Report to the Mid-Atlantic Fishery Management Council: Fishery and Survey Data Updates Regarding the Northern Shortfin Squid (*Illex illecebrosus*) and Longfin Inshore Squid (*Doryteuthis* (*Amerigo*) *pealeii*) stocks through 2015

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This report presents updates of the landings and survey relative abundance and biomass indices of the Northern shortfin squid (*Illex illecebrosus*) and longfin inshore squid (*Doryteuthis* (*Amerigo*) *pealeii*) stocks through 2015. This year, the data update report contains additional information requested by members of the Mid-Atlantic Fishery Management Council's (MAFMC) Scientific and Statistical Committee (SSC) to aid them in their task of providing an acceptable biological catch (ABC) recommendation for each of the two squid stocks. The additional information includes maps of the recent spatial distributions of the landings for both squid fisheries and stratified mean body weights from Northeast Fisheries Science Center (NEFSC) fall research bottom trawl surveys.

1.0 ***Illex illecebrosus***

I. illecebrosus, a species with a lifespan of less than one year (Dawe and Beck 1997; Hendrickson 2004), constitutes a unit stock throughout its range in the Northwest Atlantic Ocean, from Southern Labrador to Florida (Dawe and Hendrickson, 1998). The northern stock component is located in Subareas 3 and 4 (Fig. 1.1) and is managed by the Northwest Atlantic Fisheries Organization (NAFO). The southern stock component is located in Subareas 5 and 6 between the waters of the Gulf of Maine and southern Florida and is managed by the Mid-Atlantic Fishery Management Council. Landings from the northern stock component have been very low (i.e., averaging < 7% of the total stock landings) since 1999 (Hendrickson and Showell 2013), and therefore, only the U. S. EEZ landings are presented herein.

1.1 Commercial Data

During 1963-1986, landings in Subareas 5 and 6 were predominately from international fleets and total landings averaged 11,027 mt with a peak of 24,936 mt in 1976 (Table 1.1, Fig. 1.2). Since 1987, landings of *I. illecebrosus* have been solely from a domestic small-mesh bottom trawl fishery which occurs primarily during June-October, when the species is available on the US continental shelf and upper slope. During 1987-2013, landings averaged 12,576 mt and were characterized by two rise-and-fall periods. During 1987-2002, landings averaged 11,728 mt and reached a peak of 23,568 mt in 1998 when the annual quota (TAC) of 19,000 mt was exceeded (Table 1.1, Fig. 1.1). During 2003-2013 landings averaged 13,810 mt and reached a U.S fishery peak of 26,097 mt in 2004 when the quota was exceeded again. In recent years, landings have been much lower; totaling 3,792 mt in 2013 and 8,767 mt in 2014. During 2015, landings declined further to 2,423 mt; the lowest level since 2002, representing only 11% of the annual quota. During most years since 1996, a majority of the landings have been harvested by 6–15 vessels (Arkhipkin et al. 2015), but only four vessels participated in the fishery intermittently during 2015. Low fishing effort was due to low prices of *I. illecebrosus* on the export market (G. Goodwin, pers. comm.). During 2013-2015, greater than 99% of the total stock landings were from the U.S. stock component.

Illex landings from the Dealer Weighout Database are considered the most accurate from 1996 onward because reporting of squid landings purchased by federally permitted dealers became mandatory in 1996. The submittal of Vessel Trip Reports (VTRs), which are the current source of fishing effort and location data, also became mandatory in 1996 for *Illex* moratorium permit holders.

The spatial distribution of *I. illecebrosus* landings by the directed fishery was mapped as the sum of the landings by ten-minute square (TNMS) for 2007-2010 and 2011-2014. The maps were prepared with data from trips with 1:1 matches between the Dealer Weighout Database and the VTR Database which were merged to create a combined database in accordance with the methods described in Wigley et al. (2008). The 2015 merged database had not been created as of the completion date of this report. The fishery was defined using the regulatory definition of a directed trip; trips with *Illex* landings > 4,536 kg (10,000 lbs). The data used to create the 2007-2010 and 2011-2014 maps represented 73% and 85%, respectively, of the directed fishery landings. The distribution of landings for each of the two time blocks (Fig. 1.3) is typical for the fishery which is concentrated along the shelf edge in Statistical Areas 622, 626 and 632 (NEFSC 2006). The *Illex* fishery, which has no minimum codend mesh size requirement, is prohibited shoreward of 91 m during June through September to reduce the bycatch of *D. pealeii*. Based on the presence of TNMS with landings at depths < 91 m and > 400 m, some misreporting of fishing location data is evident in both maps.

1.2 Survey Data

Indices of relative abundance (stratified mean number per tow) and biomass (stratified mean kg per tow) were derived using data from the Northeast Fisheries Science Center (NEFSC) fall bottom trawl surveys conducted during 1967-2015 (Table 1.2, Fig. 1.4). Survey design and sampling protocols are described in Azarovitz (1981) and Politis et al. (2014). Catches from offshore strata 1-12 and 61-76 were used to compute the survey indices and the indices were standardized for gear and vessel changes that occurred during the time series (NEFSC 2006). The FSV *H. B. Bigelow* replaced the RV *Albatross IV* as the primary survey vessel beginning in 2009. Indices for 2009 onward were converted to *Albatross IV* units using combined-season conversion factors, computed for all sizes combined (i.e., number per tow = 1.38 and kg per tow = 1.41), based on data from a 2008 vessel calibration study conducted with both vessels during the spring and fall (Miller et al. 2010). Precision estimates (i.e., CVs computed as percentages) of the biomass and abundance indices account for the variance associated with these conversion factors (Table 1.2).

Relative abundance and biomass indices were highly variable during 1967-2015, as is typical for squid species given their sub-annual lifespans and the fact that spatial distribution patterns and recruitment are primarily determined by environmental factors (Boyle and Rodhouse 2005). Despite this variability, periods of high and low abundance are apparent. Periods of high abundance, during 1976-1981 and 1987-1990, were preceded by periods of low abundance during 1967-1974 and 1982-1986, respectively (Table 1.2, Fig. 1.4). During most years between 1991 and 2002, relative abundance fluctuated around the time series median of 8.0 squid per tow. Following a period of high variability, during 2003-2006, relative abundance declined to below the median in 2013 (4.7 squid per tow) then increased to 9.5 squid per tow in 2015 (Table 1.2, Fig. 1.4).

Stratified mean body weights of *I. illecebrosus* were computed as the annual stratified mean weight per tow divided by the stratified mean number per tow of squid caught during NEFSC fall research bottom trawl surveys. Mean body weight was highest during 1976-1981 (average = 295 g) and were at or above the 1967-2014 median (123 g) during 1967-1975, but have been much lower since 1982 (Hendrickson and Showell 2013). Since 2000, mean body weight has been consistently below the median and averaged 80 g during 2000-2014. In recent years, mean body weight declined from 86 g in 2011 to 55 g in 2015 (Fig. 1.5). Trends in squid mean body weight reflect the combined effects of growth, mortality, emigration and immigration. For *I. illecebrosus*, these factors are primarily influenced by large-scale oceanographic processes (Dawe et al. 2007). Of note is the fact that during the years when mean body weight was well below the median, annual landings during at least two of these years, 1998 and 2004, were the highest on record for the U. S. fishery (Fig. 1.5). *I. illecebrosus* is an oceanic squid species and a portion of the stock resides outside the range of NEFSC surveys; in deeper waters beyond 366 m, areas south of Cape Hatteras, and north of the Gulf of Maine in Subareas 3 and 4 (Hendrickson and Showell 2013; Arkhipkin et al. 2015). In addition, the survey bottom trawl gear may not sample all sizes of this semi-pelagic species efficiently (Hendrickson 2004). Therefore, NEFSC survey indices may represent a measure of the on-shelf availability of *I. illecebrosus* rather than a measure of relative abundance or biomass (NEFSC 2006).

1.3 References

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Table 1.1. USA EEZ (NAFO Subareas 5+6) landings (mt) of *Illex illecebrosus*, by fleet, during 1963-2015 and Total Allowable Catch (TAC, mt) during 1974-2015. The 2015 landings are preliminary and do not include all of the state data.

