

2016 NE Skate Stock Status Update (NEFSC, Lead Analyst: K. Sosebee, 7/xx/2017)

Seven species of skates occur along the North Atlantic coast of the United States: winter skate (*Leucoraja ocellata*), little skate (*L. erinacea*), barndoor skate (*Dipturus laevis*), thorny skate (*Amblyraja radiata*), smooth skate (*Malacoraja senta*), clearnose skate (*Raja eglanteria*), and rosette skate (*L. garmani*). Skates are currently managed under the New England Fishery Management Council's Skate Fishery Management Plan implemented in 2003. This plan includes mandatory reporting by species, possession prohibitions on barndoor, thorny, and smooth skates, trip limits for winter skate, and Annual Catch Limits (ACL) for the wing and bait fisheries.

Indices of relative abundance (stratified mean weight/tow) have been developed from Northeast Fisheries Science Center's (NEFSC) bottom trawl surveys for the seven species in the skate complex. These indices and their rates of change form the basis for all of the conclusions about the status of the complex. All statistically significant NEFSC gear, door, and vessel (RV *Delaware II* to RV *Albatross IV*) conversion factors were applied to little, winter, and smooth skate indices when applicable. The calibration coefficients (FSV *Henry B. Bigelow* to RV *Albatross IV*) below represent changes in overall catch rates expressed in terms of average weight per tow and these were accepted by the New England Fishery Management Council's (NEFMC) Science and Statistical Committee (SSC). All values for survey catch/tow in **Table 1** and **Figure 1** are expressed in "Albatross" units. The survey, range of years, and survey strata sets used as the basis of biological reference points for each species are given in **Table 1**. These strata sets were revised and accepted by the NEFMC SSC in 2011. The changes to the strata sets resulted in changes to biomass reference point values for all species except rosette skate, as well as a change to the overfishing reference point value for clearnose skate.

Calibration coefficients for seven skate species captured during NEFSC bottom trawl surveys:

Species	Calibration Coefficient (Std Err)*	Comment
Little <i>Leucoraja erinacea</i>	2.785519 (0.32)	Spring Survey
Winter <i>Leucoraja ocellata</i>	2.174334 (0.31)	Fall Survey
Barndoor <i>Dipturus laevis</i>	3.661128 (0.51)	Fall Survey
Thorny <i>Amblyraja radiata</i>	3.626359 (0.58)	Fall Survey
Smooth <i>Malacoraja senta</i>	4.449518 (0.67)	Fall Survey
Clearnose <i>Raja eglanteria</i>	6.189401 (0.81)	Fall Survey
Rosette <i>Leucoraja garmani</i>	8.813973 (0.98)	Based on the calibration coefficient for little skate in the fall survey comparisons

*Calibration coefficients represent the ratio of *Bigelow* to *Albatross* catch weight per tow.

Biomass reference points are based entirely on NEFSC survey data, as reliable landings and discard information are not available by species. For all species except barndoor, the B_{MSY} proxy is defined as the 75th percentile of the appropriate survey biomass index time series for that species (**Table 1**). For barndoor skate, the B_{MSY} proxy is defined as the average of 1963-1966 autumn survey biomass indices since the survey did not catch barndoor for a protracted period.

Bottom trawl surveys in autumn 2014-2016 and spring 2015-2017 were complete. However, ship problems delayed the start of the 2014 spring survey until late March and a decision was made, for

that survey only, to drop any strata south of Delaware (Offshore 61-68; Inshore 32, 35, 38, 41, and 44). The consequences of the delay were relatively minor for assessment of the skate complex overall because only the little skate assessment relies on the spring survey. Because the status determination criteria for little skate are based on 3-year survey averages, the 2014 spring survey value will enter into the little skate stock status calculation in 2015 and in 2016. The time series trends without the southern strata are very similar to the full assessment strata set and are generally within the 95% confidence limits of each series (**Figure 2**). Based on survey data from multiple years, the ratio between the survey index from the smaller (truncated) strata set and the full strata set is 1.091 kg/tow. Therefore, the estimated little skate index for spring 2014 was adjusted downward (i.e., divided) by this factor to account for the difference in spatial coverage that year. Some caution should be exercised when interpreting this value. The spring 2016 survey was complete by delayed by several weeks. The mean Julian Day from 1982-2013 ranged from 80-103. In 2014-2016, the mean Julian Days were 121, 99, and 130. It is unknown what impact this has on the little skate survey results.

The fishing mortality reference points are based on changes in survey biomass indices. If the three-year moving average of the survey biomass index for a skate species declines by more than the average CV of the survey time series, then fishing mortality is assumed to be greater than F_{MSY} and overfishing is occurring for that skate species. The average CVs of the indices are given by species in **Table 1**.

For winter skate, the 2014-2016 NEFSC autumn average biomass index of 6.65 kg/tow is above the biomass threshold reference point (2.83 kg/tow) and above the B_{MSY} proxy (5.66 kg/tow). The 2014-2016 average index is above the 2013-2015 index by 24.2%. It is recommended that this stock is not overfished and overfishing is not occurring.

For little skate, the 2015-2017 NEFSC spring average biomass index of 5.49 kg/tow is above the biomass threshold reference point (3.07 kg/tow) but below the B_{MSY} proxy (6.15 kg/tow). The 2015-2017 average index is below the 2014-2016 average by 2.6% which is less than the threshold percent change of 20%. It is recommended that this stock is not overfished and overfishing is not occurring.

For barndoor skate, the 2014-2016 NEFSC autumn average survey biomass index of 1.60 kg/tow is above the biomass threshold reference point (0.78 kg/tow) and the B_{MSY} proxy (1.57 kg/tow). The 2014-2016 average index is above the 2013-2015 index by 0.5%. It is recommended that this stock is not overfished and overfishing is not occurring.

For thorny skate, the 2014-2016 NEFSC autumn average biomass index of 0.18 kg/tow is well below the biomass threshold reference point (2.06 kg/tow). The 2014-2016 index is higher than the 2013-2015 index by 3.7%. It is recommended that this stock is overfished but overfishing is not occurring.

For smooth skate, the 2014-2016 NEFSC autumn average biomass index of 0.25 kg/tow is above the biomass threshold reference point (0.134 kg/tow) but below the B_{MSY} proxy (0.27 kg/tow). The 2014-2016 index is above the 2013-2015 index by 21.4%. It is recommended that this stock is not overfished and overfishing is not occurring.

