

Updates of NEFSC Survey Relative Biomass Indices and Catches for *Illex illecebrosus* through 2021

by
Lisa Hendrickson

Population Dynamics Branch
Northeast Fisheries Science Center, NOAA Fisheries
Woods Hole, MA 02543

June 27, 2022

1.0 Background

This report updates the *Illex illecebrosus* catches and NEFSC research survey relative biomass indices that were included in the 2021 Research Track Assessment (RTA) with the 2020 and 2021 data. These data were prepared for use by the MAFMC SSC at their July 25, 2022 meeting to set a preliminary ABC for 2023 for the U.S. stock component of this transboundary resource. During their April 2022 meeting, the Assessment Oversight Panel requested this data update report in lieu of conducting a Management Track Assessment (MTA). The inability to conduct an MTA is due to the lack of an accepted stock assessment method from the RTA, and the fact that the SSC will not be updating the ABC estimate until early 2023.

2.0 Catches

Landings from the RTA were updated for 2020 and 2021 for both the southern (U.S.) and northern (Subareas 3+4) stock components. The Subareas 5+6 (U.S.) landings were retrieved from the new Catch Accounting and Monitoring System (CAMS) database which replaced the former NEFSC Area Allocated (AA) database in 2020. Landings from the two databases can only be compared for 2019. The comparison indicated that the two values were similar; the CAMS landings (27,173) were 0.03% greater than the AA landings (27,164 mt). This minor difference was not unexpected because the AA database is static following its creation, unlike the CAMS database. A review of the 2019 CAMS data is presented in the report entitled “Review of CAMS 2019 landings, value and effort data”.

During 1998-2020, with the exception of 2006, the U.S. fishery landed most (85-100%) of the total stock landings (Table 1, Figure 1). However, during 2021, the U.S. landings represented only 75% of the total stock landings due to a large increase in landings from the Newfoundland jig fishery. During 1987-2016, U.S. landings averaged 11,914 mt, with a minimum of 1,958 mt in 1988 and a maximum of 26,097 mt in 2004 (Table 1, Figure 1). During this 30-year period, fishery closures occurred during 1998 and 2004. U.S. landings increased during 2017-2021, primarily due to increased fishing effort associated higher ex-vessel price, increased fleet size and a 37% increase in the TAC between 2018 and 2021. During 2017-2021, fishery closures occurred because the harvesting of the quota buffer tonnage was projected. The quota was exceeded during 2018 and 2019. During 2021, U.S. landings (30,886 mt) were the highest on record. Landings from SA 3+4 totaled 11,455 mt during 2021; more than triple the 2020 landings (3,099 mt) and the highest

landings for the northern stock component in 23 years. Stock-wide landings during 2021 (42,341 mt) were the highest since 1981 (Table 1, Figure 1).

The U.S. discard time series included in the RTA was updated for 2020 and 2021. Discards are not quantified for the Subarea 3 jig fishery by Canadian fishery observers, but are assumed to be negligible because the fishery utilizes hand reel jigs that select for large squid and catches are not culled (Earl Dawe, CA DFO, pers. comm.). As noted in the RTA, there has been no directed *Illex* fishery in Subarea 4 since 1999. The 2020 U.S. discards were estimated as the average percentage (4.8%) of the Dealer Area Allocated landings reported during 2017-2019 because the COVID-19 pandemic prevented observer coverage of the *Illex* fishery. The 2021 discards were estimated using the SBRM estimation method that was used to estimate the RTA discard time series, but the CAMS landings rather than the Dealer Area Allocated landings were used in the discard computations. Discards averaged 7.4% of the landings during 1997-2016 and 4.2% of the landings during 2017-2021 (Table 1, Figure 1).

During 1987-2016, U.S. catches averaged 12,534 mt, with a minimum of 2,058 mt in 1988 and a maximum of 27,499 mt in 2004 (Table 1, Figure 1). Thereafter, U.S. catches increased from 23,371 mt in 2017 to 31,421 in 2021; the latter being the highest catch on record. Total stock catch averaged 14,968 mt during 1987-2016 and 31,600 during 2017-2021. The 2021 total stock catch (42,876 mt) was the highest on record (Table 1, Figure 1).