Year	USA	International	Total	TAC[1]
1963	810		810	
1964	358	2	360	
1965	444	78	522	
1966	452	118	570	
1967	707	288	995	
1968	678	2,593	3,271	
1969	562	975	1,537	
1970	408	2,418	2,826	
1971	455	6,159	6,614	
1972	472	17,169	17,641	
1973	530	18,625	19,155	
1974	148	20,480	20,628	71,000
1975	107	17,819	17,926	71,000
1976	229	24,707	24,936	30,000
1977	1,024	23,771	24,795	35,000
1978	385	17,207	17,592	30,000
1979	1,493	15,748	17,241	30,000
1980	299	17,529	17,828	30,000
1981	615	14,956	15,571	30,000
1982	5,871	12,762	18,633	30,000
1983	9,775	1,809	11,584	30,000
1984	9,343	576	9,919	30,000
1985	5,033	1,082	6,115	30,000
1986	6,493	977	7,470	30,000
1987	10,102	0	10,102	30,000
1988	1,958	0	1,958	30,000
1989	6,801	0	6,801	30,000
1990	11,670	0	11,670	30,000
1991	11,908	0	11,908	30,000
1992	17,827	0	17,827	30,000
1993	18,012	0	18,012	30,000
1994	18,350	0	18,350	30,000
1995	13,976	0	13,976	30,000
1996	16,969	0	16,969	21,000
1997	13,356	0	13,356	19,000
1998	23,568	0	23,568	19,000
1999	7,388	0	7,388	19,000
2000	9,011	0	9,011	24,000
2001	4,009	0	4,009	24,000
2002	2,750	0	2,750	24,000
2003	6,391	0	6,391	24,000

Table 1.1. (cont.)

Year	**USA**	**International**	**Total**	**TAC**[1]
2004	26,097	0	26,097	24,000
2005	12,011	0	12,011	24,000
2006	13,944	0	13,944	24,000
2007	9,022	0	9,022	24,000
2008	15,900	0	15,900	24,000
2009	18,418	0	18,418	24,000
2010	15,825	0	15,825	24,000
2011	18,797	0	18,797	23,328
2012	11,709	0	11,709	22,915
2013	3,792	0	3,792	22,915
2014	8,767	0	8,767	22,915
2015	2,423	0	2,423	22,915
Averages				
1963-1986	1,950	9,472	11,027	
1987-2014	12,440	0	12,440	
1963-2014	7,598	4,272	11,788	

[1] TACs during 1974 and 1975 are for *Illex illecebrosus* and *Doryteuthis pealeii* combined.

Table 1.2. *Illex illecebrosus* relative abundance (stratified mean number per tow) and biomass (stratified mean kg per tow) indices, and CVs (%), derived from NEFSC fall bottom trawl surveys (offshore strata 1-12 and 61-76) conducted during 1967-2015. FSV *H. B. Bigelow* indices for 2009 onward were converted to RV *Albatross IV* units using combined-season conversion factors computed for all sizes combined based on Miller et al. (2010). CVs from 2009 onward account for the variance associated with the FSV *Bigelow* conversion factors.

Year	**Number per tow**	**CV (%)**	**Kg per tow**	**CV (%)**
1967	1.6	17	0.24	17
1968	1.6	21	0.31	17
1969	0.6	23	0.07	26
1970	2.3	21	0.27	15
1971	1.7	12	0.34	14
1972	2.2	25	0.29	15
1973	1.5	24	0.35	25
1974	2.8	40	0.39	30
1975	8.7	36	1.42	18
1976	20.6	16	7.02	19
1977	12.6	18	3.74	18
1978	19.3	21	4.53	26
1979	19.4	11	6.05	11
1980	13.8	15	3.29	18
1981	27.1	32	9.34	40
1982	3.9	15	0.60	13
1983	1.7	14	0.23	13
1984	4.5	17	0.52	19
1985	2.4	17	0.36	18
1986	2.1	15	0.26	17
1987	15.8	31	1.53	29
1988	23.2	25	3.00	24
1989	22.4	45	3.31	57
1990	16.6	12	2.40	13
1991	5.2	17	0.69	18
1992	8.2	15	0.80	16
1993	10.4	19	1.60	20
1994	6.8	24	0.86	25
1995	8.0	30	0.70	39
1996	10.8	22	0.93	19
1997	5.8	25	0.52	17
1998	14.6	29	1.40	50
1999	1.4	16	0.19	17
2000	7.4	28	0.71	22
2001	4.5	27	0.32	23
2002	6.4	20	0.44	19
2003	28.5	61	1.95	67

Table 1.2 (cont.)

Year	Number per tow	CV (%)	Kg per tow	CV (%)
2004	5.1	24	0.41	22
2005	11.0	35	0.74	41
2006	29.5	43	2.85	31
2007	15.7	33	1.31	33
2008	10.4	22	0.98	20
2009	8.7	18	0.93	21
2010	10.0	23	0.53	23
2011	6.3	20	0.54	20
2012	8.0	17	0.54	15
2013	4.7	17	0.36	16
2014	8.3	14	0.64	14
2015	9.5	36	0.52	16
Median 1967-2014	8.0		0.70	

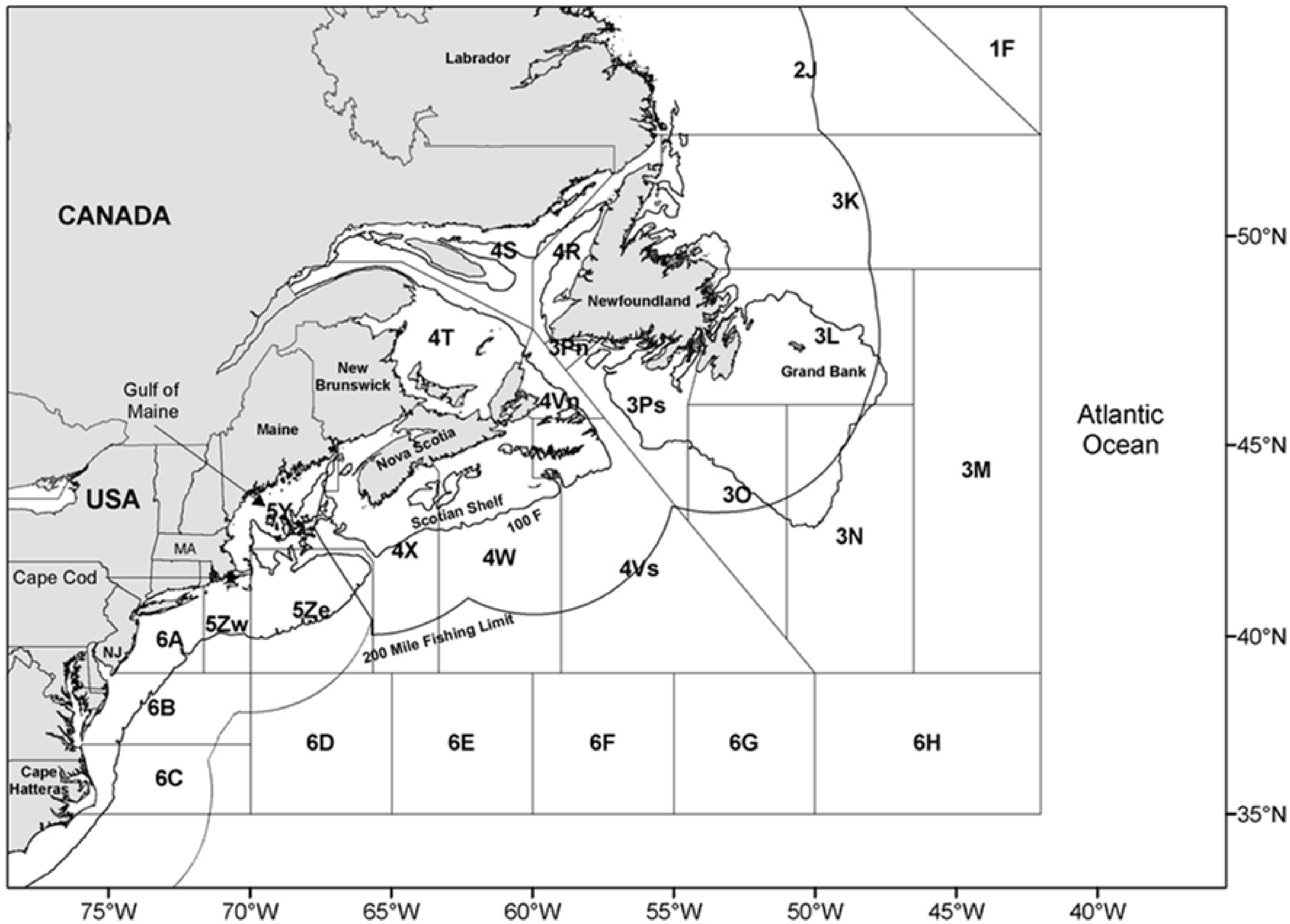


Figure 1.1. Northwest Atlantic Fisheries Organization (NAFO) nominal catch reporting areas, Subareas 3-6 and associated Divisions, for fisheries occurring in the Northwest Atlantic Ocean.