For clearnose skate, the 2014-2016 NEFSC autumn average biomass index of 0.59 kg/tow is above the biomass threshold reference point (0.33 kg/tow) but below the B_{MSY} proxy (0.66 kg/tow). The

2014-2016 index is below the 2013-2015 index by 19.5% which is less than the threshold percent change of 40%. It is recommended that this stock is not overfished and overfishing is not occurring.

For rosette skate, the 2014-2016 NEFSC autumn average biomass index of 0.047 kg/tow is above the biomass threshold reference point (0.024 kg/tow) but below the B_{MSY} proxy (0.048 kg/tow). The 2014-2016 index is below the 2013-2015 index by 7.9% which is less than the threshold percent change of 60%. It is recommended that this stock is not overfished and overfishing is not occurring.

Update and Revision of Landings and Discards

Landings of bait that are sold from boat-to-boat have ranged from 588 mt in 2014 to 3464 mt in 1999 (**Table 2**). They were 417 in 2016. Total landings were apportioned to species using the method outlined in Sosebee et al. (2016). Landings are similar to last year, but the species mix is different with more little skate and winter skate with less barndoor skate landed (**Table 3**).

Discards were updated through 2016 and revised slightly for 2013-2014 due to some small changes in the boat-to-boat landings of all species added to the dealer landings used to raise the Discard/Kept ratio to total discards for scallop dredge in particular (**Tables 4-6**). Discards have declined from 2015.

Total discards were apportioned to species using the method outlined in Sosebee et al. (2016). Discards of winter skate decreased with barndoor skate discards remaining stable and little skate discards increasing (**Table 7**). Smooth skate discards increased while clearnose skate and rosette skate discards decreased. The same discard mortality rates were applied as in Sosebee et al. (2016) to derive the dead discards (**Table 8**). Because of the change in species composition, the dead discards did not decline as much as the total discards. These were added to the landings to derive the total catch (**Table 9**).

References

Miller TJ, Das C, Politis PJ, Miller AS, Lucey SM, Legault CM, Brown RW, Rago PJ. 2010. Estimation of Albatross IV to Henry B. Bigelow calibration factors. Northeast Fish Sci Cent Ref Doc. 10-05; 233 p.

Sosebee K, Miller A, O'Brien L, McElroy D, Sherman S. 2016. Update of Thorny Skate, *Amblyraja radiata*, Commercial and Survey Data. Northeast Fish Sci Cent Ref Doc. 16-xx; in prep.

	BARNDOR	CLEARNOSE	LITTLE	ROSETTE	SMOOTH	THORNY	WINTER
Survey (kg/tow)	Autumn	Autumn	Spring	Autumn	Autumn	Autumn	Autumn
Time Series Basis	1963-1966	1975-2007	1982-2008	1967-2007	1963-2007	1963-2007	1967-2007
Strata Set	Offshore 1-30, 34-40	Offshore 61-76, Inshore 17,20,23,26,29,32,35, 38,41,44	Offshore 1-30, 34-40, 61-76, Inshore 2,5,8,11,14,17,20,23, 26,29,32,35,38,41,44- 46,56,59-61,64-66	Offshore 61-76	Offshore 1-30, 34-40	Offshore 1-30, 34-40	Offshore 1-30, 34-40, 61-76
2010	1.10	0.68	10.63	0.028	0.18	0.28	8.09
2011	1.02	1.32	6.88	0.034	0.30	0.18	6.65
2012	1.54	0.93	7.54	0.040	0.21	0.08	5.29
2013	1.07	0.77	6.90	0.056	0.14	0.11	2.95
2014	1.62	0.61	6.54 ^a	0.053	0.22	0.21	6.95
2015	2.08	0.82	6.82	0.045	0.25	0.19	6.15
2016	1.09	.339	3.56 ^p	0.044	0.27	0.13	6.84
2017			6.09				
2010-2012 3-year average	1.22	0.97	8.35	0.033	0.23	0.18	6.68
2011-2013 3-year average	1.21	1.01	7.11	0.042	0.22	0.12	4.96
2012-2014 3-year average	1.41	0.77	6.99 ^a	0.048	0.19	0.13	5.06
2013-2015 3-year average	1.59	0.73	6.75 ^a	0.051	0.21	0.17	5.35
2014-2016 3-year average	1.60	0.59	5.64 ^p	0.047	0.25	0.18	6.65
2015-2017 3-year average			5.49				
Percent change 2011-2013 compared to 2010-2012	-1.0	+3.1	-14.9	+28.8	-5.0	-31.9	-25.7
Percent change 2012-2014 compared to 2011-2013	+16.5	-23.3	-1.6	+14.6	-12.5	+8.7	+2.0
Percent change 2013-2015 compared to 2012-2014	+12.9	-4.8	-3.4	+6.0	+6.8	+26.3	+5.7
Percent change 2014-2016 compared to 2013-2015	+0.5	-19.5	-16.8	-7.9	+21.4	+3.7	+24.2
Percent change 2015-2017 compared to 2014-2016			-2.6				
Percent change for overfishing status determination in FMP	-30	-40	-20	-60	-30	-20	-20
Biomass Target	1.57	0.66	6.15	0.048	0.27	4.13	5.66
Biomass Threshold	0.78	0.33	3.07	0.024	0.13	2.06	2.83

Table 1. Footnote a. No survey tows completed south of Delaware in spring 2014. Values for 2014 were adjusted for missing strata (i.e., Offshore 61-68, inshore 32,35,38,41,44) but may not be fully comparable to other surveys which sampled all strata. B. The 2016 spring survey was later than usual.

Table 2. Landings (mt, live wt) of skate reported on VTRs as sold from boat to boat as bait.

