2018 NE Skate Stock Status Update (NEFSC, Lead Analyst: K. Sosebee, 8/14/2019)

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 *Leucoraja erinacea*	2.785519 (0.32)	Spring Survey
Winter *Leucoraja ocellata*	2.174334 (0.31)	Fall Survey
Barndoor *Dipturus laevis*	3.661128 (0.51)	Fall Survey
Thorny *Amblyraja radiata*	3.626359 (0.58)	Fall Survey
Smooth *Malacoraja senta*	4.449518 (0.67)	Fall Survey
Clearnose *Raja eglanteria*	6.189401 (0.81)	Fall Survey
Rosette *Leucoraja garmani*	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 2015-18 sampled the entire survey area. 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; **Figures 2 and 3**). 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 4**). 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 2017 autumn survey coverage was incomplete and only strata from the Gulf of Maine and Georges Bank were completed (Offshore Strata 13-30, 36-40, **Figures 2 and 3**). This has major consequences for the skate complex. For two species, rosette skate and clearnose skate, there is no survey index for autumn 2017. For this update, some explorations of various smoothers were conducted to determine if there was something other than using a two-point average which could give a more robust stock status and be used in ABC calculations. Loess smoothers using 10, 20, and 30 percent of the data as well as a Kalman filter were run (**Figures 5 and 6**). Given that the skate FMP specifically mentions a three-year average, the PDT decided that the average of 2016 and 2018 was chosen as the value to be used in the ABC calculations.

For the remaining species which use the autumn survey for a portion of the index, a ratio similar to that used for little skate in 2014 was used to adjust the survey index to account for the missing strata. For these species, the majority of the stock happens to occur in the strata that were sampled, so the consequences were not as great as for the other two species. For winter skate, barndoor skate, thorny skate and smooth skate, the lack of coverage in the Southern New England and the Mid-Atlantic strata described above for fall 2017 was analyzed for the entire time series to show the difference between including and excluding these strata on the estimate of mean biomass. In general, all four species of skate are more abundant in the northern strata. Thus relative biomass estimates (kg/tow) based on the northern strata only would be higher than estimates based on the entire strata set. Over the entire time series (1967-2016 or 1963-2016) the ratios of the time series without the southern strata to the full strata set were 1.610, 1.223, 1.423, and 1.418, respectively. These values and the indices they are applied to correct a mistake made in the report from 2018 (Sosebee 2018). To adjust the observed 2017 value for these average ratios, the 2017 values of 13.527, 1.888, 0.305, and 0.476 were divided by 1.61, 1.223, 1.423, and 1.382 yielding values of 8.40, 1.54, 0.21, and 0.34.

In fall 2018, offshore strata 30, 34, and 35 were not sampled and offshore stratum 36 only had 1 tow. This impacts winter skate, barndoor skate, thorny skate and smooth skate. The same method as used for 2017 was used. The ratios were 1.051, 0.998, 0.996, and 0.860, respectively. Even though the values for barndoor and thorny skate were near one, these 4 factors were still applied to 6.740,

2,798, 0.141, and 0.214 to yield values of 6.415, 2.804, 0.142 and 0.249 for consistency with previous years.

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 2016-2018 NEFSC autumn average biomass index of 7.22 kg/tow is above the biomass threshold reference point (2.83 kg/tow) and above the B_{MSY} proxy (5.66 kg/tow). The 2016-2018 average index is above the 2015-2017 index by 1.2%. It is recommended that this stock is not overfished and overfishing is not occurring.

For little skate, the 2017-2019 NEFSC spring average biomass index of 5.32 kg/tow is above the biomass threshold reference point (3.07 kg/tow) but below the B_{MSY} proxy (6.15 kg/tow). The 2017-2019 average index is above the 2016-2018 average by 13.4%. It is recommended that this stock is not overfished and overfishing is not occurring.

For barndoor skate, the 2016-2018 NEFSC autumn average survey biomass index of 1.81 kg/tow is above the biomass threshold reference point (0.78 kg/tow) and the B_{MSY} proxy (1.57 kg/tow). The 2016-2018 average index is above the 2015-2017 index by 15.3%. It is recommended that this stock is not overfished and overfishing is not occurring.

For thorny skate, the 2016-2018 NEFSC autumn average biomass index of 0.16 kg/tow is well below the biomass threshold reference point (2.06 kg/tow). The 2016-2018 index is below the 2015-2017 index by 8.4% which is less than the threshold percent change of 20%. It is recommended that this stock is overfished but overfishing is not occurring.

For smooth skate, the 2016-2018 NEFSC autumn average biomass index of 0.27 kg/tow is above the biomass threshold reference point (0.134 kg/tow) but below the B_{MSY} proxy (0.27 kg/tow). The 2016-2018 index is below the 2015-2017 index by 0.2% which is less than the threshold percent change of 30%. It is recommended that this stock is not overfished and is rebuilt and overfishing is not occurring.

For clearnose skate, the 2016 and 2018 NEFSC autumn two-year average biomass index of 0.61 kg/tow is above the biomass threshold reference point (0.33 kg/tow) but below the B_{MSY} proxy (0.66 kg/tow). The 2016 and 2018 two year average index is above the 2014-2016 index by 3.1%. It is recommended that this stock is not overfished and overfishing is not occurring.

For rosette skate, the 2016 and 2018 NEFSC autumn two-year 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 2016 and 2018 two year average index is above the 2014-2016 index by 0.1%. It is recommended that this stock is not overfished and overfishing is not occurring.

Update of Landings and Discards by Species

Landings of bait that are sold from boat-to-boat have ranged from 192 mt in 2018 to 3464 mt in 1999 (**Table 2**). The value in 2017 was similar to 2018. Total landings were apportioned to species using the method outlined in Sosebee et al. (2016). To fill in the species composition for fall 2017 in Southern New England and Mid-Atlantic, the kg/tow by species were averaged for 2016 and 2018. Landings are similar to last year, but the species mix is different with more little skate and less winter and barndoor skate landed (**Table 3**).

Total discards were updated through 2018 (**Tables 4-6**). Discards in the Gulf of Maine to Georges Bank region increased slightly from the lowest in the time series (10,289 mt) to 11,972 in 2018. Discards in Southern New England to the Mid-Atlantic region declined from 2017 to 11,027 which is the lowest since 2001 and the second lowest in the time series. Overall, discards declined by 10% from 25,365 mt to 22,999 mt in 2018, the lowest value in the time series.

Total discards were apportioned to species using the method outlined in Sosebee et al. (2016). To fill in the species composition for fall 2017 in Southern New England and Mid-Atlantic, the kg/tow by species were averaged for 2016 and 2018. Discards of winter skate increased with barndoor skate and little skate discards decreasing (**Table 7**). Thorny, clearnose, and rosette skate discards increased while smooth skate discards decreased. Discard mortality rates were applied by species and gear type to derive the dead discards (**Table 8**). The dead discards declined the same amount as the total discards. These were added to the landings to derive the total catch (**Table 9**).

References

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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. 16-08; 145 pp.

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	BARNDOOR	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**
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	0.34	3.56[b]	0.044	0.27	0.13	6.84
2017	1.54[c]	[c]	6.09	[c]	0.34[c]	0.21[c]	8.40[c]
2018	2.80[e]	0.88	4.41	0.051	0.25[e]	0.14[e]	6.41[e]
2019			5.45				
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[b]	0.047	0.23	0.176	6.65
2015-2017 3-year average	1.57[c]	[c]	5.49[b]	[c]	0.27[c]	0.18[c]	7.13[c]
2016-2018 3-year average	1.81[c,e]	0.61[d]	4.69[b]	.047[d]	0.27[c,e]	0.16[c,e]	7.22[c,e]
2017-2019 3-year average			5.32				
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	+13.2	+3.7	+24.2
Percent change 2015-2017 compared to 2014-2016	-0.1.5		-2.6		+16.3	-0.6	+7.3
Percent change 2016-2018 compared to 2015-2017	+15.3	+3.1 [d]	-14.6	+0.1	-0.2	-8.4	+1.2
Percent change 2017-2019 compared to 2016-2018			+13.4				
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. a. No survey tows completed south of Delaware in spring 2014. Values for 2014 were adjusted for missing strata (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. Footnote c. No survey tows completed south of Georges Bank in fall 2017. Values were adjusted for missing strata (Offshore 1-12, 61-76). Footnote d. Two-year average due to missing 2017 survey. Footnote e. Offshore strata 30, 34 and 35 not sampled but no adjustments were made.