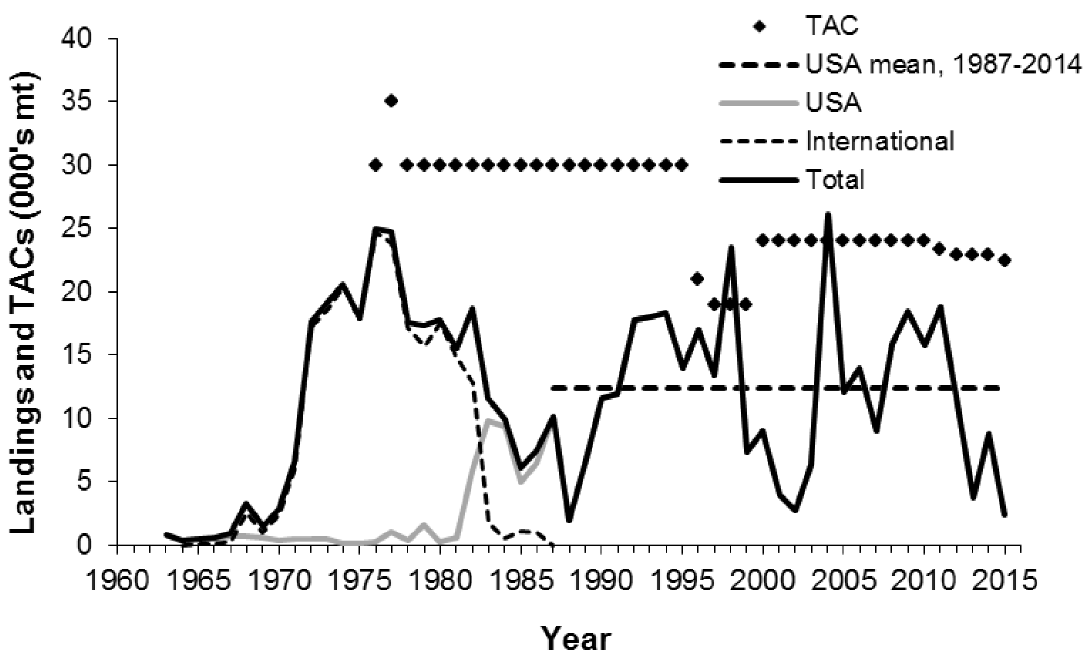
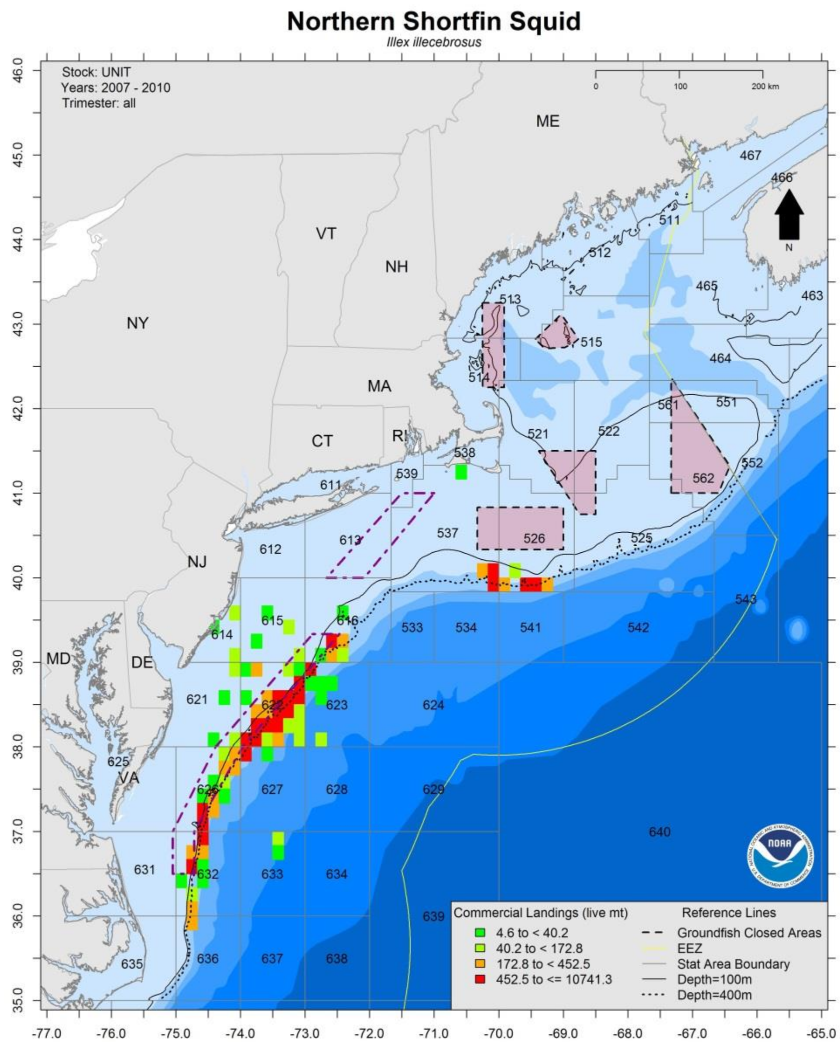


Figure 1.2 Landings (000’s mt) of *Illex illecebrosus* from the USA EEZ (NAFO Subareas 5+6), by fleet, and TACs (000’s mt) during 1963-2015. The 2015 landings are preliminary.



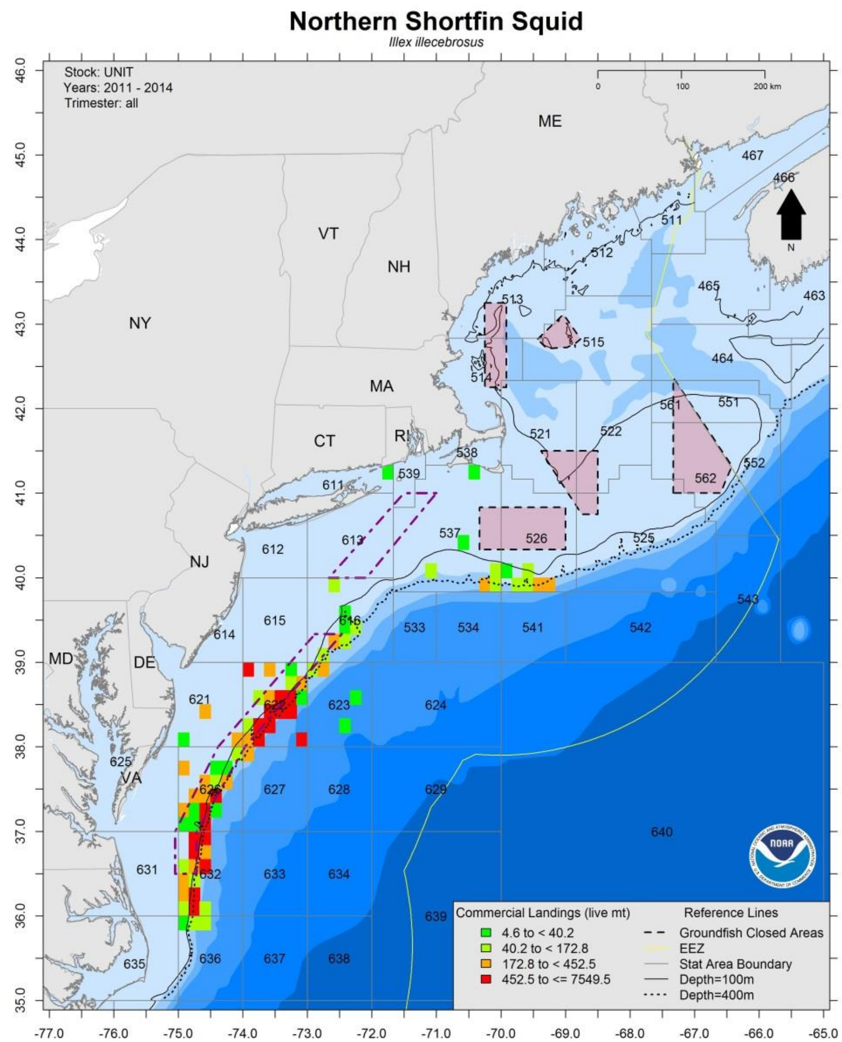


Figure 1.3. Distribution of landings (mt) from bottom trawl trips with *Illex illecebrosus* landings > 4.536 mt (10,000 lbs), by ten-minute square, during 2007- 2010 and 2011-2014. The Southern Gear Restricted Area (GRA) is in effect from January 1 to March 15 and the Northern GRA is in effect from November 1 to December 31. Squid fishing does not occur in the GRAs during these time periods because bottom trawls with codend mesh sizes < 127 mm diamond mesh (5.0 in., inside stretched mesh) are prohibited. East of 72º 30’ N, squid fishing is only permitted in small-mesh exemption areas which are not shown in the figure.