Year	Landings
1994	681.0
1995	760.7
1996	1326.7
1997	1685.7
1998	2418.4
1999	3464.1
2000	2652.1
2001	2768.1
2002	1735.7
2003	1249.0
2004	991.5
2005	771.6
2006	1010.8
2007	1206.2
2008	1245.2
2009	1508.5
2010	884.0
2011	676.2
2012	616.0
2013	689.5
2014	588.4
2015	1016.2
2016	417.3

Table 3. Landings of skates apportioned by species

	winter	little	barndoor	thorny	smooth	clearnose	rosette	Total
1968	2689	2793	315	596	81	1	8	6483
1969	3905	5071	69	177	4	234	2	9462
1970	1363	2312	66	361	26	0	0	4128
1971	1693	3307	69	768	68	0	1	5905
1972	3380	3638	119	1529	154	0	2	8823
1973	3512	2611	11	1555	254	16	5	7963
1974	1594	1662	6	344	35	10	1	3651
1975	1735	1356	3	800	63	9	2	3968
1976	336	657	2	169	21	23	3	1212
1977	328	834	0	156	14	72	14	1418
1978	540	555	0	159	29	66	3	1353
1979	401	516	0	402	44	57	3	1423
1980	595	391	0	520	94	38	12	1650
1981	280	172	0	310	32	50	3	847
1982	268	246	0	342	18	3	0	878
1983	1319	1853	0	364	50	17	0	3603
1984	1453	2336	0	331	11	14	12	4156
1985	2120	1506	0	339	14	5	0	3984
1986	2793	1084	0	241	20	113	2	4253
1987	2360	2185	1	463	28	33	8	5078
1988	3603	2752	1	757	108	20	24	7264
1989	2133	3983	4	511	60	17	2	6710
1990	5820	4279	7	1112	120	61	3	11403
1991	4790	5045	21	1205	127	141	4	11332
1992	5465	6163	43	635	62	120	38	12525
1993	4215	7077	76	1294	168	58	17	12904
1994	6212	952	207	1915	2	173	2	9463
1995	3971	3104	79	653	1	164	6	7978
1996	9516	2889	324	1670	0	1135	6	15539
1997	5578	4382	313	936	10	1406	6	12630
1998	7852	6151	127	1375	11	717	16	16250
1999	7032	6508	327	501	6	761	12	15148
2000	7594	5621	456	1109	224	1157	22	16012
2001	6556	4869	1362	940	29	1915	5	15888
2002	7425	4012	1084	961	24	1209	25	14740
2003	9253	4413	903	549	11	1115	10	16254
2004	10983	3414	909	546	7	1185	20	17063
2005	8351	3931	1799	204	11	579	9	14885
2006	8998	3825	3264	301	24	750	5	17168
2007	12822	4535	1971	304	18	637	54	20342
2008	11973	4569	2821	115	22	666	24	20191
2009	12767	5191	672	90	19	883	108	19731
2010	12370	4409	1030	203	48	617	8	18683
2011	10616	4586	1066	120	21	542	12	16963
2012	9227	4563	2470	71	3	802	7	17144
2013	8119	3914	1683	123	12	829	18	14698
2014	8888	3981	2326	177	3	516	13	15904
2015	8134	5169	1331	93	4	787	15	15532
2016	9404	5443	591	103	47	200	11	15799

Table 4. Estimated discards (mt) of skates (all species) by gear type taken in the Gulf of Maine-Georges Bank region, 1964-2016.

year	Half 1						Total Half 1	Half 2						Total Half 2	Grand Total
	Line Trawl	Otter Trawl	Shrimp Trawl	Sink Gill Net	Scallop Dredge	Line Trawl		Otter Trawl	Shrimp Trawl	Sink Gill Net	Scallop Dredge				
1964	361	36,599	0	12	6,433	43,404	402	22,820		7	7,825	31,054	74,458		
1965	425	37,899	0	17	2,588	40,928	491	24,325		5	642	25,462	66,390		
1966	311	39,141	0	26	730	40,208	625	22,370		7	1,562	24,565	64,772		
1967	319	29,986	0	22	610	30,936	470	19,144		8	2,578	22,201	53,137		
1968	224	25,468	0	37	766	26,496	414	18,033		10	1,862	20,318	46,814		
1969	295	24,422	0	32	1,048	25,796	668	15,907		6	2,282	18,863	44,660		
1970	329	22,184	0	22	1,346	23,881	584	15,206		7	2,163	17,960	41,841		
1971	517	21,090	0	21	1,818	23,446	769	14,939		8	1,806	17,522	40,968		
1972	523	18,889	0	31	1,181	20,624	711	12,399		13	1,915	15,038	35,662		
1973	605	18,957	0	31	1,724	21,317	718	13,556		15	1,664	15,954	37,271		
1974	664	17,180	0	58	1,106	19,007	763	11,945		24	1,521	14,253	33,260		
1975	693	15,315	283	61	1,331	17,683	729	11,790	36	26	2,243	14,823	32,506		
1976	495	14,747	66	99	1,705	17,111	429	12,138	0	37	3,229	15,833	32,944		
1977	319	19,178	39	169	3,631	23,336	310	14,145	0	47	8,122	22,625	45,961		
1978	580	22,489	0	189	4,468	27,727	446	14,380	0	66	9,135	24,028	51,754		
1979	905	22,301	26	156	5,673	29,061	760	16,610	0	67	9,967	27,403	56,464		
1980	833	28,089	23	194	7,452	36,590	187	18,063	0	96	8,353	26,699	63,289		
1981	260	29,358	92	262	8,467	38,439	88	15,640	0	93	11,769	27,590	66,029		
1982	254	26,373	117	94	6,054	32,893	96	19,492	7	83	9,578	29,258	62,151		
1983	340	29,158	116	117	4,983	34,715	140	16,464	22	69	6,869	23,565	58,280		
1984	282	27,426	152	125	3,458	31,444	30	13,638	53	94	5,229	19,043	50,488		
1985	240	21,701	214	117	2,279	24,551	86	10,746	70	81	5,794	16,778	41,329		
1986	275	18,687	256	171	4,247	23,637	72	8,855	83	87	7,322	16,419	40,056		
1987	567	15,012	264	141	4,098	20,081	260	8,271	46	85	8,981	17,644	37,725		
1988	539	16,809	158	163	6,472	24,142	324	8,409	46	90	11,846	20,714	44,856		
1989	483	18,497	73	56	6,567	25,676	236	8,722	17	92	13,149	22,216	47,892		
1990	347	22,874	223	347	7,560	31,352	237	9,910	71	73	18,614	28,905	60,256		
1991	729	11,624	232	99	10,858	23,542	234	8,680	44	113	12,297	21,367	44,909		
1992	1,658	8,056	255	162	9,879	20,009	893	2,848	0	56	13,873	17,670	37,679		
1993	28	4,528	35	119	5,024	9,734	22	11,686	1	65	5,819	17,591	27,325		
1994	26	4,759	11	130	1,877	6,802	25	10,295	1	72	1,853	12,246	19,048		
1995	25	7,359	8	209	405	8,006	26	2,317	1	259	1,307	3,909	11,915		
1996	21	7,506	26	279	739	8,572	21	1,743	8	65	2,789	4,625	13,197		
1997	20	4,378	34	106	1,642	6,180	21	3,816	4	16	2,796	6,653	12,833		
1998	17	3,197	9	50	3,399	6,672	24	6,290	1	56	4,278	10,650	17,322		
1999	19	1,689	4	98	1,004	2,815	21	7,055	0	110	3,093	10,280	13,095		
2000	11	4,531	6	121	2,558	7,227	22	7,650	0	740	1,386	9,798	17,025		
2001	15	19,301	0	188	472	19,975	16	6,310		153	555	7,034	27,009		
2002	17	11,090	1	135	944	12,187	20	5,783		200	2,040	8,043	20,230		