Table 2. Landings (mt, live wt) of skate reported on VTRs as sold from boat to boat from 1994-2018.

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	1016.3
2016	419.1
2017	193.4
2018	192.1

Table 3. Landings (mt, live weight) 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
2017	8961	4751	521	23	4	205	5	14470
2018	8461	5152	426	42	5	242	12	14341

Table 4. Estimated discards (mt) of skates (all species) by gear type taken in the Gulf of Maine-Georges Bank region, 1964-2018.

	Half 1							Half 2							
year	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		Grand Total
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

	Half 1							Half 2							
year	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 1		Grand Total
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
2017	8	1,690	0	55	1,726	3,479		39	4,493	0	288	1,989	6,809		10,289
2018	11	1,393	0	41	2,157	3,603		18	3,892	0	387	4,072	8,369		11,972

Table 5. Estimated discards (mt) of skates (all species) by gear type taken in the Southern New England-Mid-Atlantic region, 1964-2018.

	Half 1							Half 2							
Year	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		Grand Total
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

	Half 1							Half 2							
year	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 1		Grand Total
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
2016	81	5,786		1,135	3,184	10,187		62	5,959		328	4,552	10,901		21,088
2017	46	3,815		945	3,203	8,010		38	3,113		396	3,520	7,066		15,076
2018	23	2,731		1,275	2,431	6,460		13	3,045		177	1,331	4,567		11,027

Table 6. Estimated discards (mt) of skates (all species) by gear type from all areas combined, 1964-2018.

	Half 1							Half 2							
Year	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		Grand Total
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

	Half 1							Half 2							
year	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 1		Grand Total
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
2017	55	5,505	0	1,000	4,929	11,489		76	7,606	0	684	5,509	13,876		25,365
2018	34	4,124	0	1,316	4,588	10,063		31	6,937	0	564	5,404	12,936		22,999

Table 7. Total discards (mt) 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	10837	16376	2388	351	694	2520	105	33271
2017	9087	12081	2680	251	647	1072	67	25884
2018	9370	9298	1849	393	611	1405	74	23000

Table 8. Dead discards (mt) 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	18453
1970	2917	7405	443	4144	563	426	16	15914
1971	1990	5373	337	4617	1101	292	5	13715
1972	2378	4373	311	3846	829	350	14	12101
1973	2323	4958	42	4218	1160	170	17	12888
1974	2525	4814	55	3691	1632	600	39	13357
1975	1822	5659	21	3976	435	285	25	12224
1976	2266	6502	87	3152	722	1320	431	14480
1977	4304	6262	1	3807	728	1325	146	16573
1978	6026	6942	17	3359	1098	3648	259	21348
1979	6656	8975	10	3791	822	1999	93	22348
1980	6915	6648	1	4797	1466	982	301	21110
1981	8123	6113	2	4493	764	969	76	20538
1982	7680	10405	5	2836	339	209	25	21499
1983	7477	9165	1	2854	639	2047	23	22205
1984	6806	9137	4	2538	248	1576	524	20832
1985	5928	7430	2	2622	287	639	10	16918
1986	7641	4284	12	1973	388	4144	29	18471
1987	7847	9930	10	1686	250	3089	768	23581
1988	9230	9412	9	1655	458	403	1785	22952
1989	9782	12047	16	1621	307	1746	182	25701
1990	13055	11860	36	2747	501	4329	359	32887
1991	8554	8273	29	2348	358	4802	80	24445
1992	8908	9054	127	1470	196	3154	1249	24159
1993	3418	10812	188	1817	339	727	322	17622
1994	3639	10935	549	1166	416	4839	20	21565
1995	3190	13382	112	368	272	2056	187	19568
1996	2478	14075	31	323	186	1391	109	18593
1997	1656	7441	289	407	237	308	28	10366
1998	1944	7832	236	510	242	485	67	11316
1999	1459	6776	517	213	142	480	22	9608
2000	1413	8248	686	266	210	1445	101	12369
2001	1546	5471	572	329	146	374	37	8475
2002	1851	7816	738	219	231	1253	25	12132
2003	1746	10680	551	432	323	539	14	14283
2004	2469	6604	603	403	596	541	32	11249
2005	2253	7036	1442	334	799	899	102	12866
2006	1874	5292	1542	241	528	631	25	10134
2007	2134	7103	1636	217	273	1791	28	13182
2008	1787	5138	1455	62	259	1411	48	10160
2009	2346	4764	1128	106	232	1452	41	10070
2010	2616	5333	1382	127	184	864	17	10523
2011	2548	3991	2312	112	355	1177	14	10508
2012	2101	4013	2004	104	373	1404	88	10087
2013	2737	4846	2003	142	253	1505	64	11551
2014	2740	6103	2736	135	204	694	61	12673
2015	2419	4653	1230	137	268	1606	104	10417
2016	1690	5733	1194	106	399	1260	52	10435
2017	1429	4758	1340	82	365	536	33	8544
2018	1772	3686	925	124	334	702	37	7580

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

Year	winter	little	barndoor	thorny	smooth	clearnose	rosette	Total
1968	7111	12210	2495	5013	972	238	64	28103
1969	7468	14644	725	3867	540	664	7	27915
1970	4280	9717	510	4505	588	426	16	20042
1971	3682	8681	406	5385	1169	292	5	19620
1972	5758	8011	430	5375	983	351	16	20924
1973	5834	7569	53	5773	1414	185	22	20851
1974	4119	6476	61	4035	1667	610	40	17008
1975	3557	7015	25	4776	499	294	27	16192
1976	2602	7159	89	3321	744	1343	434	15692
1977	4632	7096	1	3963	742	1397	160	17991
1978	6567	7497	17	3518	1127	3713	262	22701
1979	7057	9492	11	4193	866	2056	97	23770
1980	7511	7038	1	5316	1560	1021	313	22760
1981	8403	6285	2	4803	796	1019	79	21385
1982	7949	10651	5	3178	357	213	25	22377
1983	8796	11018	1	3217	689	2064	23	25808
1984	8259	11473	4	2869	259	1590	536	24989
1985	8048	8936	2	2961	301	644	10	20902
1986	10434	5368	12	2215	408	4257	31	22725
1987	10208	12115	11	2149	279	3122	776	28658
1988	12833	12163	11	2412	566	423	1810	30216
1989	11915	16030	20	2132	367	1763	183	32411
1990	18876	16139	43	3859	621	4390	363	44290
1991	13344	13317	51	3553	486	4943	84	35778
1992	14372	15218	170	2105	258	3273	1287	36684
1993	7633	17889	263	3111	507	785	339	30526
1994	9851	11887	756	3081	418	5012	23	31027
1995	7161	16485	191	1021	273	2221	193	27546
1996	11994	16964	355	1993	187	2526	115	34133
1997	7234	11822	602	1343	247	1714	34	22996
1998	9797	13983	364	1885	252	1202	83	27566
1999	8491	13284	844	714	148	1240	34	24756
2000	9007	13869	1142	1375	263	2602	123	28381
2001	8102	10340	2147	1269	175	2289	42	24364
2002	9276	11828	1821	1180	254	2462	50	26872
2003	10999	15092	1454	981	333	1655	23	30537
2004	13452	10018	1512	950	603	1726	52	28312
2005	10604	10968	3241	538	810	1479	111	27750
2006	10872	9117	4806	542	553	1382	30	27302
2007	14956	11638	3607	521	291	2428	82	33524
2008	13760	9708	4276	178	281	2077	72	30351
2009	15114	9955	1800	196	251	2336	149	29801
2010	14986	9742	2413	330	231	1480	25	29206
2011	13164	8577	3378	232	376	1719	26	27472
2012	11328	8576	4474	175	377	2206	96	27231
2013	10856	8760	3686	266	265	2334	82	26249
2014	11629	10084	5062	312	208	1210	73	28578
2015	10553	9822	2561	230	272	2393	118	25949
2016	11095	11177	1785	209	446	1460	63	26234
2017	10389	9509	1861	106	369	741	39	23014
2018	10233	8838	1351	167	339	945	48	21921