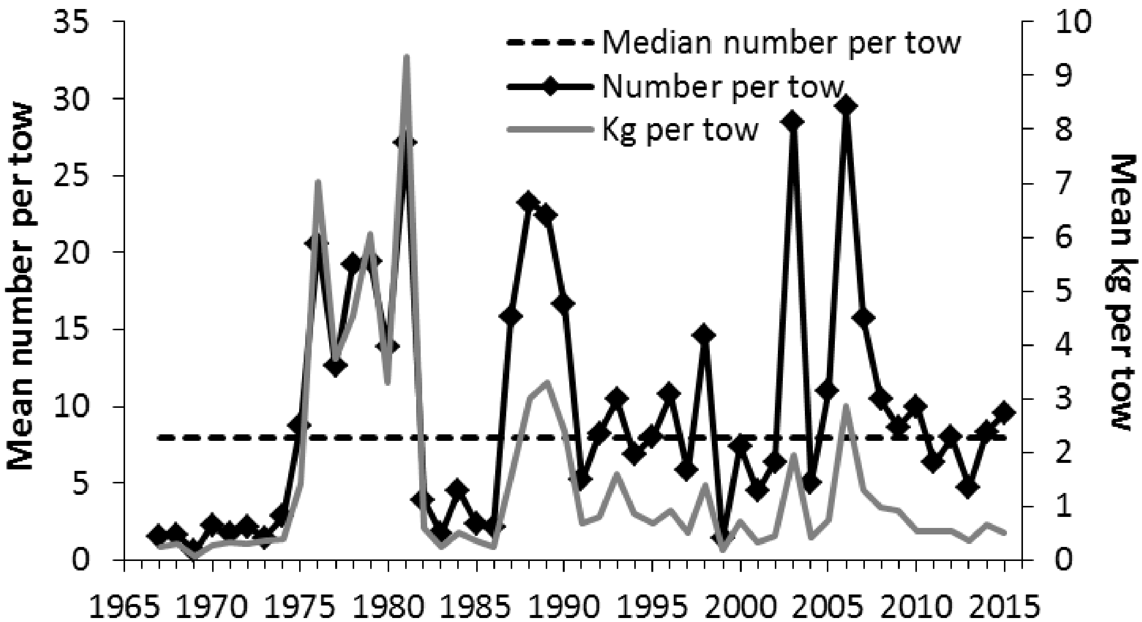


Figure 1.4. *Illex illecebrosus* indices of relative abundance (stratified mean number per tow) and biomass (stratified mean kg per tow) derived from NEFSC fall bottom trawl survey data, 1967-2015.

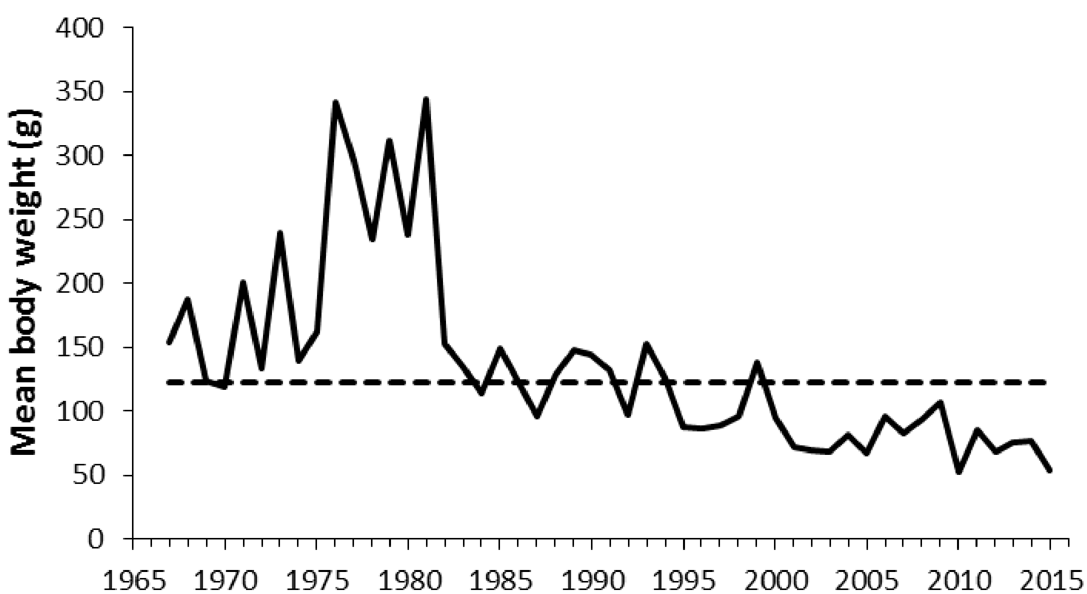


Figure 1.5. Stratified mean body weights of *Illex illecebrosus* (stratified mean kg per tow / stratified mean number per tow) derived from NEFSC fall bottom trawl survey data, 1967-2015. The dashed line represents the 1967-2014 median body weight.

2.0 ***<u>Doryteuthis (Amerigo) pealeii</u>***

Longfin inshore squid (*Doryteuthis* (*Amerigo*) *pealeii*), hereafter referred to as *D. pealeii*, also has a lifespan of less than one year (Macy and Brodziak 2001). *D. pealeii* inhabits continental shelf and upper slope waters between southern Newfoundland and the Gulf of Venezuela, including the Gulf of Mexico and the Caribbean Sea (Jereb *et al*. 2010). The species is most abundant between Georges Bank and Cape Hatteras, North Carolina where a small-mesh bottom trawl fishery occurs throughout the year. The U.S. East coast longfin squid population is managed as a single stock based on evidence from genetics studies (Arkhipkin et al. 2015).

2.1 Commercial Data

During 1967-1984, landings of *D. pealeii* in Subareas 5 and 6 were predominately from international fleets. During 1963-1986, total landings averaged 16,489 mt with a peak of 37,613 mt in 1973 (Table 2.1, Fig. 2.1). Since 1987, landings of *D. pealeii* have been solely from a domestic, small-mesh bottom trawl fishery which occurs throughout the year. During 1987-2014, landings averaged 15,484 mt with a peak of 23,738 mt in 1989 (Table 2.1, Fig. 2.1). During 1999-2010, landings gradually declined from 19,173 mt to 6,913 mt, respectively, then increased again to 12,820 mt in 2012. During 2013-2015, landings were slightly above the 2007-2014 average (10,689 mt). Preliminary landings for 2015, which do not include all state landings, totaled 11,928 mt. Annual quotas (TACs) for the U.S. fishery were exceeded only once, during 2000, but landings totaled 94%-99% of the annual quotas during 2002, 2005 and 2006 when the quota was only 17,000 mt (Table 2.1). During 2009-2015, the quota was increased and ranged between 18,667 mt in 2010 and 22,445 mt in 2015 and about 50% of the quota was harvested on average.

In addition to stock abundance, availability, and ex-vessel price of *D. pealeii*, monthly landings trends have been affected by in-season longfin squid quotas since 2000. Landings trends have also been affected by trimester-based Atlantic butterfish (*Peprilus triacanthus*) catch quotas since 2011 and discard quotas since March 5, 2013. One or more longfin squid fishery closures have occurred per year, with the exception of 2010, 2013, and 2015, due to attainment of in-season quota buffers for *D. pealeii* (Table 2.2). *D. pealeii* landings were more evenly distributed across months during 1987-1995 than thereafter (Fig. 2.2). Monthly landings trends were similar during 1996-1999 (no in-season quotas) and 2001-2006 (quarterly quotas) and generally declined from a peak in February (15-16% of annual landings) to a minimum of 2% in June then increased to 13% during October (Arkhipkin et al. 2015). During the current management regime of trimester-based quotas (2000 and 2007-2014), the landings peak shifted to October (13%) with a secondary peak of 12% harvested during July. This shift in the landings peakis in part attributable to a consistent decline between 1998 and 2012 in the number of large vessels involved in the offshore fishery during November-April (Arkhipkin et al. 2015). Landings during Trimesters 1, 2 and 3 totaled 32%, 37%, and 32%, respectively, of the combined landings for the period including 2000 and 2007-2014, but the interannual variability of landings by trimester was high (Fig. 2.3). The current quota allocations for Trimesters 1-3 are 43%, 17%, and 40%, respectively. As of 2010, a Trimester 2 quota increase of up to 150% is allowable when a comparable underage of the Trimester 1 quota occurs.

