

2.0 STOCK ASSESSMENT INFORMATION

2.1 SPECIES DISTRIBUTION

Draft distribution maps for juveniles and adults for each of the seven species in the northeast skate complex are attached in **Appendix I**. A description of the general distribution of each species is contained in Table 1.

At the time of publication of the Final Skate SAFE Report, the maps in Appendix I contain some minor errors, which will be corrected for the Draft FMP document.

2.2 LIFE HISTORY AND HABITAT INFORMATION

Available life history and habitat information for each of the seven species in the northeast skate complex can be found in the *Draft Essential Fish Habitat Source Documents* for each of the species in the northeast region skate complex. These documents contain available information on life history, reproduction, food habits, predation, migration, stock structure, habitat characteristics, geographical distribution, stock status, etc. for each species in the northeast skate complex.

The Draft EFH Source Documents (Final documents pending) represent **Appendix II** to this SAFE Report and can be obtained by contacting the Council office at (978) 465-0492.

2.3 SAW 30 INFORMATION

The Stock Assessment Review Committee (SARC) meeting of the 30th Northeast Regional SAW was held in the Aquarium Conference Room of the Northeast Fisheries Science Center's (NEFSC) Woods Hole Laboratory in Woods Hole, Massachusetts from November 29 – December 3, 1999. The SARC Chairman was Dr. Robert Mohn, Bedford Institute of Oceanography, DFO, Halifax, Nova Scotia. Members of the SARC includes scientists from the NEFSC, NMFS Northeast Regional Office (NERO), NMFS Headquarters, the Mid-Atlantic Fishery Management Council (MAFMC), Atlantic States Marine Fisheries Commission (ASMFC), the States of Rhode Island and Massachusetts, DFO-Canada, and the Virginia Institute of Marine Sciences. Preliminary results from SAW 30 were presented to the Council at its January 18-20, 2000 meeting, and the final results were published in April 2000.

The following Terms of Reference were provided by the SAW Steering Committee as the context for the assessment of the northeast region skate complex reviewed by SARC 30 in November 1999:

- (1) Summarize available biological studies (age and growth, maturity, etc.) for the seven species in the skate complex.
- (2) Update commercial and recreational landings and survey indices through 1998/99.
- (3) To the extent practicable, summarize fishery discard rates through the use of sea sampling data or other information sources.
- (4) Estimate fishing mortality rates, and trends in relative or absolute stock size, and consider appropriate reference points for stock size and fishing mortality rate consistent with provisions of the Sustainable Fisheries Act (SFA).
- (5) Provide an assessment of the status of the species in the complex relative to overfishing

criteria, and evaluate the status of the barndoor skate resource relative to listing factors considered in the Endangered Species Act.

For the purposes of simplification, not all of the information contained in the SAW 30 documents is presented in this SAFE Report. The SAW 30 documents are referenced in this SAFE Report and should be reviewed in conjunction with this report in order to obtain a complete record of available biological information for each of the seven species of skate in the northeast region.

2.3.1 Research Survey Data

This section presents data collected through seasonal NEFSC trawl surveys and state research surveys. Information has been updated through the 1999 autumn survey and the 2000 spring survey.

Indices of relative abundance have been developed from NEFSC bottom trawl surveys for the seven species in the skate complex, and these form the basis for most of the conclusions about the status of the complex. All statistically significant NEFSC gear, door, and vessel conversion factors were applied to little, winter, and thorny skate indices when applicable (Sissenwine and Bowman, 1978; NEFSC 1991). Juvenile little and winter skates are not readily distinguished in the field. The numbers of juveniles were split between the two species based on the abundance of the adults in the same tow. For the aggregate skate complex, the spring survey index of biomass was relatively constant from 1968 to 1980, then increased significantly to peak levels in the mid to late 1980s. The index of skate complex biomass then declined steadily until 1994, but has recently begun to increase again (Figure 1).

If the species in the complex are divided into large- (barndoor, winter, and thorny) and small-sized skates (little, clearnose, rosette, and smooth), it is evident that the large increase in skate biomass in the mid to late 1980s was dominated by winter and little skate (Figure 1 and Figure 2). The biomass of large-sized skates has steadily declined since the mid-1980s (Figure 2, top). The recent increase in aggregate skate biomass has been due to an increase in little skate (Figure 2, bottom).