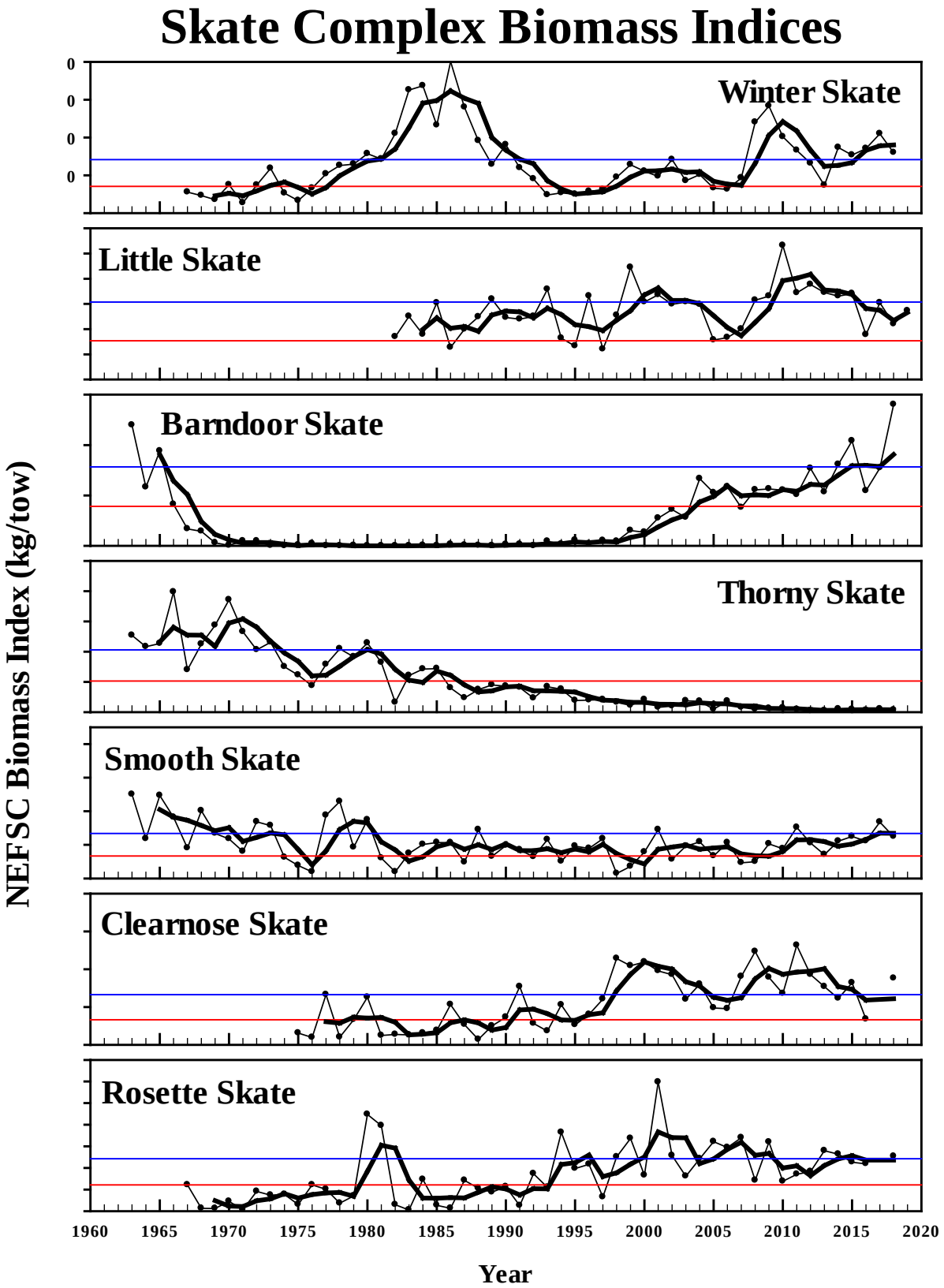

Figure 1. NEFSC survey biomass indices (kg/tow). Thin lines with symbols are annual indices, thick lines are 3-year moving averages, and the thin horizontal lines are the biomass thresholds and targets developed through 2007/2008 with consistent strata sets.

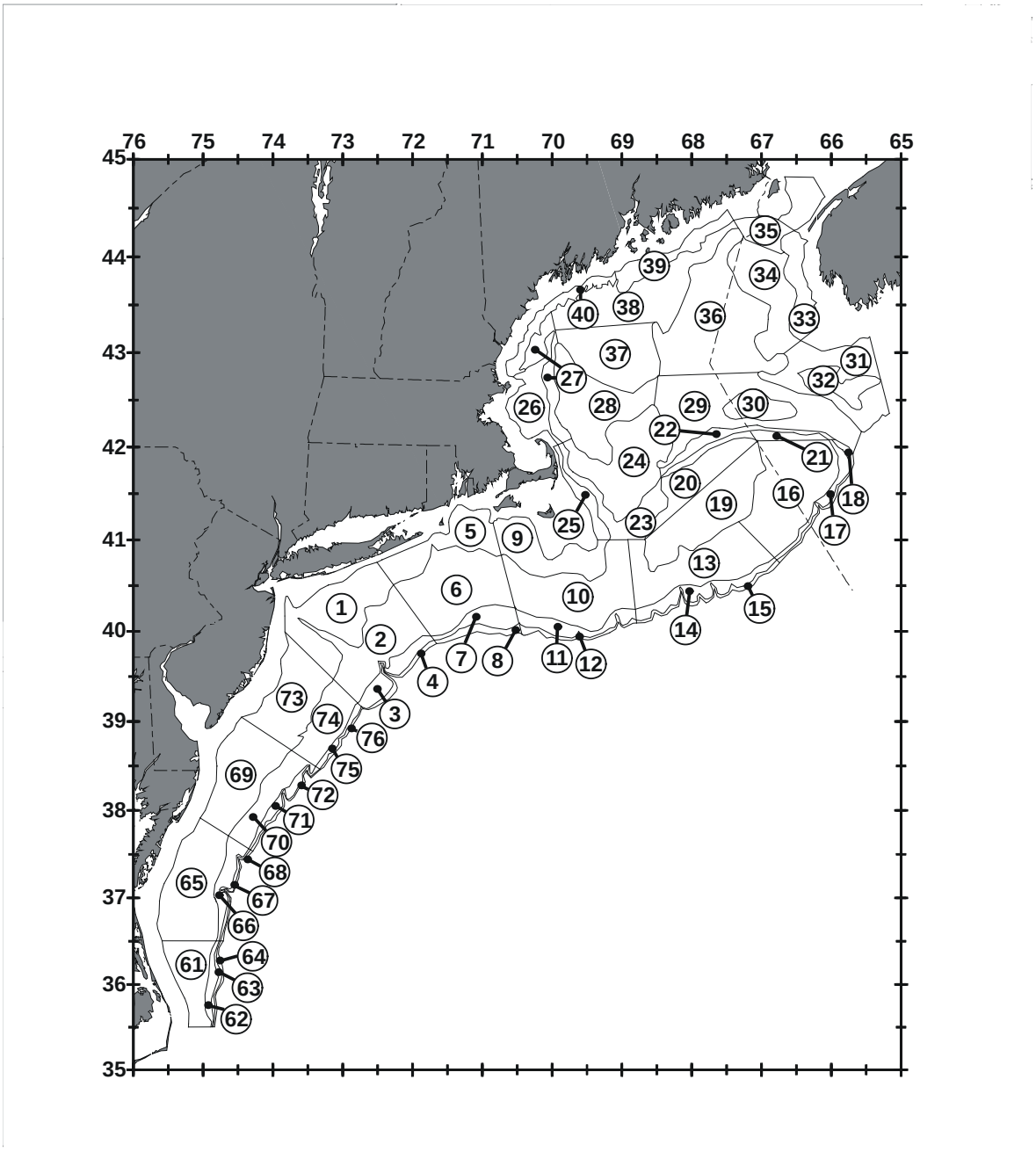

Figure 2. Offshore strata from the NEFSC spring and fall surveys.