D. pealeii landings from 1996 onward are considered the most accurate because reporting of squid landings purchased by federally permitted dealers became mandatory in 1996. The submittal of Vessel Trip Reports (VTRs), which are the current source of fishing effort and location data, also became mandatory in 1996 for longfin squid/butterfish moratorium permit holders.

The spatial distribution of *D. peleaii* landings by the directed fishery was mapped using the same methodology as described above in Section 1.1 but separate maps were prepared for each trimester. The fishery was defined using the regulatory definition of a directed trip; trips with *Illex* landings > 1,134 kg (2,500 lbs). The mapped landings data for each trimester represented 69%, 72% and 74%, respectively, of the 2007-2010 directed fishery landings and 88%, 90% and 87%, respectively, and of the 2011-2014 directed fishery landings. The landings distribution patterns indicated in Figs. 2.4 and 2.5 are typical for the fishery, which generally occurs offshore during October-March and inshore during April-September (NEFSC 2011). The Trimester 2 map for 2011-2014 (Fig. 2.4) reflects the unusually high landings that occurred inshore during 2012 (totaling 62% of the annual landings) and which resulted in increased incidental catches of longfin squid in the offshore *Illex* fishery. Based on the presence of TNMS with landings at depths > 400 m, some misreporting of fishing location data is evident in all six maps.

2.2 Survey Data

The efficiency of the NEFSC survey bottom trawl gear for *D. pealeii*, a diel vertical migrator, is highest during the daytime (Jacobson et al. 2015). Indices of relative abundance (stratified mean number per tow) and biomass (stratified mean kg per tow) were derived using daytime tows (tows with solar zenith angles of 43°-80°) from NEFSC fall bottom trawl surveys conducted during 1975-2015 based on the methods used in the most recent stock assessment (NEFSC 2011). Indices include catches from inshore strata 5, 8, 11, 14, 17, 20, 23, 26, 29, 32, 35, 38, 41, 44-46, 59-61 and 65-66 plus offshore strata 1-23, 25-26, and 61-76. FSV *H. B. Bigelow* indices for 2009 onward were converted to RV *Albatross IV* units using daytime conversion factors, computed for all sizes combined, from a 2008 vessel calibration study conducted with both vessels during the fall (NEFSC 2011). Coefficients of variation of the survey indices account for the variance associated with the *Bigelow* conversion factors (Table 2.3).

Since 2009, NEFSC survey strata ranging in depth from 6 m to 18 m can no longer be sampled because they are too shallow for operation of the FSV *H. B. Bigelow*. These strata constitute habitat for longfin squid, primarily squid ≤ 10 cm dorsal mantle length, during the fall (Brodziak and Hendrickson 1999). Therefore, longfin squid relative abundance and biomass indices are also provided for the 2007-2015 fall Northeast Area Monitoring and Assessment Program (NEAMAP) research bottom trawl surveys. The NEAMAP surveys, which are funded by NOAA Fisheries and conducted by staffs from the Virginia Institute of Marine Science, were designed to sample the nearshore strata formerly sampled during NEFSC surveys. The stratified random survey is conducted is conducted by a fishing vessel (FV *Darana R*) with a smaller version of the trawl gear used by the FSV *Bigelow*. The difference between the NEAMAP and NEFSC survey gears is a 3-in. cookie sweep versus a 16-in. diameter rockhopper sweep (14-in. diameter on the wings, Politis et al. 2014), respectively. Both surveys use the same towing protocols (20 min. at 3.0 kts). During the fall NEAMAP surveys, most of the tows were conducted during October. The NEAMAP surveys occur between Rhode Island Sound and Cape Hatteras, North Carolina and all stations are sampled between sunrise and sunset (approximately 0715-1715). Survey sampling methods and protocols and the methods used to derive the longfin squid relative abundance and biomass indices are provided in Bonzek et al. (2015). However, the longfin squid survey indices included in Bonzek et al. (2015) contained some errors. Therefore, the corrected fall indices are provided herein. The indices were derived by NEAMAP staff as the back-transformed, stratified geometric mean catch per area-swept (in numbers and kg) and include longfin squid catches from all survey strata (Jim Gartland, pers. comm.).

Relative abundance and biomass indices of *D. pealeii* (Fig. 2.6) were much more variable than the indices for *I. illecebrosus* (Figure 1.3), making any underlying trends difficult to discern. In recent years, relative abundance declined from the third highest point in the time series during 2006 (1,778 squid per tow) to 416 squid per tow in 2009, a level below the time series median of 651 squid per tow (Table 2.3, Fig. 2.6). During 2012-2014 relative abundance was above the median, but declined from 1,371 squid per tow to 744 squid per tow, respectively, then dropped below the median to 596 squid per tow in 2015.

NEAMAP relative abundance indices increased from below the 2007-2014 median (79 squid per tow) in 2010 (30 squid per tow) to a peak of 208 squid per tow in 2014 (Table 2.4, Fig. 2.7). During 2015, relative abundance declined but remained above the median and was slightly greater than the 2013 index. Trends in the relative biomass indices were similar to trends in relative abundance. The NEAMAP fall survey indices were provided as back-transformed geometric means, and as such, cannot be compared directly with the NEFSC fall survey indices which were computed as arithmetic means. In addition, there are no gear/vessel conversion coefficients available with which to standardize longfin squid catches between the two surveys and longfin squid migration rates between the two survey areas during the fall are unknown.

Stratified mean body weights of *D. pealeii* were computed, as described above in Section 1.2, using data from NEFSC fall research bottom trawl surveys. During most years between 1976 and 1994, mean body weights were above the 1975-2014 median of 20 g and were below the median during most years thereafter (Fig. 2.8). Trends in squid mean body weight reflect the combined effects of growth, mortality, emigration and immigration. For *D. pealeii*, these factors are primarily influenced by water temperatures during the early life history stages (Dawe et al. 2007).

2.3 References

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Table 2.1. Landings (mt) of *Doryteuthis pealeii*, by fleet, during 1963-2015. The 2015 landings are preliminary and do not include all of the state data.

Year	USA	International	Total	TAC[1]
1963	1,294	0	1,294	
1964	576	2	578	
1965	709	99	808	
1966	722	226	948	
1967	547	1,130	1,677	
1968	1,084	2,327	3,411	
1969	899	8,643	9,542	
1970	653	16,732	17,385	
1971	727	17,442	18,169	
1972	725	29,009	29,734	
1973	1,105	36,508	37,613	
1974	2,274	32,576	34,850	70,000
1975	1,621	32,180	33,801	70,000
1976	3,602	21,682	25,284	44,000
1977	1,088	15,586	16,674	44,000
1978	1,476	9,355	10,831	44,000
1979	4,252	13,068	17,320	44,000
1980	3,996	19,750	23,746	44,000
1981	2,316	20,212	22,528	44,000
1982	2,848	15,805	18,653	44,000
1983	10,867	11,720	22,587	44,000
1984	7,689	11,031	18,720	44,000
1985	6,899	6,549	13,448	44,000
1986	11,525	4,598	16,123	44,000
1987	10,367	2	10,369	44,000
1988	18,593	3	18,596	44,000
1989	23,733	5	23,738	44,000
1990	15,399	0	15,399	44,000
1991	20,299	0	20,299	44,000
1992	19,018	0	19,018	44,000
1993	23,020	0	23,020	44,000
1994	23,480	0	23,480	44,000
1995	18,880	0	18,880	36,000
1996	12,503	0	12,503	25,000
1997	16,270	0	16,270	21,000
1998	19,145	0	19,145	21,000
1999	19,173	0	19,173	21,000
2000	17,540	0	17,540	15,000
2001	14,345	0	14,345	17,000
2002	16,868	0	16,868	17,000
2003	11,941	0	11,941	17,000

Table 2.1 (cont.)

Year	USA	International	Total	TAC[1]
2004	14,800	0	14,800	17,000
2005	16,724	0	16,724	17,000
2006	15,928	0	15,928	17,000
2007	12,354	0	12,354	17,000
2008	11,406	0	11,406	17,000
2009	9,307	0	9,307	19,000
2010	6,913	0	6,913	18,667
2011	9,556	0	9,556	19,906
2012	12,820	0	12,820	22,220
2013	11,183	0	11,183	22,049
2014	12,063	0	12,063	22,049
2015	11,928	0	11,928	22,445
Averages				
1963-1986	2,896	14,184	16,489	
1987-2014	15,484	0	15,484	
2007-2014	10,689	0	10,689	
1963-2014	9,674	6,397	15,948	

[1] TACs during 1974 and 1975 are for *Illex illecebrosus* and *Doryteuthis pealeii* combined.

