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Interim Monitoring Report for the Assessment of Northern Shortfin Squid (*Illex illecebrosus*) in Subareas 3+4 during 2004

by

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Abstract

This document provides an interim update of the status of the Subareas 3+4 component of the *Illex illecebrosus* stock during 2004. The Subareas 3+4 stock component has been in a state of low productivity since 1982. During 2004, relative abundance and biomass indices from the July 4VWX survey were the third highest on record. However, the indices should be interpreted with caution because the 2004 survey was conducted with a vessel different from the one utilized since 1983 and *Illex* catch rates could not be standardized. The ten-fold increase observed in relative abundance between 2003 and 2004 is not uncommon during the low productivity period; an increase of similar magnitude occurred between 1987 and 1988. The mean weight of squid during 2004 was also within the range of mean weights observed during the low productivity period. Therefore, there is no compelling evidence to suggest a change in stock status during 2004.

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 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. During 1987-1999, Subarea 4 catches were primarily from an international bottom trawl fishery for silver hake (*Merluccius bilinearis*), *I. illecebrosus* and argentine (*Argentina* sp.) that occurred on the Scotian Shelf (Dawe and Hendrickson 1998). However, there has been no directed fishery for *Illex* in Subarea 4 since 1999 (Hendrickson *et al*., 2004). 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, comprised of U.S. vessels, 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 1982-2003). The average weights of

squid were larger during the high productivity period and smaller during the low productivity period in both Subarea 4 and Subareas 5+6 (Hendrickson, 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 composed 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 update of the status of the Subareas 3+4 component, during 2004, based on trends in commercial fishery data, research survey data, and fishing mortality indices.

Materials and Methods

Commercial Fishery Data

Nominal catches from Subarea 3 and Subarea 4 are presented for 1953-2004. Subarea 3 catches were obtained from Dawe (1981) and the catch database maintained by the Division of Fisheries and Oceans in Newfoundland. Subarea 4 catches were obtained from ICNAF (1973), and during 1987-2004, were obtained from the Canadian Observer Database and the Zonal Inter-change Format (ZIF) Database. Catches from Subareas 5+6, during 1963-1978, were obtained from Lange and Sissenwine (1980) and catches during 1979-2004 were obtained from the Weighout Database maintained by the Northeast Fisheries Science Center of the United States National Marine Fisheries Service. As of May of 2004, the data collection method for reporting catches in Subareas 5+6 changed from electronic reporting of purchases by Federal port agents to electronic reporting of purchases by dealers.

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. 4VWX (Scotian Shelf) since July of 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 4VWX survey indices. Different vessels were used to conduct the surveys during 1970-1981 (R/V *A. T. Cameron*), 1982 (R/V *Lady Hammond*), 1983-2003 (R/V *Alfred Needler*), and 2004 (R/V Teleost), and a net change occurred in 1982. However, there are no gear or vessel conversion coefficients available for the standardization of *Illex* caches throughout the time series (Fanning, 1985). All offshore strata, between depths of 27-366 m (Grosslein, 1969), were included in the computations of the Subareas 5+6 survey indices and gear and vessel standardization coefficients were applied (NEFSC, 1999). Sampling during both surveys was conducted around the clock.

The Div. 4VWX July survey indices are considered pre-fishery indices because the survey generally occurs prior to the Subarea 3 fishery and during the early phase of the Subarea 4 fishery. Indices from the survey in Subareas 5+6 are considered post-fishery indices because the survey occurs near the end of the *Illex* fisheries in all Subareas.

Fishing Mortality

Annual fishing mortality indices for Subareas 3+4, during 1970-2004, were computed by dividing annual catches in Subareas 3+4 by the annual biomass indices from the July Div. 4VWX surveys.

Results

Catches

During the high productivity period (1976-1981), catches in Subareas 3+4 ranged from 32,862 t to 162,092 t, but only ranged between 57 t and 15,614 t during the low productivity period in 1982-2003 (Table 1, Fig. 1). Since 2000, there has been no directed fishery for *Illex* in Subarea 4 (Hendrickson *et al*., 2004) and total catches in Subareas 3+4 have been primarily from the Subarea 3 jig fishery. Catches in Subareas 3+4 increased from 1,128 t in 2003 to 2,034 t in 2004 but remained below the average for the low productivity period (3,441 t during 1982-2003).