3.0 NEFSC Research Survey Relative Biomass Indices

Relative biomass indices (standardized, stratified mean kg per tow) derived with data from the NEFSC spring and fall bottom trawl surveys were updated for 2020 and 2021. Availability of this species to the spring surveys is much lower than for the fall surveys, but the spring survey indices are presented here because both the spring and fall biomass indices are used in the Rago Indirect Estimation Approach.

As is characteristic of most squid species, both the NEFSC spring and fall survey biomass indices are highly variable, especially for the spring biomass indices which have higher CVs (Table 2, Figure 3). During 2020, the spring survey ended early and the fall survey was not conducted due to the COVID-19 pandemic, so there are no 2020 biomass indices available. In recent years, the fall survey biomass indices decreased from 2.85 kg per tow in 2006 to 0.53 kg per tow in 2010, which was below the median (0.68 kg per tow). With the exception of 2018 (1.32 kg per tow), fall biomass indices were primarily below the median during 2011-2021. The 2021 biomass index was 0.64 kg per tow. During 2006-2021, the spring survey biomass indices fluctuated without trend, but were generally below the median (0.024 kg per tow) during 2006-2016 and well above the median during 2017-2021. The 2017-2021 period included the three highest biomass indices of the time series, of which the 2021 biomass index (0.319 kg per tow) was the second highest (Figure 3).

Table 1. *Illex illecebrosus* landings, discards and catches (mt) in NAFO Subareas (SA) 5+6 (within the U.S. EEZ after 1976) and Subareas 3+4 (NAFO and Canadian waters) during 1963-2021¹⁻¹¹ and total allowable catches (TACs) during 1974-2022.