Table 2.2. *Doryteuthis pealeii* fishery closures which occurred during 2000-2015 when in-season quotas were in effect. Quotas were trimester-based during 2000 and 2007-2015 and quarterly during 2001-2006. Closures trigger a regulatory trip limit of 1,134 kg of *D. pealeii*.

Year	**Quota period I**	**Quota period II**	**Quota period III**	**Quota period IV**
2000	Mar 25 – Apr 30	Jul 1- Aug 31	Sep 7 – Oct 6, Oct 26 - Dec 31	
2001		May 29 – Jun 30		
2002		May 28 – Jun 30	Aug 16 – Sep 30	Nov 2 - Dec 11, Dec 24 – Dec 31
2003	Mar 25 - Mar 31			
2004	Mar 5 - Mar 31			
2005	Feb 20 - Mar 31	Apr 25 - Jun 30		Dec 18 - Dec 31
2006	Feb 13 - Mar 31	Apr 21 - Apr 27, May 23 - Jun 30	Sep 2 - Sep 30	
2007	Apr 13 - Apr 30			
2008		July 17 - Aug 31		
2009		Aug 6 - Aug 31		
2010				
2011		Aug 23-Aug 31		
2012	*Apr 17-Apr 30	July 10 - Aug 31		
2013				
2014		Aug 11-Aug 31		
2015				

* Closure due to reaching incidental catch cap for Atlantic butterfish (*Peprilus triacanthus*).

Table 2.3. Relative abundance (stratified mean number per tow) and biomass (stratified mean kg per tow) indices for *Doryteuthis pealeii*, and CVs (%), derived using daytime tows (tows conducted when solar zenith angles were between 43° and 80°) from NEFSC fall bottom trawl surveys conducted during 1975-2015. Indices include catches from inshore strata 5, 8, 11, 14, 17, 20, 23, 26, 29, 32, 35, 38, 41, 44-46, 59-61 and 65-66 plus offshore strata 1-23, 25-26, and 61-76. FSV *H. B. Bigelow* indices for 2009 onward were converted to RV *Albatross IV* units using "daytime", fall survey conversion factors computed for all sizes combined based on NEFSC (2011). CVs from 2009 onward account for the variance associated with the FSV *Bigelow* conversion factors.

Year	Number per tow	CV (%)	Kg per tow	CV (%)
1975	1,038	14	14.4	11
1976	730	12	18.8	15
1977	513	14	11.5	18
1978	270	16	7.6	11
1979	376	12	8.2	12
1980	562	13	14.2	8
1981	402	10	12.5	6
1982	529	13	12.4	15
1983	814	14	23.7	20
1984	625	10	20.8	17
1985	709	15	19.6	11
1986	720	13	14.8	4
1987	101	9	2.8	9
1988	651	14	9.3	13
1989	830	25	21.5	34
1990	480	12	10.4	14
1991	375	12	11.5	10
1992	2,029	27	10.4	20
1993	185	26	4.9	10
1994	905	11	27.5	15
1995	340	15	5.8	8
1996	306	18	3.8	20
1997	548	21	10.3	22
1998	381	14	5.3	14
1999	1,341	10	15.4	10
2000	1,035	12	30.4	7
2001	431	11	8.5	8
2002	1,960	4	23.4	5
2003	951	8	14.0	11
2004	1,055	14	8.6	10
2005	530	14	9.9	20
2006	1,778	10	22.9	6
2007	1,111	17	10.1	18
2008	667	18	11.3	25
2009	416	9	6.3	13
2010	708	21	15.0	12

Table 2.3 (cont.)

Year	Number per tow	CV (%)	Kg per tow	CV (%)
2011	339	16	6.6	12
2012	1,371	11	21.0	9
2013	1,012	36	13.3	16
2014	744	13	12.8	11
2015	596	8	9.7	8
Median 1975-2014	659		12.0	

Table 2.4 Relative abundance and biomass indices (back-transformed, stratified geometric mean number and kg, respectively, per area-swept) for *Doryteuthis pealeii*, and 95% confidence limits, derived using data from NEAMAP fall bottom trawl surveys conducted during 2007-2015. All NEAMAP survey tows are conducted during the daytime, between sunrise and sunset.

Year	LCI	Number per tow	UCI	LCI	Kg per tow	UCI
2007	116.5	143	174.4	4.16	4.9	5.84
2008	38.1	48	60.9	2.40	2.8	3.33
2009	91.6	118	152.0	4.95	5.8	6.85
2010	29.3	38	48.8	2.88	3.4	4.08
2011	38.1	46	56.0	2.67	3.1	3.47
2012	49.1	60	74.0	2.90	3.4	3.92
2013	76.5	97	123.6	4.76	5.7	6.75
2014	208.4	260	324.0	9.44	11.0	12.79
2015	87.9	105	126.3	6.48	7.5	8.69

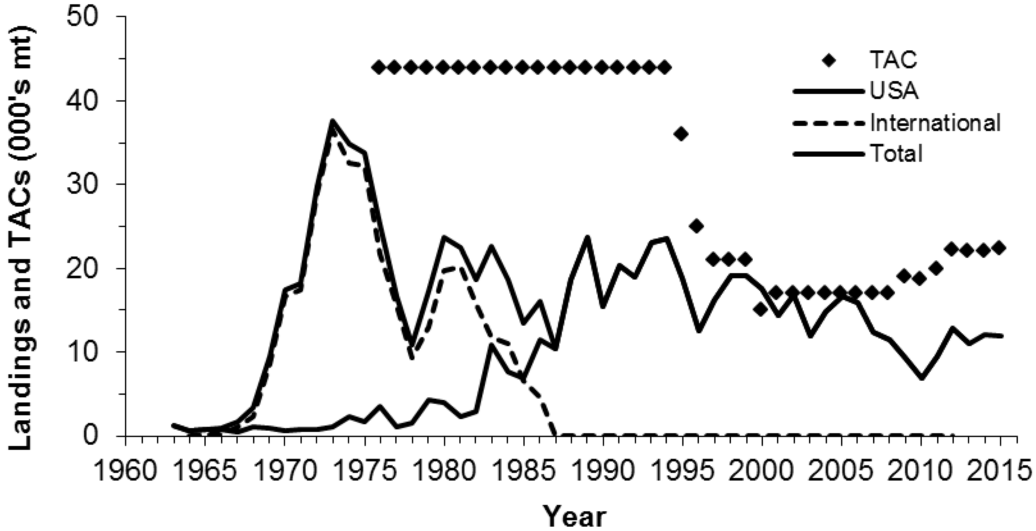

Figure 2.1. Landings (000's mt) of *Doryteuthis pealeii*, by fleet, and TACs (000's mt) during 1963-2015. The 2015 landings are preliminary and do not include all state data.

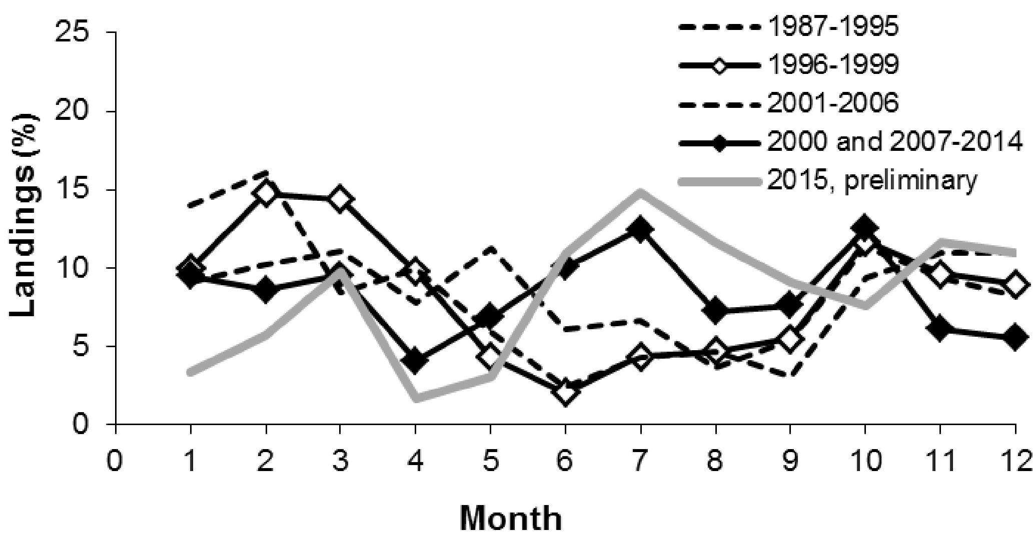

Figure 2.2. Landings (%) of *Doryteuthis pealeii*, by month, during four fishery management periods: annual quotas without (1987-1995) and with (1996-1999) mandatory landings reporting; quarterly quotas (2001-2006); and trimester quotas (2000 and 2007-2015) in comparison to preliminary landings for 2015.