Figure 1 Species Composition of Skates from the Spring Survey

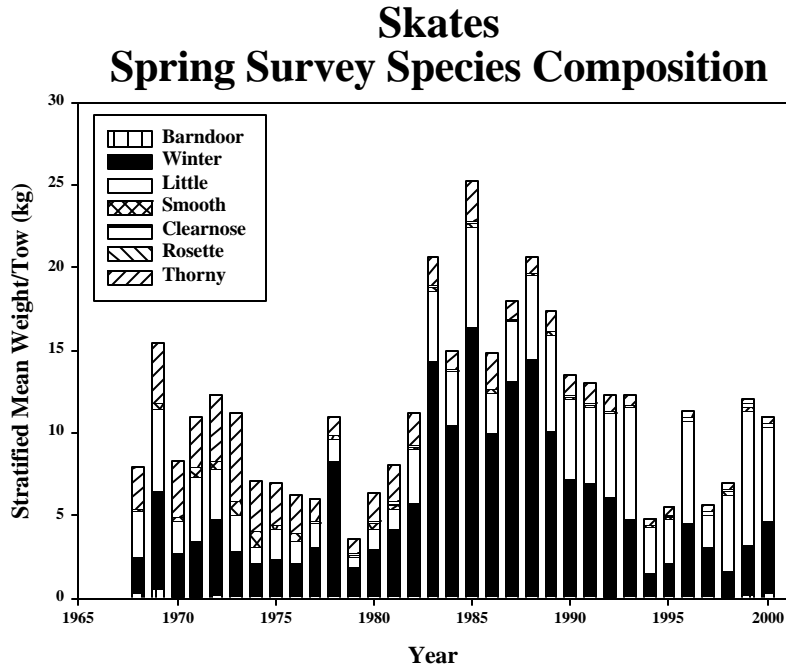
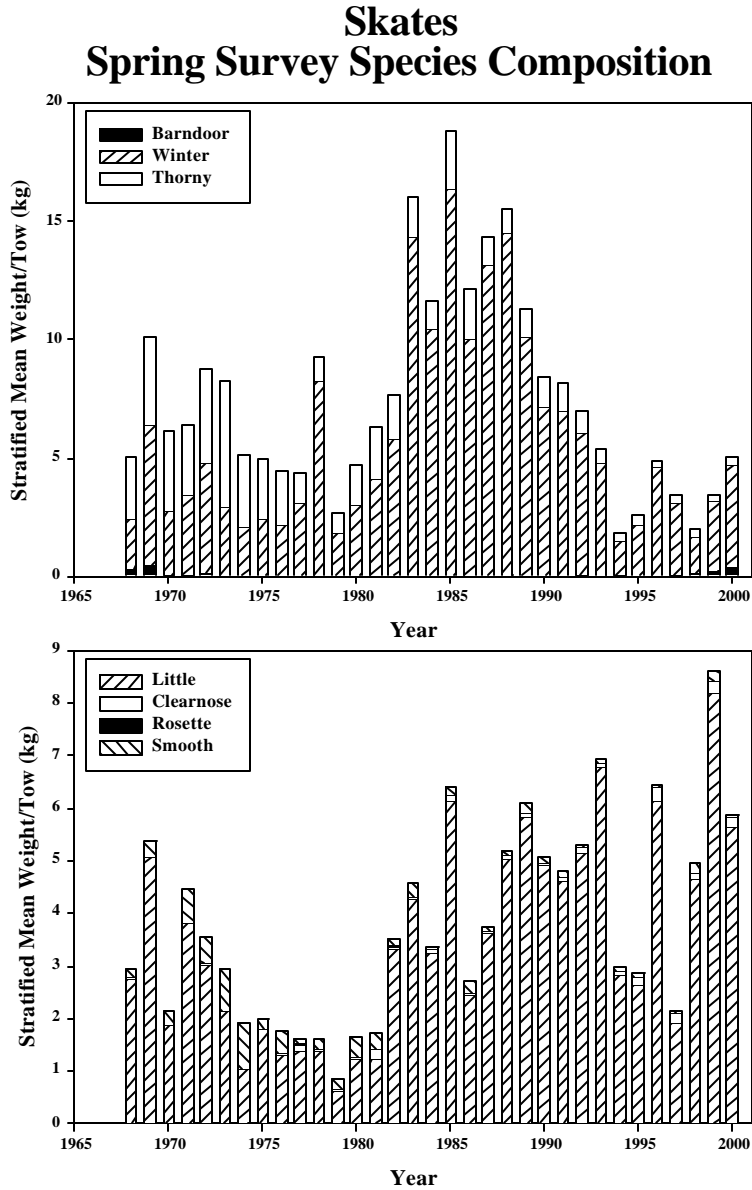


Figure 2 Species Composition of Skates from the Spring Survey

The top panel shows the composition of large species (>100 cm maximum length) while the bottom panel shows the composition of the small species (maximum length < 100 cm).