Table 4. cont

year	Half 1						Total Half 1	Line Trawl	Half 2					Total Half 1	Grand Total
	Line Trawl	Otter Trawl	Shrimp Trawl	Sink Gill Net	Scallop Dredge	Line Trawl			Otter Trawl	Shrimp Trawl	Sink Gill Net	Scallop Dredge			
2003	32	11,666	8	254	1,132	13,092	13	9,875		153	1,731	11,772	24,864		
2004	3	11,476	4	269	317	12,069	10	13,927	0	219	1,044	15,201	27,270		
2005	88	9,482	2	399	589	10,561	51	12,773	0	204	2,238	15,267	25,828		
2006	54	8,082	0	173	1,059	9,369	17	9,408	1	294	2,482	12,202	21,570		
2007	70	10,577	0	359	892	11,897	22	10,870	0	360	3,179	14,431	26,328		
2008	69	6,662	2	139	1,549	8,420	13	8,648	0	302	2,136	11,099	19,519		
2009	60	7,109	1	563	1,155	8,889	48	10,573	0	203	1,401	12,224	21,113		
2010	143	7,421	0	94	291	7,950	46	9,038	0	274	1,031	10,390	18,340		
2011	89	7,672	3	153	269	8,187	55	8,538	0	257	1,963	10,813	18,999		
2012	29	5,170	3	114	1,140	6,456	25	7,103	0	127	2,597	9,853	16,310		
2013	26	4,205	0	67	1,541	5,839	79	9,182	0	211	2,159	11,631	17,470		
2014	11	5,158		45	1,236	6,449	107	6,083		262	2,476	8,929	15,378		
2015	9	4,094		47	3,166	7,316	287	7,524		276	1,393	9,480	16,796		
2016	5	2,303		113	1,637	4,058	70	6,269		286	1,499	8,124	12,182		

Table 5. Estimated discards (mt) of skates (all species) by gear type taken in the Southern New England-Mid-Atlantic region, 1964-2016.

Year	Half 1					Total Half 1	Half 2					Total Half 2	Grand Total
	Line Trawl	Otter Trawl	Shrimp Trawl	Sink Gill Net	Scallop Dredge		Line Trawl	Otter Trawl	Shrimp Trawl	Sink Gill Net	Scallop Dredge		
1964	0	16,916		0	1	16,917	0	15,172		0	463	15,635	32,552
1965	0	20,746		0	2,441	23,187	0	16,887		0	8,298	25,185	48,372
1966	0	23,680		0	4,813	28,494	0	13,499		0	4,961	18,460	46,954
1967	0	26,886		0	2,273	29,159	0	15,909		0	2,157	18,066	47,225
1968	0	30,741		0	2,905	33,646	0	15,978		0	3,028	19,006	52,652
1969	2	30,557		0	1,246	31,805	1	13,392		0	735	14,128	45,933
1970	2	21,694		0	492	22,188	0	11,596		0	579	12,175	34,363
1971	2	13,419		0	98	13,519	0	5,158		0	746	5,904	19,422
1972	2	13,272		0	819	14,094	1	5,566		0	644	6,210	20,304
1973	13	15,425		0	379	15,816	6	6,182		0	182	6,369	22,185
1974	34	19,170		0	888	20,091	15	5,810		0	1,324	7,148	27,239
1975	34	9,882		0	1,284	11,200	15	5,522		0	2,515	8,052	19,252
1976	19	7,688		0	2,381	10,089	11	7,512		0	5,085	12,608	22,697
1977	10	7,639		0	3,579	11,228	4	7,534		0	1,984	9,521	20,750
1978	248	12,605		1	4,580	17,434	215	9,103		0	5,317	14,635	32,069
1979	114	16,229		1	3,513	19,857	211	11,372		0	3,574	15,157	35,014
1980	224	11,730		1	2,448	14,403	167	11,570		0	2,750	14,487	28,890
1981	244	13,828		1	1,036	15,108	169	10,820		0	1,049	12,038	27,147
1982	146	17,088		1	1,725	18,960	101	18,388		0	2,994	21,483	40,442
1983	131	20,196		1	3,672	23,999	86	17,247		0	5,096	22,429	46,428
1984	95	21,023		1	4,879	25,998	57	17,623		1	4,674	22,354	48,353
1985	80	18,452		2	4,542	23,076	87	12,760		0	3,689	16,536	39,612
1986	132	18,225		2	3,574	21,932	99	16,662		1	4,758	21,520	43,452
1987	126	21,129		2	8,589	29,846	104	12,907		1	9,972	22,984	52,829
1988	98	18,544		3	7,319	25,964	17	12,771		1	7,231	20,020	45,984
1989	59	19,166		18	11,639	30,882	28	11,537		20	6,303	17,887	48,769
1990	43	26,989		0	9,602	36,634	37	29,098		0	4,844	33,978	70,612
1991	110	11,258		0	8,457	19,824	63	8,799		0	6,515	15,377	35,201
1992	392	5,763		107	3,800	10,062	377	16,761		51	8,950	26,139	36,202
1993	14	3,358		92	6,243	9,708	6	15,139		45	6,881	22,072	31,780
1994	7	52,689		60	4,607	57,363	3	7,561		158	3,768	11,490	68,853
1995	5	14,621		234	6,980	21,840	4	8,898		91	18,174	27,167	49,007
1996	7	8,716		135	7,636	16,494	6	28,879		60	8,469	37,413	53,908
1997	10	3,207		282	8,488	11,986	8	3,582		74	3,264	6,928	18,914
1998	8	2,906		168	5,670	8,752	6	4,198		196	4,264	8,665	17,417
1999	4	966		500	7,537	9,007	3	2,802		150	3,056	6,011	15,018
2000	3	2,252		60	6,466	8,782	4	10,525		51	3,573	14,153	22,935
2001	5	773		216	3,143	4,138	6	2,138		54	2,694	4,893	9,031
2002	4	1,078		256	5,711	7,050	5	4,284		2,519	6,006	12,814	19,863