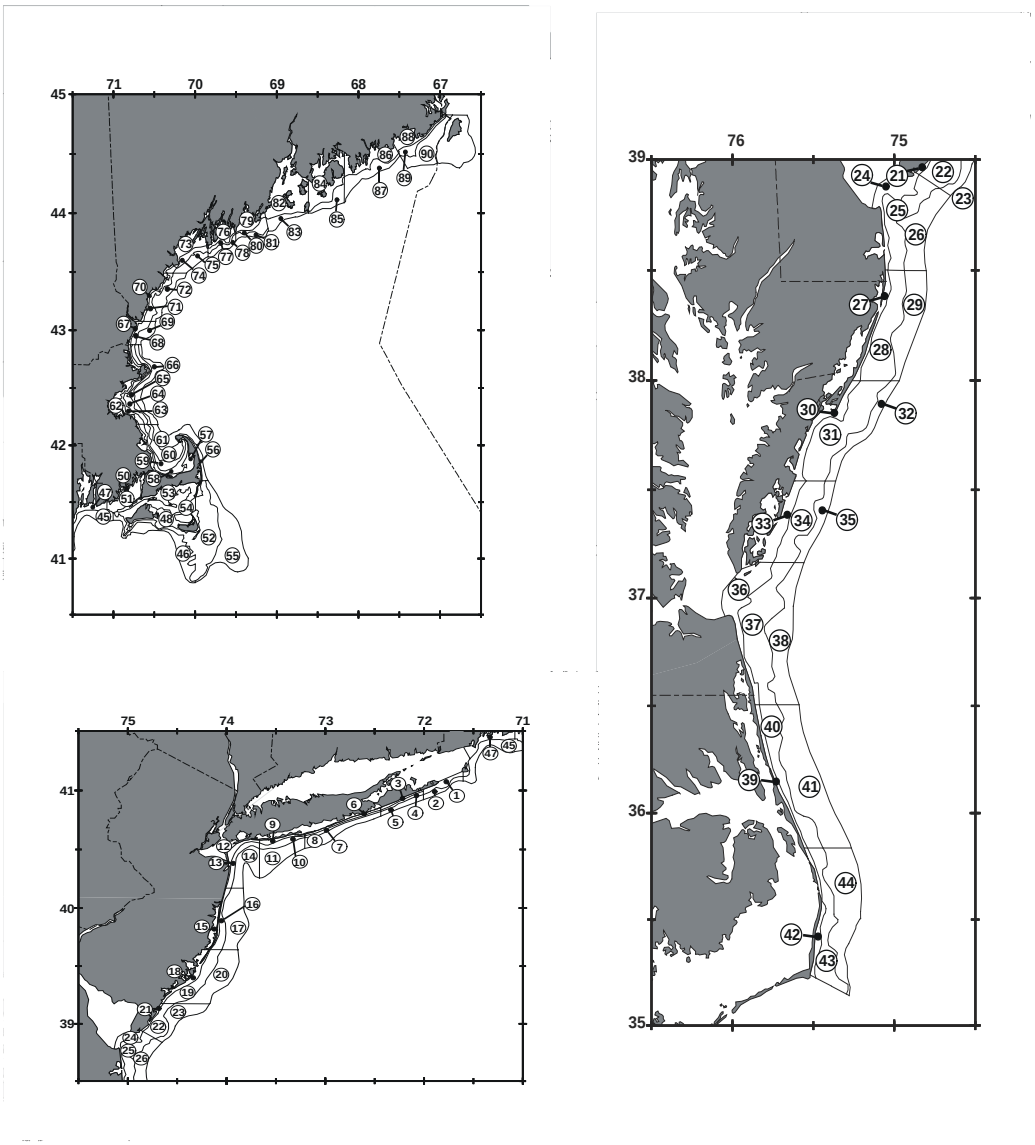

Figure 3. Inshore strata from the NEFSC spring and fall surveys.

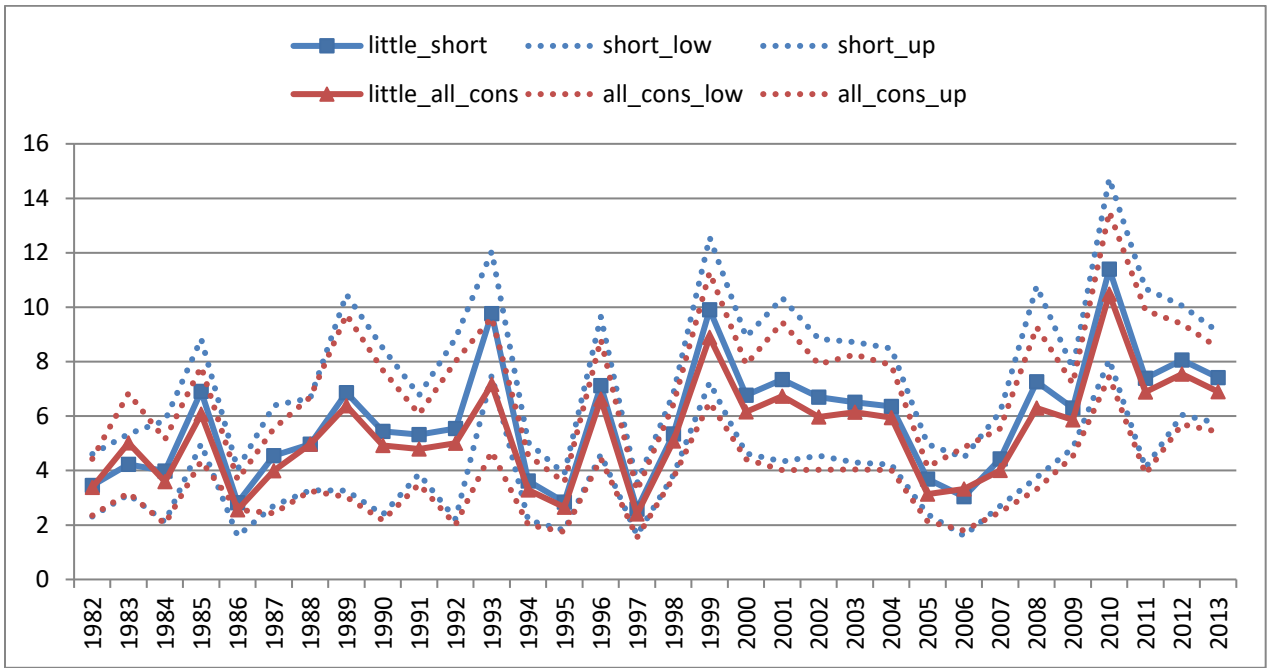

Figure 4. Little skate spring indices (kg/tow) based on all strata (i.e., full strata set; red triangles) and based on truncated strata set (i.e., strata south of Delaware Bay were removed; blue squares) from 1982-2013. The 95% confidence limits for each series are shown as dotted lines in the same color. 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).