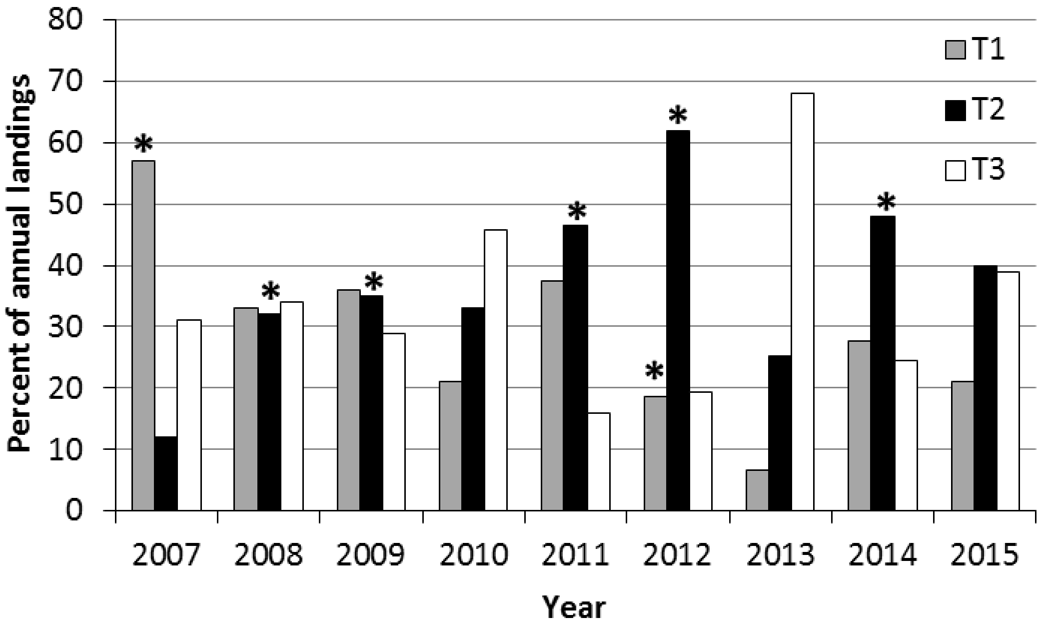

Figure 2.3. Landings (%) of *Doryteuthis pealeii*, by trimester (T1, T2 and T3), during the current management regime of trimester quotas (2007-2015). Landings during 2015 are preliminary. Asterisks indicate *D. pealeii* fishery closures during a portion of the trimester indicated due to attaining the buffer percentage of the specific trimester quota for *D. pealeii*. The fishery closure that occurred during T1 was attributable to attaining the incidental catch cap for Atlantic butterfish (*Peprilus triancanthus*).

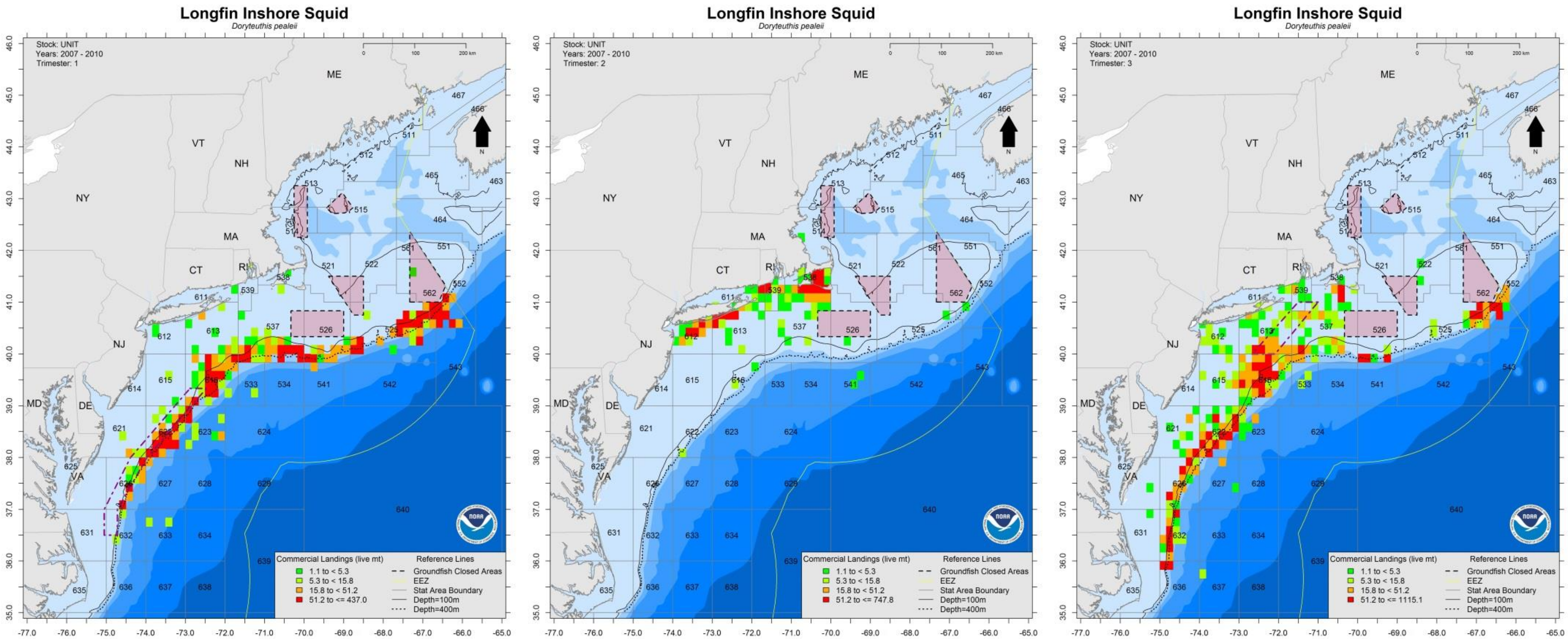

Figure 2.4. Distribution of landings (mt) from bottom trawl trips with *Doryteuthis pealeii* landings > 1.134 mt (2,500 lbs), by trimester and ten-minute square, during 2007- 2010. The Southern Gear Restricted Area (GRA) is in effect from January 1 to March 15 (Trimester 1) and the Northern GRA is in effect from November 1 to December 31. Squid fishing does not occur in these GRAs when they are in effect because bottom trawls with a codend mesh size < 127 mm diamond mesh (5.0 in., inside stretched mesh) are prohibited. East of 72º 30’ N, squid fishing is only permitted in small-mesh exemption areas.