Table 5. cont

year	Half 1						Total Half 1	Half 2						Total Half 1	Grand Total
	Line Trawl	Otter Trawl	Shrimp Trawl	Sink Gill Net	Scallop Dredge	Line Trawl		Otter Trawl	Shrimp Trawl	Sink Gill Net	Scallop Dredge				
2003	6	6,592		269	6,090	12,957	6	7,854		289	6,234	14,382	27,339		
2004	6	2,848		181	5,227	8,261	6	7,809		284	3,192	11,290	19,552		
2005	0	4,822		642	5,823	11,287	0	6,496		355	2,507	9,359	20,646		
2006	1	2,470		680	3,720	6,872	1	2,960		68	3,092	6,121	12,993		
2007	0	3,990		631	4,920	9,541	0	5,345		396	3,309	9,050	18,591		
2008	49	3,729		1,093	3,261	8,132	43	4,490		442	2,403	7,378	15,511		
2009	104	3,944		1,070	3,748	8,867	137	4,125		406	2,792	7,461	16,328		
2010	125	2,040		963	7,364	10,493	163	2,834		1,070	3,865	7,932	18,425		
2011	83	4,095		1,823	4,794	10,795	116	6,222		948	1,678	8,965	19,760		
2012	17	4,771		1,543	3,075	9,405	27	6,283		697	1,551	8,559	17,964		
2013	282	10,239		1,334	2,106	13,961	375	7,758		312	2,798	11,243	25,203		
2014	3	7,476		1,630	6,279	15,388	4	8,344		618	3,025	11,991	27,378		
2015	50	7,503		929	2,933	11,415	20	7,081		421	2,163	9,684	21,099		

Table 6. Estimated discards (mt) of skates (all species) by gear type from all areas combined, 1964-2016.

Year	Half 1						Half 2						Grand Total
	Line Trawl	Otter Trawl	Shrimp Trawl	Sink Gill Net	Scallop Dredge	Total Half 1	Line Trawl	Otter Trawl	Shrimp Trawl	Sink Gill Net	Scallop Dredge	Total Half 2	
1964	361	53,514	0	12	6,434	60,321	402	37,992	0	7	8,288	46,690	107,011
1965	425	58,644	0	17	5,029	64,115	491	41,212	0	5	8,940	50,647	114,762
1966	311	62,821	0	26	5,543	68,701	625	35,869	0	7	6,524	43,025	111,726
1967	319	56,872	0	22	2,882	60,095	470	35,053	0	8	4,735	40,267	100,362
1968	224	56,209	0	37	3,672	60,142	414	34,010	0	10	4,890	39,324	99,466
1969	296	54,979	0	32	2,294	57,602	669	29,299	0	6	3,017	32,991	90,593
1970	331	43,878	0	22	1,838	46,069	584	26,802	0	7	2,742	30,135	76,204
1971	519	34,509	0	21	1,916	36,965	769	20,097	0	8	2,552	23,426	60,391
1972	525	32,161	0	31	2,000	34,718	711	17,965	0	13	2,559	21,248	55,966
1973	618	34,382	0	31	2,103	37,134	724	19,738	0	15	1,846	22,323	59,457
1974	697	36,349	0	58	1,994	39,099	778	17,754	0	24	2,845	21,401	60,499
1975	727	25,197	283	61	2,615	28,883	744	17,313	36	26	4,757	22,875	51,758
1976	514	22,435	66	99	4,086	27,200	441	19,650	0	37	8,313	28,441	55,641
1977	329	26,817	39	169	7,210	34,564	314	21,679	0	47	10,106	32,146	66,710
1978	829	35,094	0	190	9,048	45,161	661	23,484	0	66	14,452	38,662	83,823
1979	1,019	38,530	26	157	9,186	48,918	971	27,982	0	67	13,540	42,560	91,478
1980	1,056	39,819	23	195	9,900	50,993	354	29,633	0	96	11,104	41,186	92,179
1981	503	43,186	92	264	9,502	53,547	257	26,460	0	93	12,818	39,628	93,175
1982	400	43,461	117	95	7,779	51,853	197	37,880	7	84	12,572	50,740	102,593
1983	471	49,354	116	118	8,655	58,714	226	33,711	22	70	11,965	45,994	104,708
1984	378	48,449	152	126	8,337	57,442	87	31,261	53	94	9,903	41,398	98,840
1985	321	40,153	214	119	6,821	47,628	173	23,506	70	81	9,483	33,314	80,941
1986	406	36,913	256	173	7,821	45,569	171	25,517	83	88	12,080	37,938	83,508
1987	692	36,141	264	143	12,687	49,927	364	21,178	46	86	18,953	40,627	90,554
1988	638	35,353	158	166	13,791	50,106	341	21,180	46	91	19,077	40,734	90,840
1989	542	37,663	73	74	18,206	56,558	264	20,260	17	111	19,452	40,104	96,661
1990	390	49,863	223	347	17,162	67,986	273	39,008	71	73	23,458	62,883	130,869
1991	839	22,882	232	99	19,314	43,366	297	17,478	44	113	18,812	36,744	80,110
1992	2,050	13,819	255	269	13,679	30,072	1,270	19,609	0	107	22,823	43,809	73,881
1993	42	7,886	35	211	11,268	19,442	28	26,825	1	110	12,700	39,663	59,105
1994	33	57,447	11	190	6,484	64,165	28	17,856	1	230	5,621	23,735	87,900
1995	30	21,980	8	443	7,385	29,846	30	11,215	1	350	19,481	31,077	60,922
1996	28	16,222	26	414	8,376	25,066	27	30,622	8	125	11,258	42,039	67,105
1997	30	7,584	34	388	10,130	18,166	30	7,398	4	90	6,059	13,581	31,747
1998	25	6,103	9	218	9,069	15,425	30	10,488	1	252	8,543	19,314	34,739
1999	23	2,655	4	598	8,542	11,823	24	9,857	0	261	6,149	16,291	28,113
2000	14	6,783	6	181	9,024	16,009	26	18,175	0	791	4,959	23,951	39,960
2001	20	20,075	0	404	3,615	24,114	22	8,449	0	207	3,249	11,927	36,040
2002	21	12,168	1	392	6,655	19,237	25	10,067	0	2,718	8,046	20,857	40,094