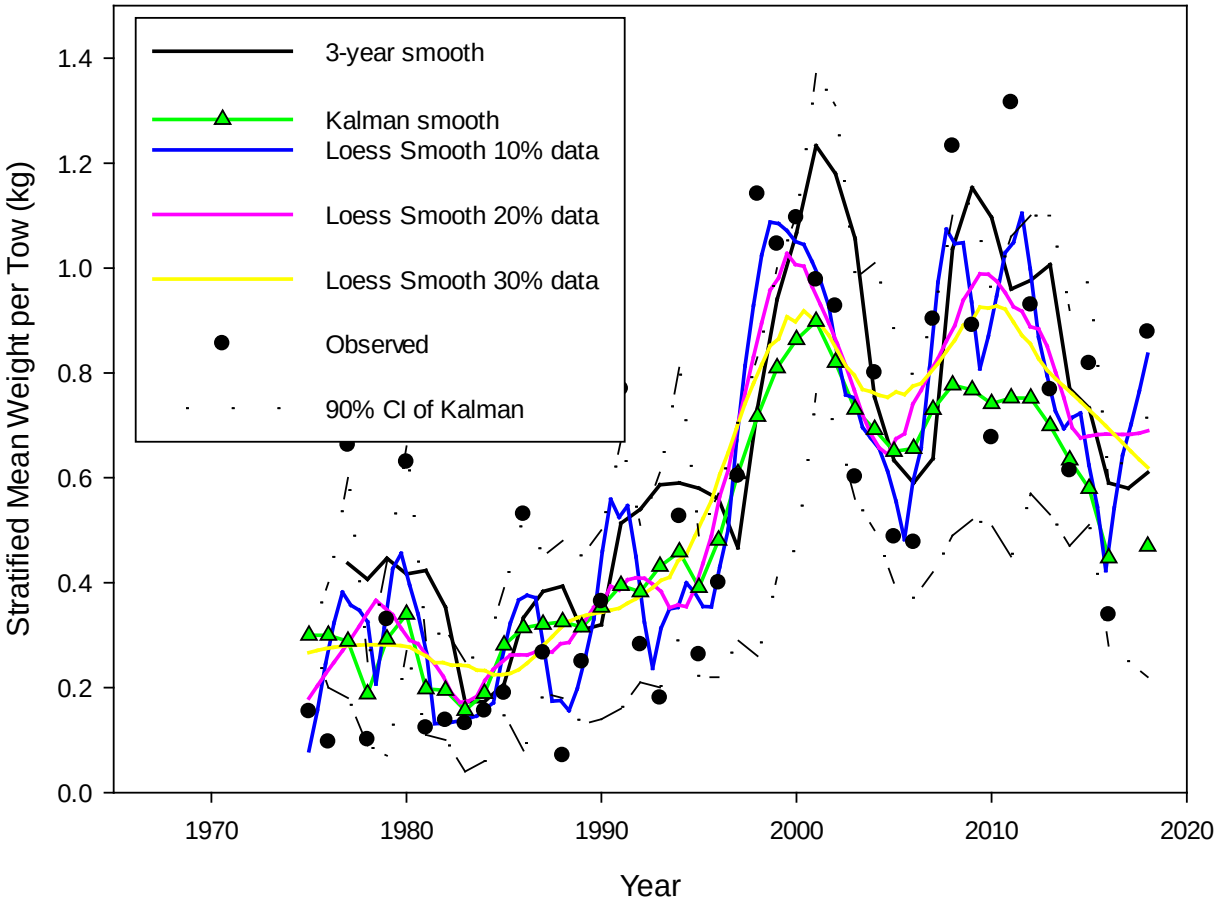

Figure 5. Comparison of smoothers for clearnose skate.

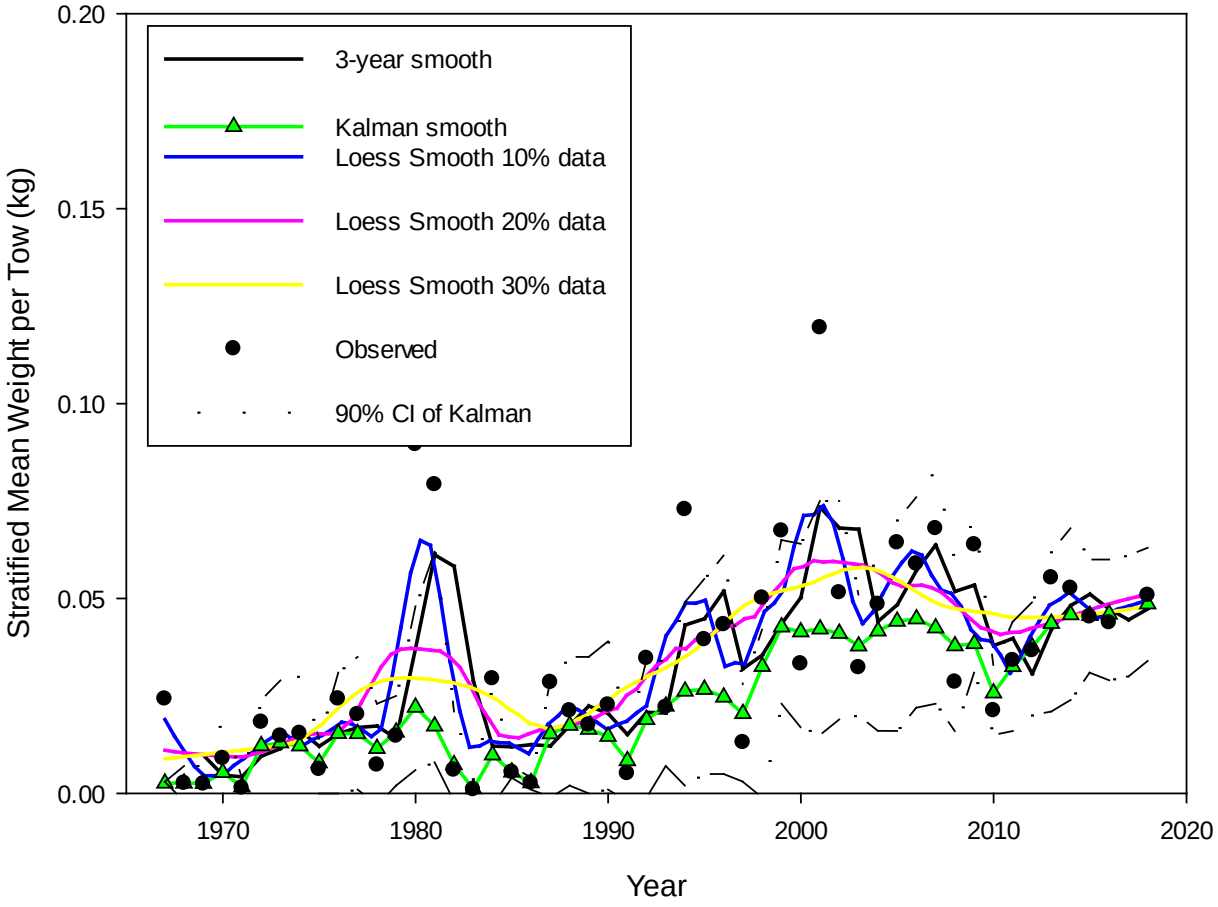

Figure 6. Comparison of smoothers for rosette skate.