Year	Cape Hatteras to the Gulf of Maine SA 5+6 Landings			SA 3+4	SA 3-6 Total	SA 5+6		SA 3-6 Total	SA 5+6				
	Domestic (mt)	International (mt)	Total (mt)	Landings (mt)	Landings (mt)	Discards (mt)	Catches (mt)	Catches (mt)	TAC (mt)		% of TAC Harvested	Fishery Closure Dates	% of SA 3-6 Landings
1963	810		810	2,222	3,032								
1964	358	2	360	10,777	11,137								
1965	444	78	522	8,264	8,786								
1966	452	118	570	5,218	5,788								
1967	707	288	995	7,033	8,028								
1968	678	2,593	3,271	56	3,327								
1969	562	975	1,537	86	1,623								
1970	408	2,418	2,826	1,385	4,211								
1971	455	6,159	6,614	8,906	15,520								
1972	472	17,169	17,641	1,868	19,509								
1973	530	18,625	19,155	9,877	29,032								
1974	148	20,480	20,628	437	21,065					71,000			98
1975	107	17,819	17,926	17,696	35,622					71,000			50
1976	229	24,707	24,936	41,767	66,703				25,000	30,000	83		37
1977	1,024	23,771	24,795	83,480	108,275				25,000	35,000	71		23
1978	385	17,207	17,592	94,064	111,656				100,000	30,000	59		16
1979	1,593	15,748	17,341	162,092	179,433				120,000	30,000	58		10
1980	299	17,529	17,828	69,606	87,434				150,000	30,000	59		20
1981	615	14,956	15,571	32,862	48,433				150,000	30,000	52		32
1982	5,871	12,762	18,633	12,908	31,541				150,000	30,000	62		59
1983	9,775	1,809	11,584	426	12,010				150,000	30,000	39		96
1984	9,343	576	9,919	715	10,634				150,000	30,000	33		93
1985	5,033	1,082	6,115	673	6,788				150,000	30,000	20		90
1986	6,493	977	7,470	111	7,581				150,000	30,000	25		99
1987	10,102	0	10,102	562	10,664	517	10,619	11,181	150,000	30,000	34		95
1988	1,958	0	1,958	811	2,769	100	2,058	2,869	150,000	30,000	7		71
1989	6,801	0	6,801	5,971	12,772	498	7,299	13,270	150,000	30,000	23		53
1990	11,670	0	11,670	10,975	22,645	341	12,011	22,986	150,000	30,000	39		52
1991	11,908	0	11,908	2,913	14,821	1,150	13,058	15,971	150,000	30,000	40		80
1992	17,827	0	17,827	1,578	19,405	248	18,075	19,653	150,000	30,000	59		92
1993	18,012	0	18,012	2,686	20,698	443	18,455	21,141	150,000	30,000	60		87
1994	18,350	0	18,350	5,951	24,301	354	18,704	24,655	150,000	30,000	61		76
1995	13,976	0	13,976	1,055	15,031	58	14,034	15,089	150,000	30,000	47		93
1996	16,969	0	16,969	8,742	25,711	243	17,212	25,954	150,000	21,000	81		66
1997	13,356	0	13,356	15,614	28,970	1,002	14,358	29,972	150,000	19,000	70		46
1998	23,568	0	23,568	1,902	25,470	586	24,154	26,056	150,000	19,000	124	8/28	93
1999	7,388	0	7,388	305	7,693	1,094	8,482	8,787	75,000	19,000	39		96
2000	9,011	0	9,011	366	9,377	106	9,117	9,483	34,000	24,000	38		96
2001	4,009	0	4,009	57	4,066	466	4,475	4,532	34,000	24,000	17		99
2002	2,750	0	2,750	260	3,010	157	2,907	3,167	34,000	24,000	11		91
2003	6,391	0	6,391	1,133	7,524	166	6,557	7,690	34,000	24,000	27		85
2004	26,097	0	26,097	2,574	28,671	1,402	27,499	30,073	34,000	24,000	109	9/21	91
2005	12,011	0	12,011	578	12,589	1,850	13,861	14,439	34,000	24,000	50		95
2006	13,944	0	13,944	6,981	20,925	1,556	15,500	22,481	34,000	24,000	58		67
2007	9,022	0	9,022	246	9,268	639	9,661	9,906	34,000	24,000	38		97
2008	15,900	0	15,900	534	16,434	1,529	17,429	17,963	34,000	24,000	66		97
2009	18,418	0	18,418	718	19,136	672	19,090	19,808	34,000	24,000	77		96
2010	15,825	0	15,825	120	15,945	569	16,394	16,514	34,000	24,000	66		99
2011	18,797	0	18,797	126	18,923	690	19,487	19,613	34,000	23,328	81		99
2012	11,709	0	11,709	47	11,756	502	12,211	12,258	34,000	22,915	51		100
2013	3,792	0	3,792	27	3,819	315	4,107	4,134	34,000	22,915	17		99
2014	8,767	0	8,767	21	8,788	575	9,342	9,363	34,000	22,915	38		100
2015	2,422	0	2,422	14	2,436	451	2,873	2,887	34,000	22,915	11		99
2016	6,684	0	6,684	152	6,836	320	7,004	7,156	34,000	22,915	29		98
2017	22,516	0	22,516	365	22,881	855	23,371	23,736	34,000	22,915	98	9/15	98
2018	24,117	0	24,117	1,545	25,662	1,407	25,524	27,069	34,000	22,915	105	8/15	94
2019	27,164	0	27,164	2,914	30,078	1,331	28,495	31,409	34,000	24,825	109	8/21	90
2020	28,447	0	28,447	3,099	31,546	1,365	29,812	32,911	34,000	28,644	99	8/31	90
2021	30,886	0	30,886	11,455	42,341	535	31,421	42,876	34,000	31,478	98	8/30	73
2022									34,000	38,156			
AVERAGES													
1976-1981	691	18,986	19,677	80,645	100,322						64		23
1963-1986	1,950	9,472	11,027	23,855	34,882						51		56
1987-2020	13,520	0	13,520	2,381	15,901	693	14,213	16,593			55		88
1997-2020	13,838	0	13,838	1,654	15,492	817	14,655	16,309			59		92
1963-2020	8,732	3,890	12,488	11,267	23,755								

¹ Subarea 5+6 landings for some countries, during 1963-1979, were not reported by species and are shown as prorated estimates from Lange and Sissenwine (1980)

² Subareas 5+6 landings during 1980-2003 were retrieved from the Northeast Fisheries Science Center Dealer Database.