Table 6. cont

year	Half 1						Total Half 1	Half 2						Total Half 1	Grand Total
	Line Trawl	Otter Trawl	Shrimp Trawl	Sink Gill Net	Scallop Dredge			Line Trawl	Otter Trawl	Shrimp Trawl	Sink Gill Net	Scallop Dredge			
2003	38	18,258	8	522	7,222	26,048	18	17,728	0	442	7,965	26,154	52,203		
2004	9	14,324	4	450	5,544	20,331	16	21,736	0	503	4,236	26,491	46,822		
2005	88	14,304	2	1,041	6,412	21,848	51	19,269	0	559	4,746	24,626	46,473		
2006	55	10,552	0	854	4,779	16,241	18	12,368	1	362	5,574	18,323	34,564		
2007	70	14,566	0	990	5,812	21,438	22	16,214	0	756	6,488	23,481	44,919		
2008	119	10,391	2	1,232	4,810	16,553	56	13,138	0	744	4,539	18,478	35,030		
2009	164	11,054	1	1,634	4,903	17,756	185	14,698	0	609	4,193	19,685	37,441		
2010	269	9,461	0	1,058	7,655	18,443	209	11,872	0	1,344	4,896	18,322	36,765		
2011	172	11,768	3	1,976	5,063	18,982	171	14,760	0	1,205	3,642	19,777	38,759		
2012	46	9,941	3	1,657	4,215	15,861	53	13,386	0	825	4,149	18,412	34,274		
2013	308	14,444	0	1,401	3,647	19,800	454	16,940	0	523	4,957	22,874	42,673		
2014	14	12,634	0	1,675	7,514	21,837	111	14,427	0	880	5,502	20,919	42,757		
2015	60	11,596	0	976	6,099	18,731	307	14,605	0	696	3,556	19,164	37,895		
2016	86	8,090	0	1,248	4,821	14,245	132	12,228	0	614	6,051	19,025	33,270		

Table 7. Total discards of skates apportioned by species.

Year	winter	little	barndoor	thorny	smooth	clearnose	rosette	Total
1968	35519	39452	4359	18050	1501	474	112	99466
1969	31764	40884	1311	14863	901	860	10	90593
1970	24856	32087	887	16542	948	851	32	76204
1971	17029	22455	674	17772	1867	584	9	60391
1972	20891	17881	622	14427	1416	701	29	55966
1973	19983	21121	85	15920	1975	340	33	59457
1974	22534	19640	109	14169	2768	1200	79	60499
1975	15499	20744	43	14108	745	569	50	51758
1976	16244	22877	175	11607	1235	2640	861	55641
1977	27322	21545	3	13657	1242	2650	293	66710
1978	38837	23466	34	11803	1871	7295	517	83823
1979	41242	31612	21	13001	1417	3999	187	91478
1980	48389	22849	3	15809	2563	1965	601	92179
1981	52939	21826	3	14987	1331	1937	152	93175
1982	52829	38355	9	10350	582	418	49	102593
1983	56193	32992	1	10282	1098	4094	46	104708
1984	50390	34422	7	9398	423	3152	1047	98840
1985	43767	25501	4	9883	488	1278	20	80941
1986	51644	15478	24	7352	665	8288	58	83508
1987	45440	30851	20	6101	429	6177	1536	90554
1988	51125	29173	18	5344	803	805	3571	90840
1989	47770	39318	32	5146	541	3492	364	96661
1990	66332	45412	73	8802	874	8657	719	130869
1991	37598	25401	59	6645	642	9604	161	80110
1992	33314	27386	255	3752	369	6307	2498	73881
1993	17268	33266	375	5495	603	1453	644	59105
1994	32855	39386	1098	4133	712	9679	41	87903
1995	17865	36636	223	1246	466	4113	375	60924
1996	17042	45815	63	850	337	2782	218	67107
1997	9247	19551	578	1275	424	616	57	31748
1998	10533	20600	472	1589	441	969	134	34740
1999	7498	17684	1034	686	250	959	43	28154
2000	9521	24745	1372	867	363	2890	202	39961
2001	14554	17948	1145	1320	252	748	74	36041
2002	14321	20508	1475	835	399	2506	50	40094
2003	15698	32172	1101	1561	566	1079	27	52204
2004	19772	22073	1206	1611	1015	1082	64	46823
2005	16205	22789	2884	1231	1364	1799	204	46474
2006	12478	15986	3084	796	909	1263	49	34565
2007	15712	21085	3272	737	476	3583	56	44920
2008	13801	14752	2909	184	468	2821	96	35031
2009	16938	14483	2256	375	402	2904	82	37441
2010	17797	13659	2765	464	319	1727	34	36766
2011	19049	11689	4624	395	623	2353	28	38760
2012	14900	11371	4008	355	656	2808	177	34274
2013	18530	16059	4007	493	449	3009	128	42674
2014	17577	17392	5471	445	363	1388	122	42758
2015	17213	13915	2460	407	479	3213	207	37894
2016	10828	16376	2388	351	694	2520	105	33262

Table 8. Dead discards of skates apportioned by species.

