bottom trawl survey. The 50, 100 and 200 m isobaths are shown.

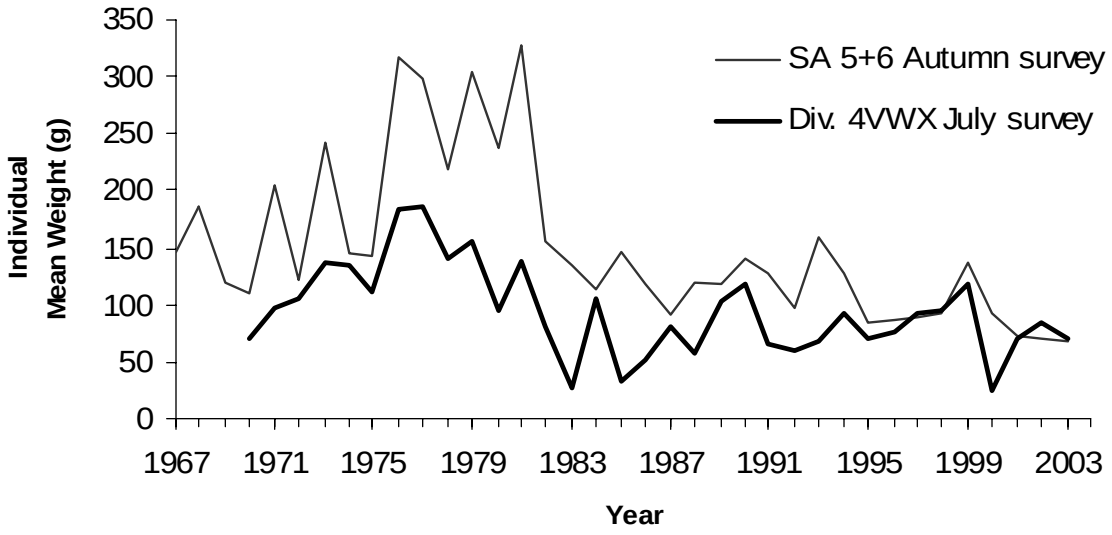

Fig. 7. Mean weight per individual (g) of *Illex illecebrosus* caught in the Subareas 5+6 autumn bottom trawl surveys (1967-2003) and Canadian Div. 4VWX July bottom trawl surveys (1970-2003).

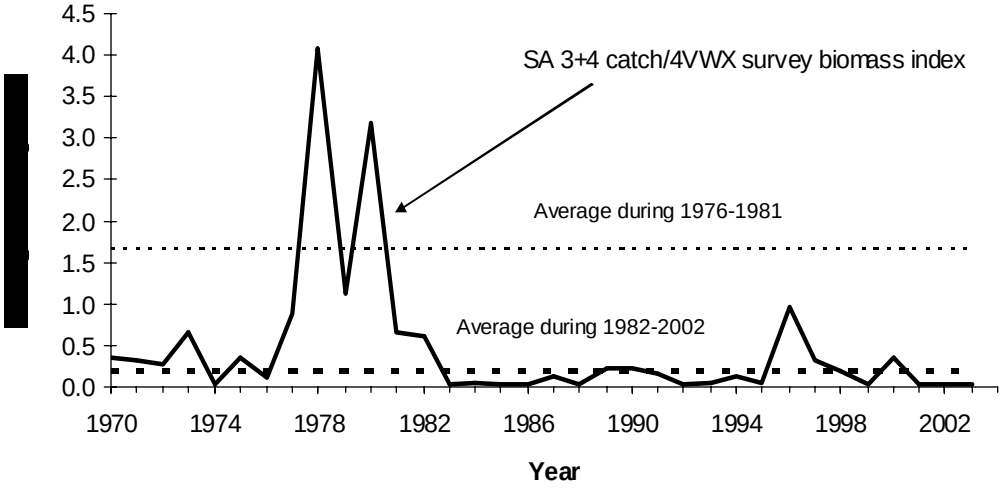

Fig. 8. Fishing mortality indices (SA 3+4 nominal catch/Div. 4VWX July survey biomass index) in Subareas 3+4 during 1970-2003, and averages during the high (1976-1981) and low (1982-2003) productivity periods. Fishing mortality indices were divided by 10,000 to scale the values.