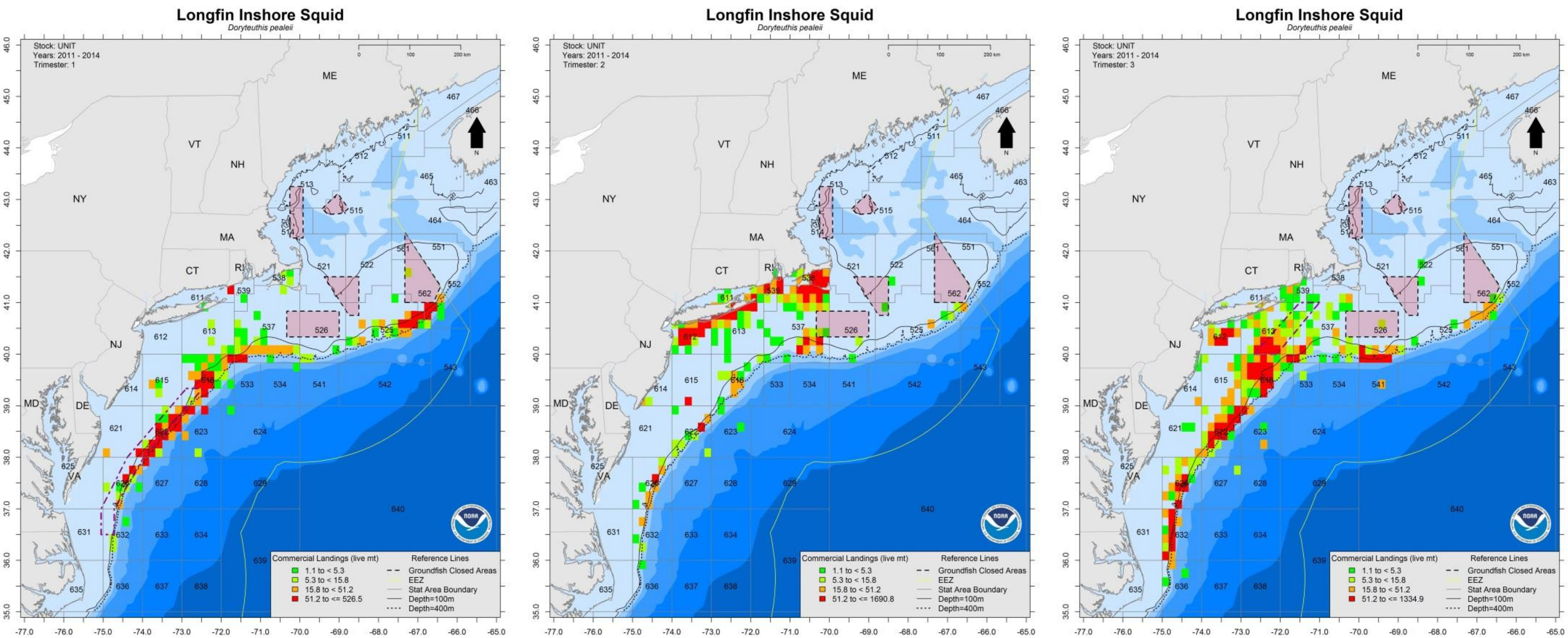

Figure 2.5. Distribution of landings (mt) from bottom trawl trips with *Doryteuthis pealeii* landings > 1.134 mt (2,500 lbs), by trimester and ten-minute square, during 2011- 2014. The Southern Gear Restricted Area (GRA) is in effect from January 1 to March 15 (Trimester 1) and the Northern GRA is in effect from November 1 to December 31. Squid fishing does not occur in these GRAs when they are in effect because bottom trawls with a codend mesh size < 127 mm diamond mesh (5.0 in., inside stretched mesh) are prohibited. East of 72º 30' N, squid fishing is only permitted in small-mesh exemption areas.

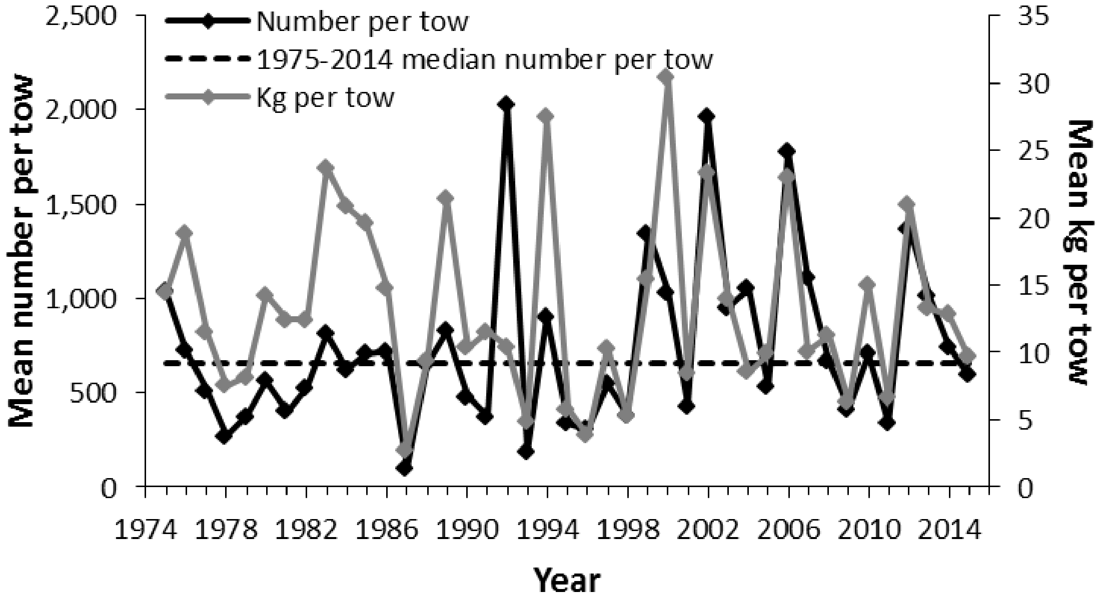

Figure 2.6. *Doryteuthis pealeii* indices of relative abundance (stratified mean number per tow) and biomass (stratified mean kg per tow) derived using daytime tows (solar zenith angles of 43°-80°) from NEFSC fall bottom trawl surveys conducted during 1975-2015.

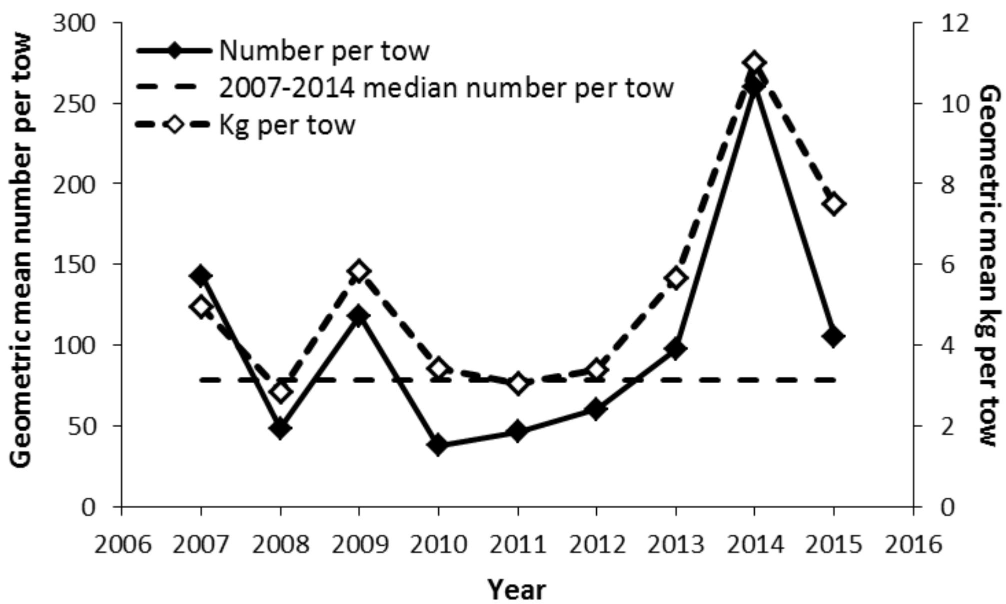

Figure 2.7. *Doryteuthis pealeii* indices of relative abundance (stratified geometric mean number per tow) and biomass (stratified geometric mean kg per tow) derived using catch data from NEAMAP fall bottom trawl surveys conducted during 2007-2015.

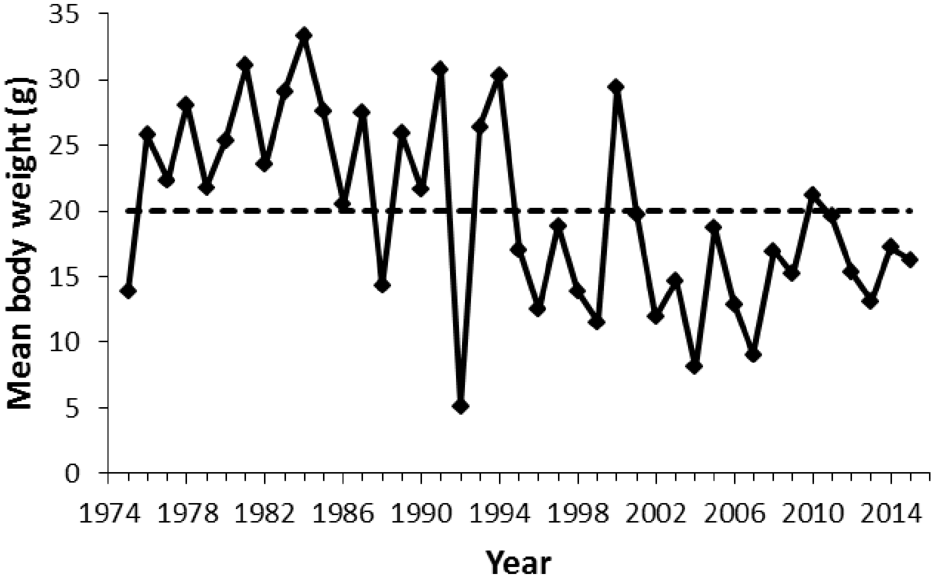

Figure 2.8. Stratified mean body weights of *Doryteuthis pealeii* (stratified mean kg per tow / stratified mean number per tow) derived from NEFSC fall bottom trawl survey data, 1967-2015. The dashed line represents the 1967-2014 median body weight.