Year	winter	little	barndoor	thorny	smooth	clearnose	rosette	Total
1968	4422	9417	2179	4417	891	237	56	21620
1969	3563	9574	656	3690	536	430	5	18454
1970	2918	7405	443	4144	563	426	16	15914
1971	1990	5373	337	4617	1101	292	5	13715
1972	2379	4373	311	3846	829	350	14	12102
1973	2323	4958	42	4218	1160	170	17	12888
1974	2526	4814	55	3691	1632	600	39	13357
1975	1823	5659	21	3976	435	285	25	12225
1976	2267	6502	87	3152	722	1320	431	14481
1977	4306	6262	1	3807	728	1325	146	16575
1978	6028	6942	17	3359	1098	3648	259	21350
1979	6674	8975	10	3791	822	1999	93	22366
1980	6937	6648	1	4797	1466	982	301	21131
1981	8137	6113	2	4493	764	969	76	20552
1982	7695	10405	5	2836	339	209	25	21514
1983	7493	9165	1	2854	639	2047	23	22221
1984	6830	9137	4	2538	248	1576	524	20856
1985	5941	7430	2	2622	287	639	10	16931
1986	7663	4284	12	1973	388	4144	29	18493
1987	7866	9930	10	1686	250	3089	768	23599
1988	9247	9412	9	1655	458	403	1785	22969
1989	9811	12047	16	1621	307	1746	182	25729
1990	13073	11860	36	2747	501	4329	359	32904
1991	8571	8273	29	2348	358	4802	80	24462
1992	8931	9054	127	1470	196	3154	1249	24182
1993	3452	10812	188	1817	339	727	322	17657
1994	3691	10935	549	1166	416	4839	20	21617
1995	3292	13382	112	368	272	2056	187	19670
1996	2568	14075	31	323	186	1391	109	18683
1997	1714	7441	289	407	237	308	28	10423
1998	1993	7832	236	510	242	485	67	11364
1999	1584	6776	517	213	142	480	22	9732
2000	1675	8248	686	266	210	1445	101	12631
2001	1659	5471	572	329	146	374	37	8589
2002	2813	7816	738	219	231	1253	25	13095
2003	1905	10680	551	432	323	539	14	14442
2004	2617	6604	603	403	596	541	32	11397
2005	2415	7036	1442	334	799	899	102	13028
2006	2031	5292	1542	241	528	631	25	10290
2007	2435	7103	1636	217	273	1791	28	13483
2008	1994	5138	1455	62	259	1411	48	10367
2009	2792	4764	1128	106	232	1452	41	10515
2010	3046	5333	1382	127	184	864	17	10953
2011	3158	3991	2312	112	355	1177	14	11119
2012	2466	4013	2004	104	373	1404	88	10452
2013	3020	4846	2003	142	253	1505	64	11834
2014	3090	6103	2736	135	204	694	61	13023
2015	2710	4653	1230	137	268	1606	104	10708
2016	1959	5733	1194	106	399	1260	52	10703

Table 9. Total catch (landings plus dead discards) of skates apportioned by species.

Year	winter	little	barndoor	thorny	smooth	clearnose	rosette	Total
1968	7111	12210	2495	5013	972	238	64	28103
1969	7469	14644	725	3867	540	664	7	27916
1970	4280	9717	510	4505	588	426	16	20042
1971	3682	8681	406	5385	1169	292	5	19620
1972	5759	8011	430	5375	983	351	16	20925
1973	5835	7569	53	5773	1414	185	22	20851
1974	4120	6476	61	4035	1667	610	40	17008
1975	3558	7015	25	4776	499	294	27	16193
1976	2603	7159	89	3321	744	1343	434	15693
1977	4634	7096	1	3963	742	1397	160	17993
1978	6568	7497	17	3518	1127	3713	262	22703
1979	7075	9492	11	4193	866	2056	97	23788
1980	7532	7038	1	5316	1560	1021	313	22781
1981	8417	6285	2	4803	796	1019	79	21400
1982	7964	10651	5	3178	357	213	25	22392
1983	8812	11018	1	3217	689	2064	23	25824
1984	8283	11473	4	2869	259	1590	536	25013
1985	8061	8936	2	2961	301	644	10	20915
1986	10456	5368	12	2215	408	4257	31	22747
1987	10226	12115	11	2149	279	3122	776	28677
1988	12850	12163	11	2412	566	423	1810	30234
1989	11944	16030	20	2132	367	1763	183	32439
1990	18893	16139	43	3859	621	4390	363	44307
1991	13360	13317	51	3553	486	4943	84	35794
1992	14396	15218	170	2105	258	3273	1287	36708
1993	7667	17889	263	3111	507	785	339	30561
1994	9903	11887	756	3081	418	5012	23	31080
1995	7264	16485	191	1021	273	2221	193	27648
1996	12084	16964	355	1993	187	2526	115	34223
1997	7291	11822	602	1343	247	1714	34	23054
1998	9845	13983	364	1885	252	1202	83	27614
1999	8615	13284	844	714	148	1240	34	24880
2000	9270	13869	1142	1375	263	2602	123	28643
2001	8215	10340	2147	1269	175	2289	42	24477
2002	10238	11828	1821	1180	254	2462	50	27834
2003	11158	15092	1454	981	333	1655	23	30696
2004	13600	10018	1512	950	603	1726	52	28460
2005	10766	10968	3241	538	810	1479	111	27912
2006	11029	9117	4806	542	553	1382	30	27459
2007	15257	11638	3607	521	291	2428	82	33825
2008	13967	9708	4276	178	281	2077	72	30558
2009	15559	9955	1800	196	251	2336	149	30247
2010	15415	9742	2413	330	231	1480	25	29636
2011	13774	8577	3378	232	376	1719	26	28082
2012	11693	8576	4474	175	377	2206	96	27596
2013	11139	8760	3686	266	265	2334	82	26532
2014	11979	10084	5062	312	208	1210	73	28928
2015	10844	9822	2561	230	272	2393	118	26240
2016	11363	11177	1785	209	446	1460	63	26502