³ Domestic landings during 1982-1991 include Joint-Venture landings.

⁴ Landings from Subareas 3+4 include small amounts of landings from Subarea 2.

⁵ Catches during 2021 are preliminary for all Subareas.

⁶ Subareas 5+6 2020 discards were assumed to be 4.8 % of the landings (2017-2019 average) because observers were not placed on fishing vessels until after the fishery closure due to COVID-19.

⁷ Subareas 5+6 discards were hindcast for the first two years of the domestic fishery (1987 and 1988) and were estimated as the average % of the landings during 1989-1990 (5.12%).

⁸ There are no discard data available for the Subarea 3 offshore international fleets (trawlers and jiggers) during 1970-1979, which comprised a maximum of 14% of Subarea 3 total landings (Dawe 1981).

⁹ Subarea 3 discards for the inshore jig fishery were not sampled by fishery observers and were assumed to be zero during all years because jigs select for large squid so the catches are not culled.

¹⁰ The 2022 TAC for Subareas 5+6 will go into effect prior to the end of the fishing season.

¹¹ Landings data from 2020 onward were retrieved from the Catch Accounting and Monitoring System (CAMS) database which replaced the Allocated Area database.

¹² The 2020 discards were estimated as the average percentage (4.8%) of the 2017-2019 catch because the pandemic prevented sampling of the *Illex* fishery.

Table 2. *Illex illecebrosus* relative biomass indices (standardized stratified mean kg per tow), and CVs, derived from delta-transformed catch data from the NEFSC spring and fall bottom trawl surveys (offshore strata 1-40 and 61-76) conducted during 1968-2021 and 1967-2021, respectively. Biomass indices for 2009 onward were converted from FSV *H. B. Bigelow* to RV *Albatross IV* units using the *I. illecebrosus* combined-season conversion factor (Miller et al. 2010). CVs from 2009 onward account for the variance associated with the FSV *H. B. Bigelow* conversion factors.

Year	Spring Mean kg per tow	CV (%)	Fall Mean kg per tow	CV (%)
1967			0.24	17
1968	0.021	40	0.31	17
1969	0.033	49	0.07	26
1970	0.027	30	0.27	15
1971	0.010	34	0.34	14
1972	0.003	30	0.29	15
1973	0.008	51	0.35	25
1974	0.048	28	0.39	30
1975	0.016	24	1.42	18
1976	0.021	23	7.02	19
1977	0.013	18	3.74	18
1978	0.073	72	4.53	26
1979	0.047	26	6.05	11
1980	0.024	23	3.29	18
1981	0.061	30	9.34	40
1982	0.035	21	0.60	13
1983	0.004	27	0.23	13
1984	0.005	31	0.52	19
1985	0.024	35	0.36	18
1986	0.008	38	0.26	17
1987	0.015	45	1.53	29
1988	0.012	39	3.00	24
1989	0.029	28	3.31	57
1990	0.020	29	2.40	13
1991	0.046	39	0.69	18
1992	0.025	23	0.80	16
1993	0.033	30	1.60	20
1994	0.041	27	0.86	25
1995	0.023	20	0.70	39
1996	0.008	39	0.93	19
1997	0.093	46	0.52	17
1998	0.041	57	1.40	50
1999	0.027	17	0.19	17
2000	0.006	14	0.71	22
2001	0.020	38	0.32	23
2002	0.012	55	0.44	19
2003	0.004	34	1.95	67

Table 2. (cont.)