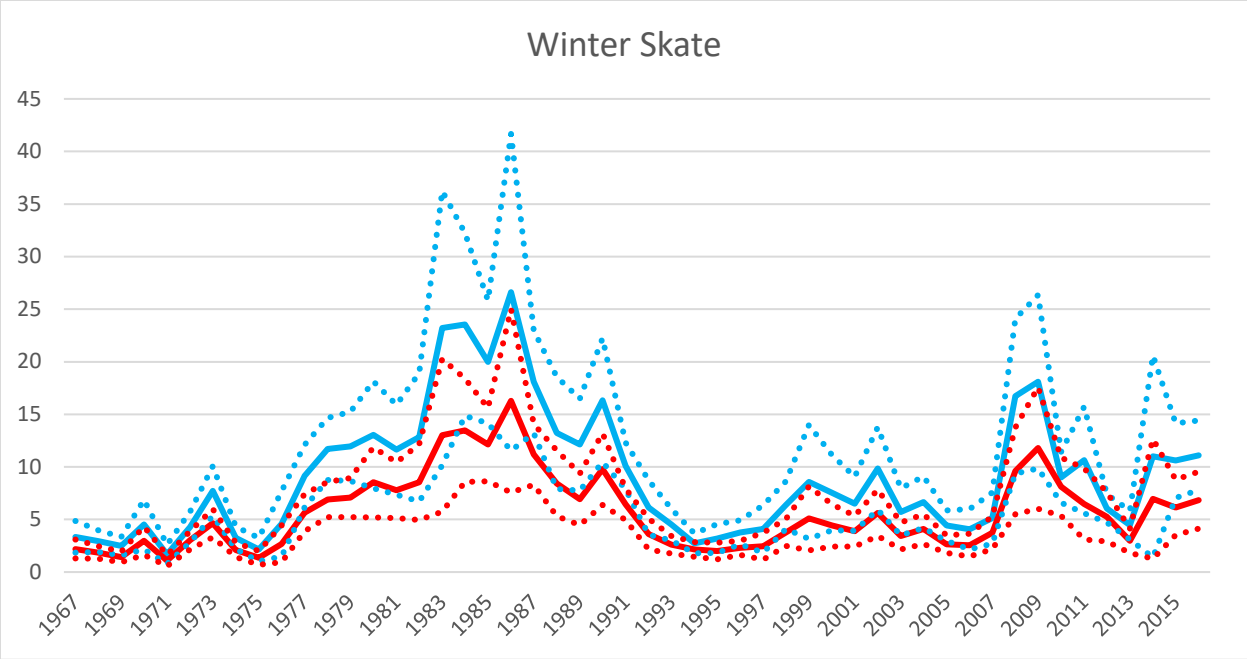

Figure 7. Winter skate autumn indices (kg/tow) based on all offshore strata (full strata set; red) and based on truncated strata set (strata south of Georges Bank were removed; blue) from 1967-2016. The 95% confidence limits for each series are shown as dotted lines in the same color. The survey catch ratio of the truncated strata set to the full strata set is 1.610 (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).

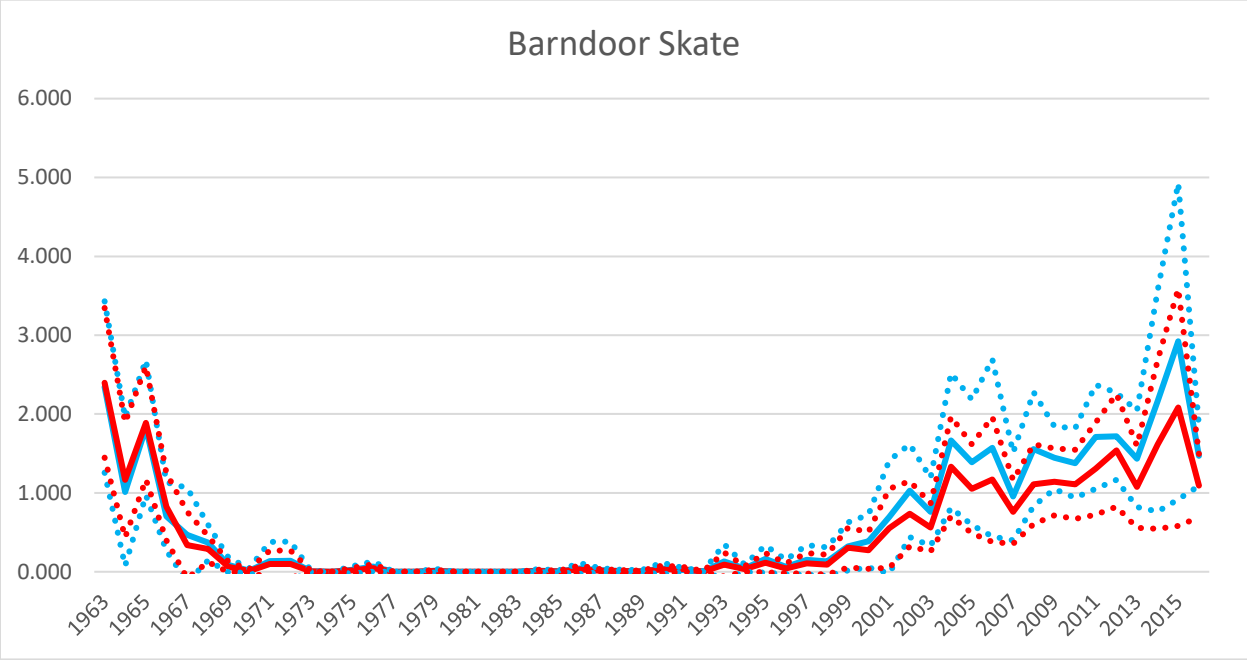

Figure 8. Barndoor skate autumn indices (kg/tow) based on offshore strata from Gulf of Maine to Southern New England (full strata set; red) and based on truncated strata set (strata south of Georges Bank were removed; blue) from 1963-2016. The 95% confidence limits for each series are shown as dotted lines in the same color. The survey catch ratio of the truncated strata set to the full strata set is 1.222 (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).

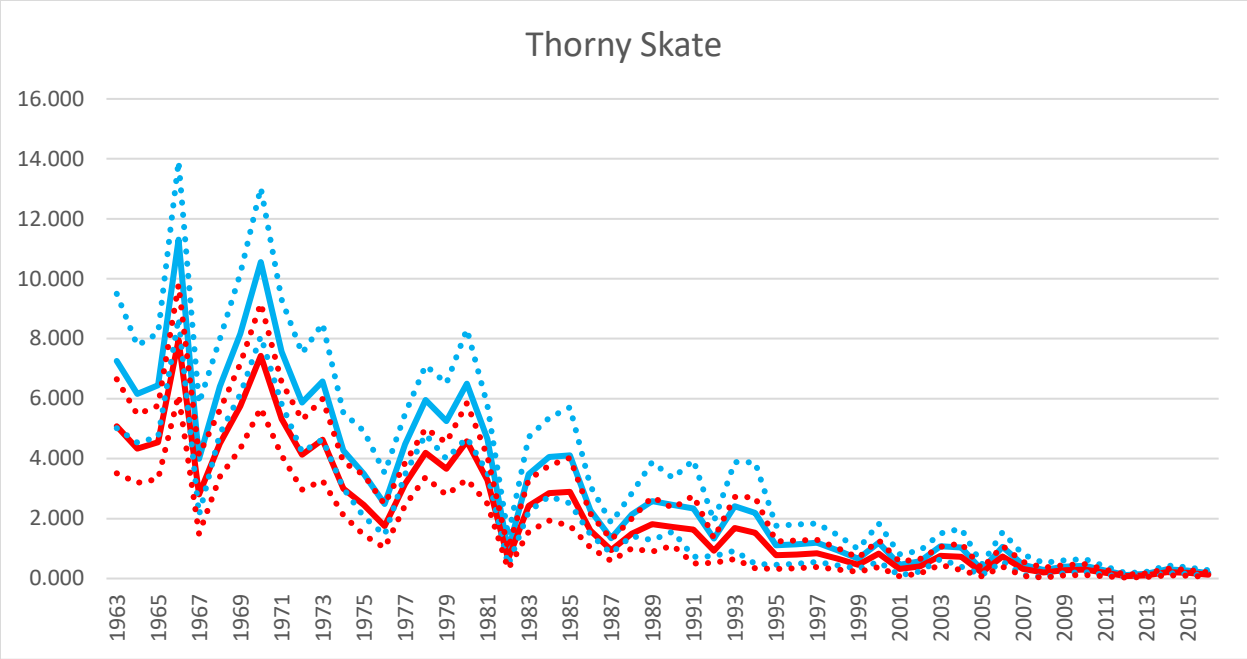

Figure 9. Thorny skate autumn indices (kg/tow) based on offshore strata from Gulf of Maine to Southern New England (full strata set; red) and based on truncated strata set (strata south of Georges Bank were removed; blue) from 1963-2016. The 95% confidence limits for each series are shown as dotted lines in the same color. The survey catch ratio of the truncated strata set to the full strata set is 1.423 (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).