During the high productivity period, catches in Subareas 5+6 ranged from 15,571 t to 24,936 t (Table 1, Fig. 1). During 1982-2003, catches ranged from 1,958 t to 23,597 t. The Subareas 5+6 *Illex* fishery was closed in September 2004 because the TAC (24,000 t) had been attained.

Combined catches from Subareas 3-6 increased from 7,517 t in 2003 to 27,260 t in 2004; the highest level since 1997 (Table 1, Fig. 1). This increase was primarily due to an increase in catches from Subareas 5+6.

Research Survey Abundance and Biomass Indices

Relative biomass indices from the 4VWX surveys indicate a period of high productivity during 1976-1981, averaging 12.6 kg/tow, followed by a low productivity period during 1982-2003, averaging 2.3 kg/tow (Fig. 2). During 2004, indices of relative abundance (119.3 squid per tow) and biomass (12.9 kg per tow) were the third highest on record. However, the indices should be interpreted with caution because the 2004 survey was conducted with a vessel different from the one that has been utilized since 1983 and *Illex* catch rates could not be standardized. The ten-fold increase observed in relative abundance between 2003 and 2004 is not uncommon during the low productivity period; an increase of similar magnitude occurred between 1987 and 1988.

Relative abundance indices from research bottom trawl surveys conducted in Subareas 5+6 dropped sharply between 2003 and 2004, from the highest level on record, 28.5 squid per tow, to 5.1 squid per tow (Fig. 2). Biomass indices dropped from 1.9 to 0.4 kg per tow between 2003 and 2004.

Body Size

The mean weight of squid caught in the Division 4VWX surveys was 150 g during the high productivity period and 75 g during the low productivity period (Fig. 3). During 2004, the mean weights of squid from Div. 4VWX and Subareas 5+6 were108 g and 82 g, respectively. A mean weight of 108 g is within the range of mean weights observed during the low productivity period (25 g to 119 g). However, the 2004 mean size of squid from the Division 4VWX survey could not be standardized against the rest of the time series.

Fishing Mortality Indices

Annual fishing mortality indices for Subareas 3+4 were high during 1977-1981, reaching a peak of 4.09 in 1978 (Fig. 4) and averaging 1.67 during the high productivity period (1976-1981). Relative fishing mortality rates were much lower during 1982-2003 and averaged 0.17. During 2004, the fishing mortality index was very low (0.02) similar to the 2001 and 2002 levels.

Summary

The Subareas 3+4 stock component has been in a state of low productivity since 1982. During 2004, relative abundance and biomass indices from the July 4VWX survey were the third highest on record. However, the indices should be interpreted with caution because the 2004 survey was conducted with a vessel different from the one utilized since 1983 and *Illex* catch rates could not be standardized. The ten-fold increase observed in relative abundance between 2003 and 2004 is not uncommon during the low productivity period; an increase of similar magnitude occurred between 1987 and 1988. The mean weight of squid during 2004 was also within the range of mean weights observed during the low productivity period. Therefore, there is no compelling evidence to suggest a change in stock status during 2004.

Acknowledgements

We thank Bob Mohn and Stephen Smith for providing the 2004 catches and survey indices for Subarea 4.

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Table 1. Nominal catches (t) of *Illex illecebrosus* in NAFO Subareas 3 and 4, during 1953-2004, and Subareas 5+6 (U.S. EEZ), during 1963-2004, and total allowable catches (TACs) in Subareas 3+4 and Subareas 5+6.