Year	Spring Mean kg per tow	CV	Fall Mean kg per tow	CV
2004	0.025	72	0.41	22
2005	0.002	24	0.74	41
2006	0.022	32	2.85	31
2007	0.027	32	1.31	33
2008	0.010	34	0.98	20
2009	0.074	39	0.93	21
2010	0.018	31	0.53	23
2011	0.054	30	0.54	20
2012	0.200	35	0.54	15
2013	0.004	29	0.36	16
2014 ¹	-		0.64	14
2015	0.039	22	0.52	16
2016	0.480	39	0.66	27
2017 ²	0.057	28	-	
2018	0.069	24	1.32	15
2019	0.346	59	0.60	16
2020 ³	-		-	
2021	0.450	49	0.64	18
Median 1967-2020	0.024		0.68	

¹ The 2014 spring survey index was not computed because the primary *Illex* habitat areas were not adequately sampled due to vessel operational difficulties.

² The 2017 fall survey index was not computed because the primary *Illex* habitat areas, the Mid-Atlantic Bight and Southern New England, were not sampled due to vessel mechanical problems.

³ Due to the COVID-19 pandemic, the 2020 spring survey ended early so the biomass index was not computed because of inadequate sampling of *Illex* habitat, and the fall survey was not conducted.

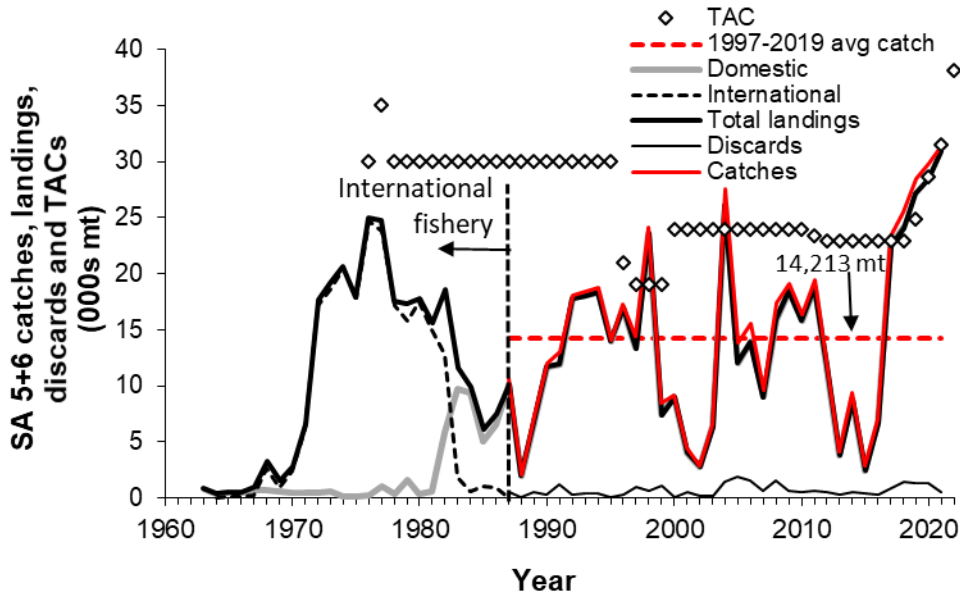


Figure 1. *Illex illecebrosus* catches by the domestic fleet (1987-2021), landings (000's mt) by fleet (1963-2021), discards (000's mt) by the domestic fleet (1987-2021) and TACs (000's mt) during 1975-2022 from NAFO Subareas 5+6. Domestic fishery closures occurred during 1998, 2004 and 2017-2021 when the quota buffer (a percentage of the TAC defined by regulations to avoid exceeding the quota) was projected to be harvested.