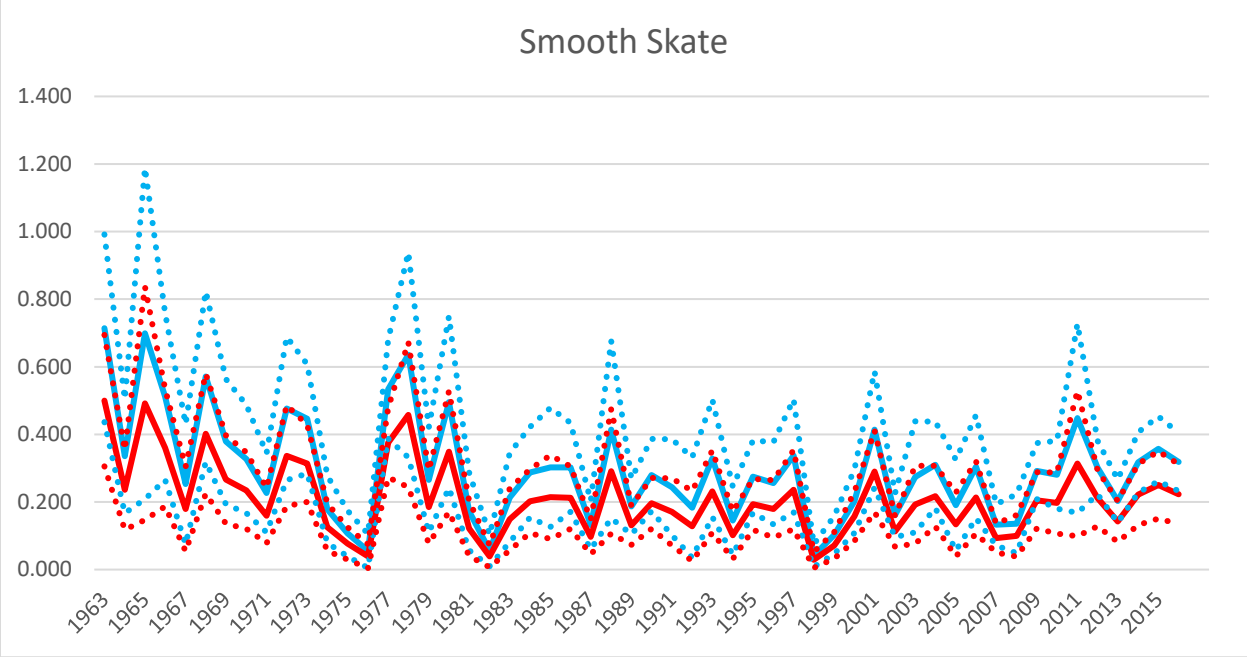

Figure 10. Smooth skate autumn indices (kg/tow) based on offshore strata from Gulf of Maine to Southern New England (full strata set; red) and based on truncated strata set (strata south of Georges Bank were removed; blue) from 1963-2016. The 95% confidence limits for each series are shown as dotted lines in the same color. The survey catch ratio of the truncated strata set to the full strata set is 1.418 (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).

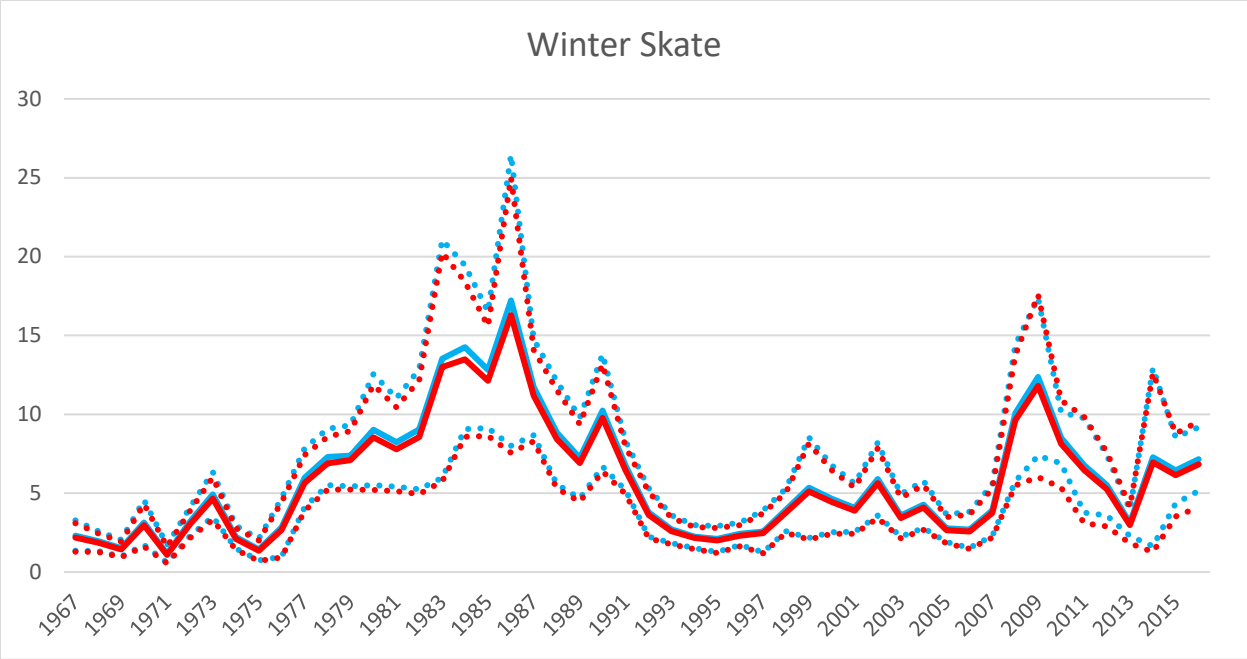

Figure 11. Winter skate autumn indices (kg/tow) based on all offshore strata (full strata set; red) and based on truncated strata set (offshore strata 01300, 01340, and 01351 were removed; blue) from 1967-2016. The 95% confidence limits for each series are shown as dotted lines in the same color. The survey catch ratio of the truncated strata set to the full strata set is 1.051 (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).