Year	Subarea 3[2] (t)	Subarea 4[3] (t)	Total Subarea 3+4 (t)	Subareas 5+6[4,5] (t)	Total Subareas (3-6)[6] (t)	TAC (t)[1] 3+4	TAC (t)[1] 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
Year	**(t)**	**(t)**	**(t)**	**(t)**	**(t)**		
1997	12,748	2,866	15,614	13,629	29,243	150,000	19,000

	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
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
2004	2,000	34	2,034	25,226	27,260	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		
1997-2003	2,178	626	2,804	9,539	12,343		
1982-2003	2,201	1,240	3,441	11,280	14,721		

[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 Subsareas 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 1994-2004 are provisional

[6] Catches during 2004 are provisional for all Subareas

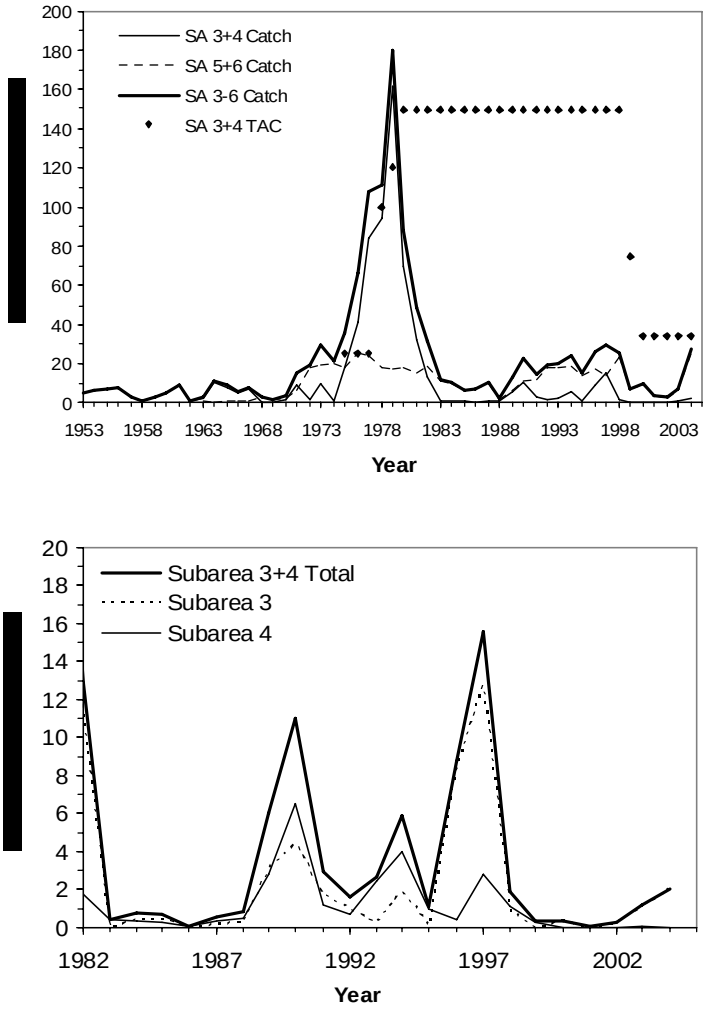

Fig. 1. Nominal catches ('000 t) of *Illex illecebrosus* and TACs in Subareas 3 and 4, during 1953-2004, and Subareas 5+6 during 1963-2004 (top) and nominal catches in Subarea 3 and Subarea 4 during 1982-2004 (bottom).