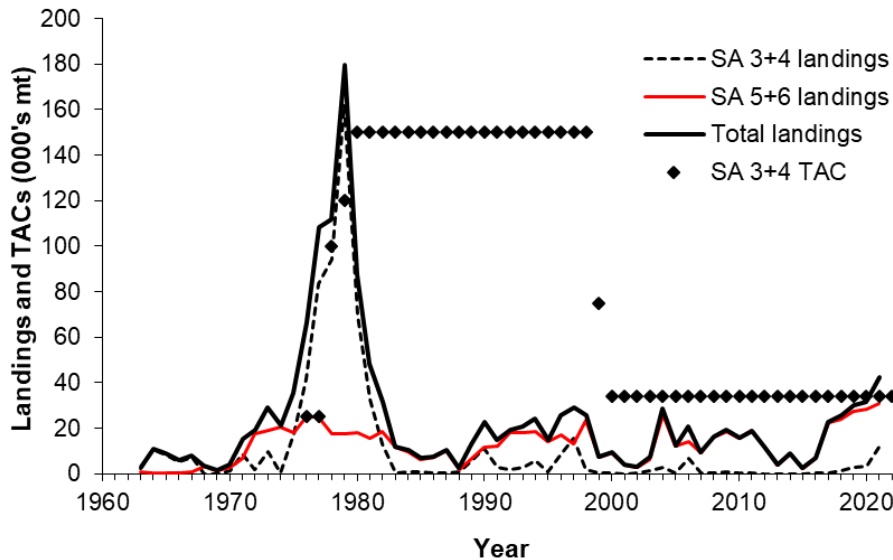


Figure 2. *Illex illecebrosus* landings (000's mt) for Subareas 3+4 (1963-2021), Subareas 5+6 (1963-2021), total landings for the stock (1987-2021) and Subareas 3+4 TACs (000's mt) during 1975-2022 for NAFO Subareas 3+4.

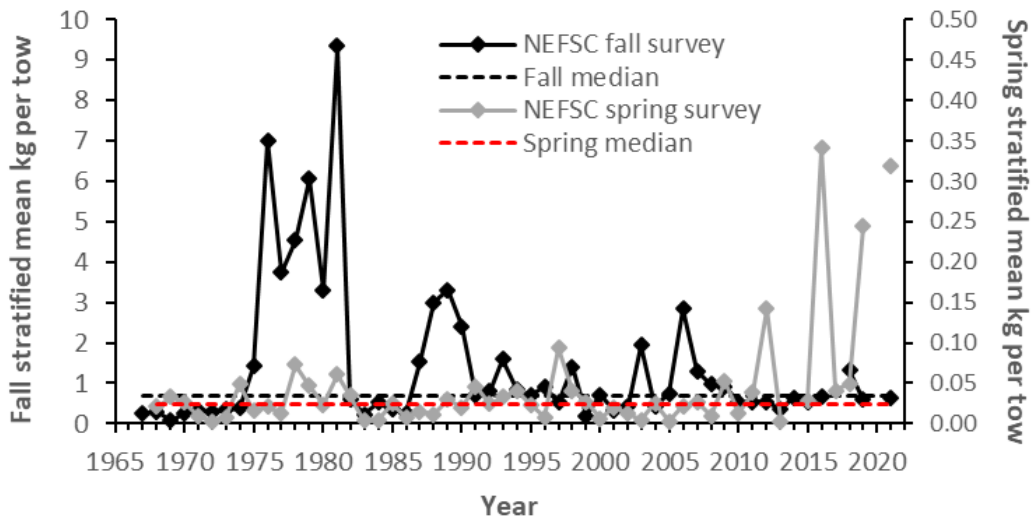


Figure 3. *Illex illecebrosus* indices of relative biomass (stratified mean kg per tow) derived from standardized delta-transformed catch data from NEFSC spring (1968-2021) and fall (1967-2021) bottom trawl surveys. Data from 2009 onward were converted from SRV *H. B. Bigelow* to RV *Albatross IV* units. The 2014 spring and 2017 fall survey indices were not computed because the primary *Illex* habitat areas were not sampled due to vessel mechanical problems. The 2020 spring and fall survey indices were not computed because the COVID-19 pandemic prevented the fall survey from occurring and led to inadequate sampling coverage of primary *Illex* habitat areas.