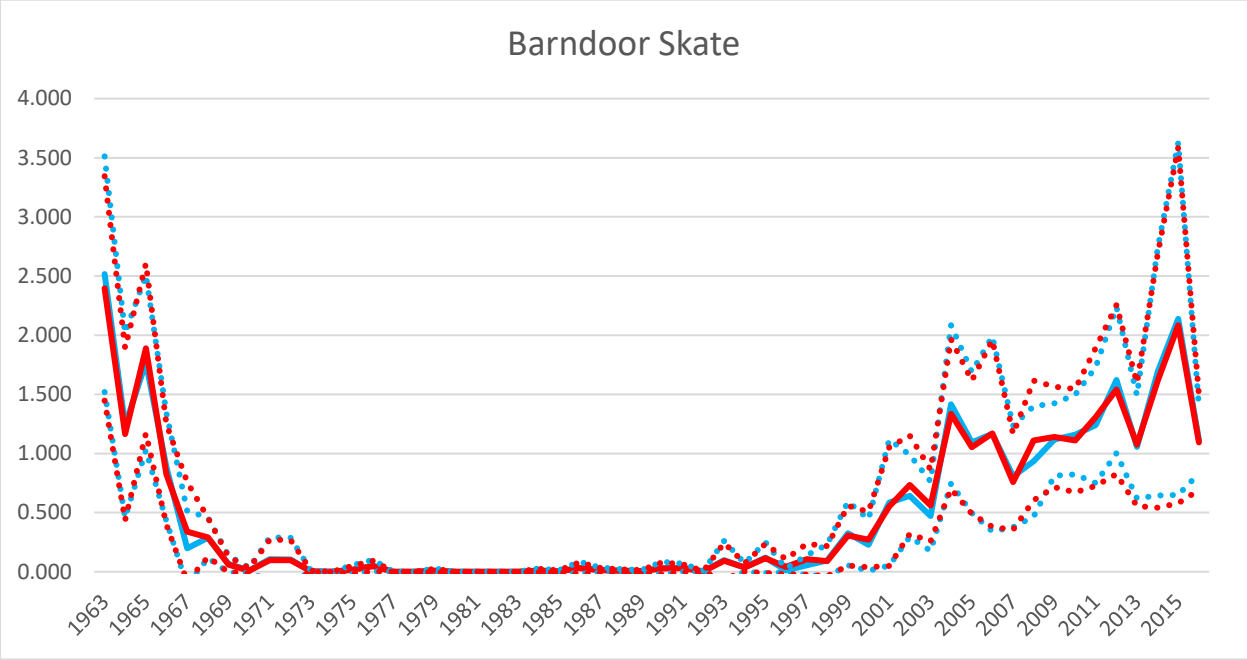

Figure 12. Barndoor skate autumn indices (kg/tow) based on offshore strata from Gulf of Maine to Southern New England (full strata set; red) and based on truncated strata set (offshore strata 01300, 01340, and 01351 were removed; blue) from 1963-2016. The 95% confidence limits for each series are shown as dotted lines in the same color. The survey catch ratio of the truncated strata set to the full strata set is 0.998 (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).

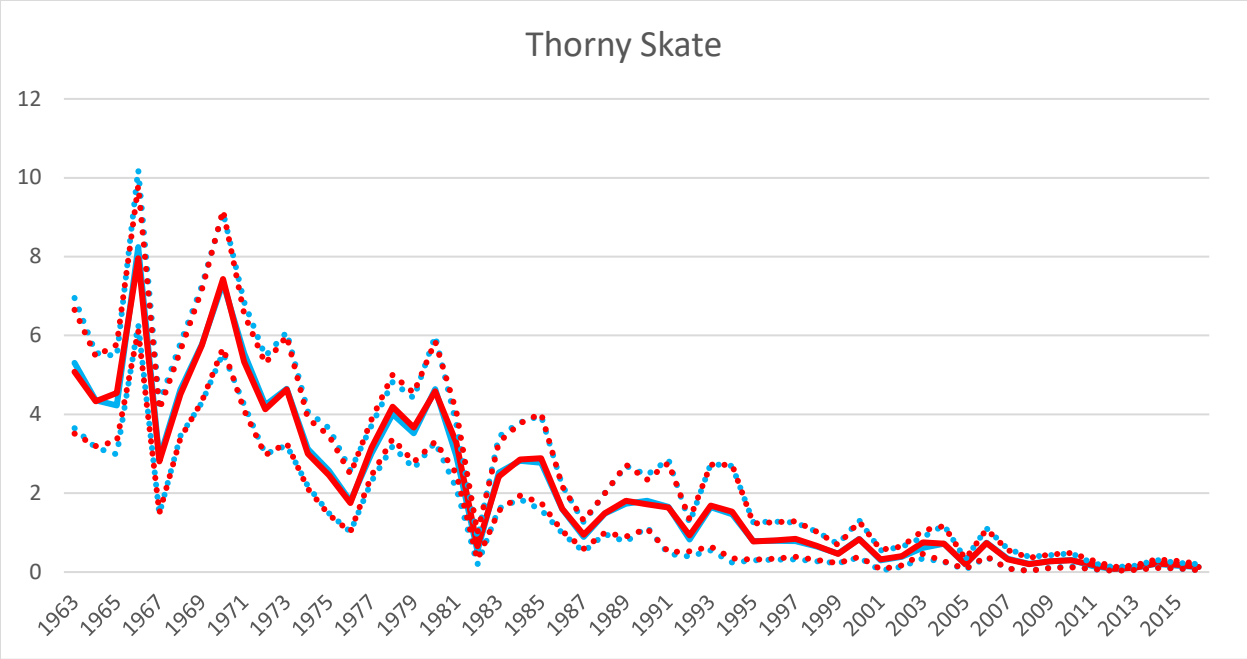

Figure 13. Thorny skate autumn indices (kg/tow) based on offshore strata from Gulf of Maine to Southern New England (full strata set; red) and based on truncated strata set (offshore strata 01300, 01340, and 01351 were removed; blue) from 1963-2016. The 95% confidence limits for each series are shown as dotted lines in the same color. The survey catch ratio of the truncated strata set to the full strata set is 0.996 (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).

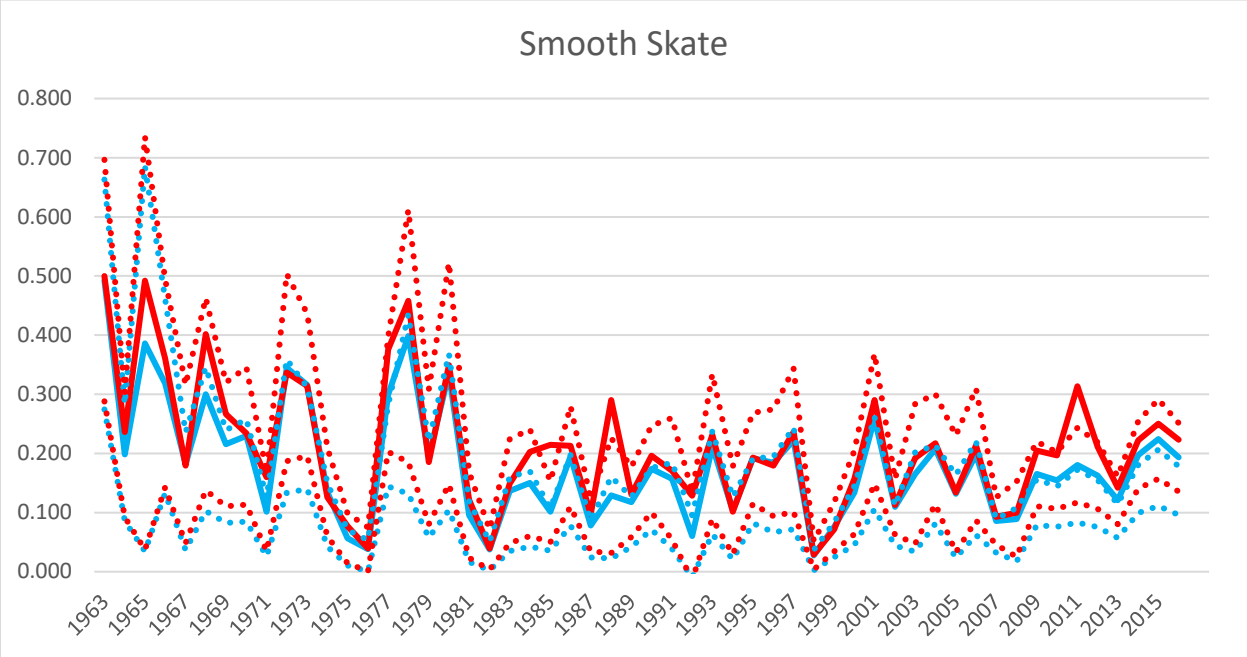

Figure 14. Smooth skate autumn indices (kg/tow) based on offshore strata from Gulf of Maine to Southern New England (full strata set; red) and based on truncated strata set (offshore strata 01300, 01340, and 01351 were removed; blue) from 1963-2016. The 95% confidence limits for each series are shown as dotted lines in the same color. The survey catch ratio of the truncated strata set to the full strata set is 0.860 (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).