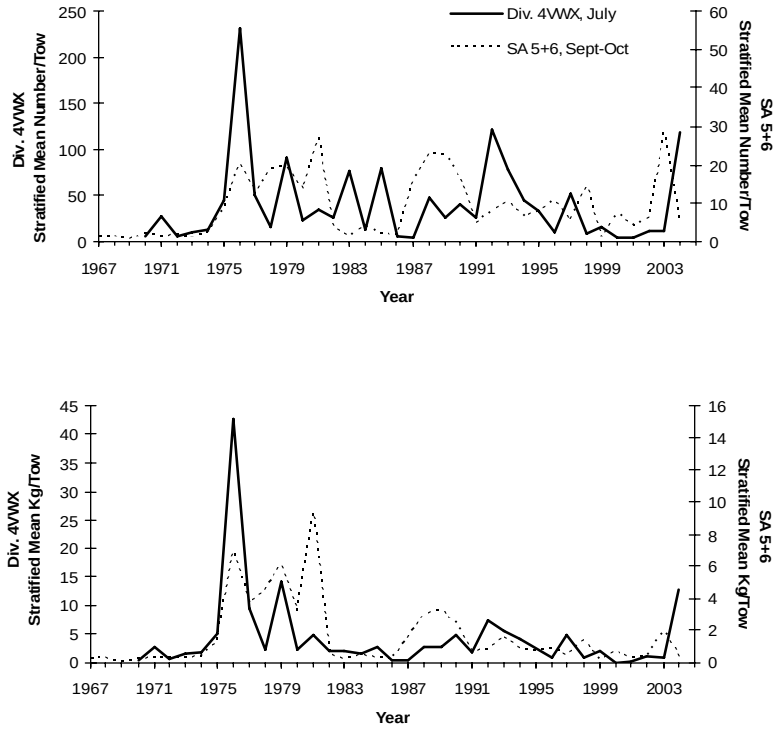

Fig. 2. *Illex illecebrosus* relative abundance (stratified mean number/tow) (top) and biomass indices (stratified mean kg/tow) (bottom) from the Division 4VWX surveys (July, 1970-2004) and Subareas 5+6 surveys (September-October, 1967-2004). Survey indices are not standardized for vessel changes that occurred during 1981, 1982, 1983, and 2004.

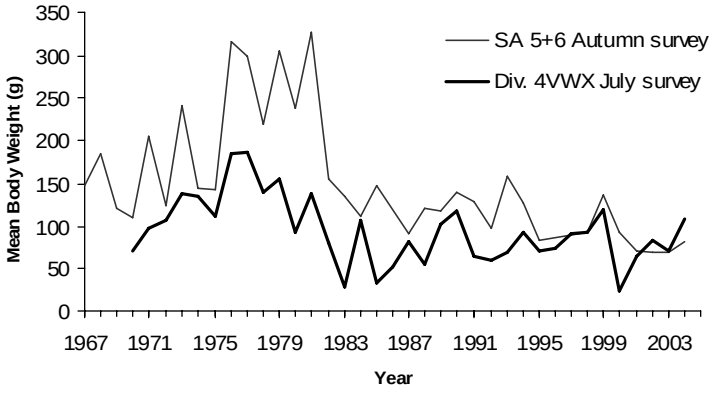

Fig. 3. Mean weight per individual (g) of *Illex illecebrosus* caught in the Subareas 5+6 autumn bottom trawl survey (1967-2004), Canadian Division 4VWX July bottom trawl surveys (1970-2004).

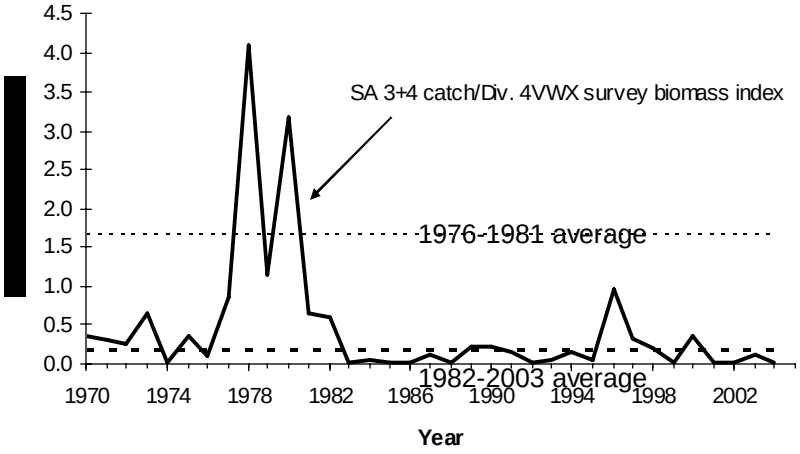

Fig. 4. Fishing mortality indices (SA 3+4 nominal catch/Division 4VWX July survey biomass index) in Subareas 3+4, during 1970-2004, and averages during the high (1976-1981) and low (1982-2004) productivity periods. Fishing mortality indices were divided by 10,000 to scale the values.