Skate Complex Biomass Indices

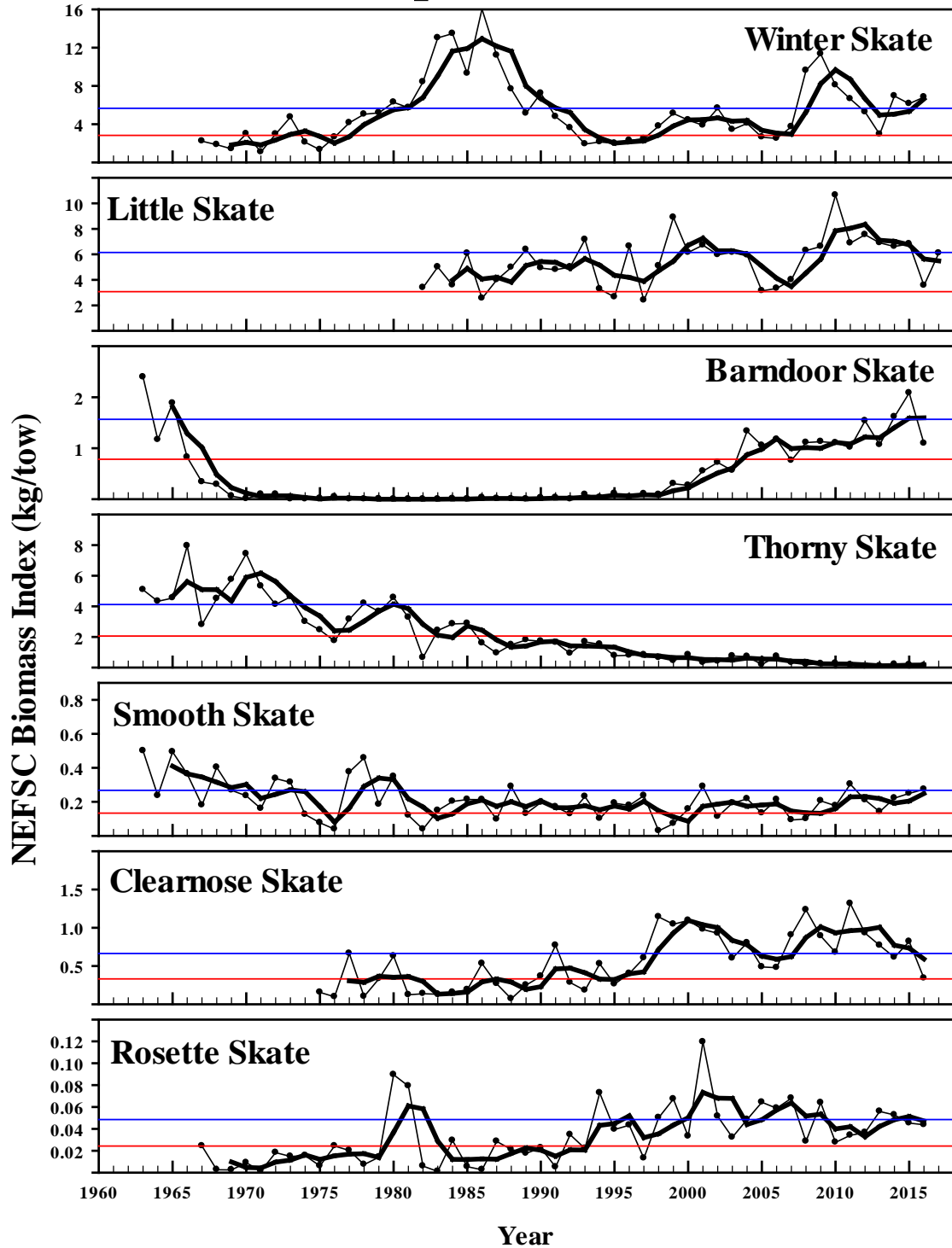


Figure 1. NEFSC survey biomass indices (kg/tow). Thin lines with symbols are annual indices, thick lines are 3-year moving averages, and the thin horizontal lines are the biomass thresholds and targets developed through 2007/2008 with consistent

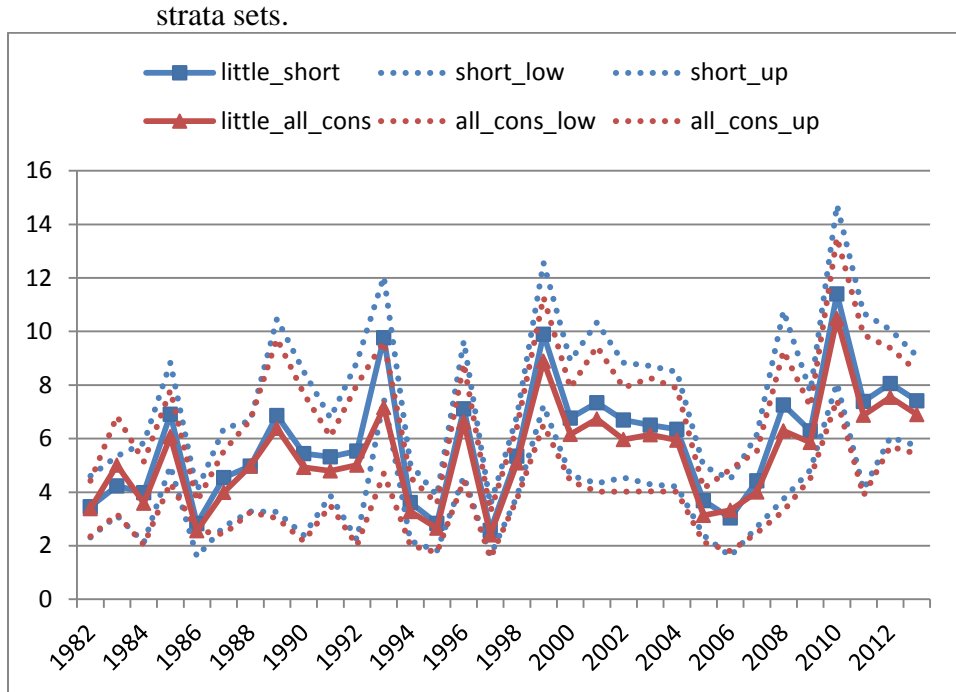


Figure 2. Little skate spring indices (kg per tow) based on all strata (i.e., full strata set; red triangles) and based on truncated strata set (i.e., strata south of Delaware Bay were removed; blue squares) from 1982-2013. The 95% confidence limits for each series are shown as dotted lines in the same color. The survey catch ratio of the truncated strata set to the full strata set is 1.091 (based on a ratio estimator = sum across years of survey estimates based on truncated series divided by sum of estimates based on full strata set).