2.3.1.1 Winter Skate

NEFSC bottom trawl surveys indicate that winter skate are most abundant in the Georges Bank (GB) and Southern New England (SNE) offshore strata regions, with few fish caught in the Gulf of Maine (GOM), or Mid-Atlantic (MA) regions (**Appendix I**). In the NEFSC spring survey offshore strata (1968-2000), the annual total catch of winter skate has ranged from 160 fish in 1976 to 1,891 fish in 1985. In the NEFSC autumn survey offshore strata (1963-1999), the annual total catch of winter skate has ranged from 115 fish in 1975 to 1,187 fish in 1984. Calculated on a per tow basis, these spring survey catches equate to maximum stratified mean number per tow indices for the GOM-MA offshore strata of about 7.9 fish, or 16.4 kg, per tow during 1985; autumn maximum catches equate to indices of 3.7 fish, or 13.3 kg per tow, in 1984 (Table 2 and Table 3).

The catchability of winter skate in the recently instituted NEFSC winter bottom trawl survey (which substitutes a chain sweep with small cookies for the large rollers used in the spring and autumn surveys, to better target flatfish) is significantly higher than in the spring and autumn series, especially for smaller winter skates. NEFSC winter survey (1992-1999) annual catches of winter skate have ranged from 841 fish in 1993 to 4,055 fish in 1996, equating to a maximum stratified mean catch per tow of 43.5 fish or 25.2 kg per tow in 1996 (Table 4). The winter survey is focused in the Southern New England and Mid-Atlantic offshore regions, with a limited number of samples on Georges Bank, and no sampling in the Gulf of Maine.

Indices of winter skate abundance and biomass from the NEFSC spring and autumn surveys were stable, but below the time series mean, during the late 1960s and 1970s. Winter skate indices increased to the time series mean by 1980, and then reached a peak during the mid 1980s. Winter skates indices began to decline in the late 1980s. Current NEFSC indices of winter skate abundance are below the time series mean, at about the same value as during the early 1970s. Current NEFSC indices of winter skate biomass are about 25% of the peak observed during the mid 1980s (Figure 3 – Figure 5).

Table 2 Abundance and Biomass from NEFSC Spring Surveys for Winter Skate for the Gulf of Maine to Mid-Atlantic Region

The mean index, 95% confidence intervals, individual fish weight, minimum, mean, and maximum length, 5th, 50th, and 95th percentiles of length, number of nonzero tows, and number of fish caught are presented for 1968-2000.

	weight/tow			number/tow			ind wt	length					nonzero		
	mean	lower	upper	mean	lower	upper		min	5%	50%	mean	95%	max	tows	no fish
1968	2.171	1.640	2.978	0.854	0.530	1.178	2.542	32	42	56	58.6	79	112	36	232
1969	5.913	4.283	7.543	2.790	1.907	3.672	2.119	15	25	53	53.5	79	111	68	640
1970	2.645	1.627	3.663	0.971	0.626	1.317	2.723	37	43	59	61.0	83	103	44	275
1971	3.387	2.066	4.708	1.894	0.873	2.915	1.788	15	30	48	51.8	76	103	41	513
1972	4.620	3.033	6.207	2.602	1.253	3.951	1.776	15	24	48	49.5	74	97	63	634
1973	2.905	2.024	3.786	1.257	0.824	1.689	2.311	21	32	55	55.5	79	100	49	347
1974	2.091	1.352	2.830	0.943	0.505	1.381	2.218	29	34	53	55.6	76	101	46	222
1975	2.395	1.521	3.269	0.893	0.556	1.230	2.682	17	38	59	59.4	79	99	46	227
1976	2.153	1.075	3.231	0.628	0.279	0.978	3.428	22	38	64	63.1	86	97	29	160
1977	3.111	1.815	4.408	0.838	0.513	1.163	3.712	20	29	69	64.7	93	106	35	204
1978	8.275	-0.327	16.877	1.355	0.121	2.589	6.108	43	62	79	78.5	89	96	41	395
1979	1.852	1.095	2.608	0.333	0.206	0.459	5.568	23	35	78	73.5	93	105	50	204
1980	2.990	1.751	4.229	0.538	0.331	0.745	5.559	22	45	78	74.8	97	104	49	187
1981	4.140	2.905	5.376	2.083	1.199	2.966	1.988	15	22	39	47.6	91	104	56	586
1982	5.773	3.876	7.670	2.137	1.195	3.080	2.701	15	26	46	54.9	95	109	64	707
1983	14.329	8.182	20.476	3.264	1.772	4.756	4.391	15	28	67	64.4	96	108	65	817
1984	10.480	6.816	14.144	2.948	1.694	4.201	3.555	15	22	60	59.0	94	106	59	753
1985	16.373	11.119	21.627	7.861	4.653	11.069	2.083	15	22	46	54.3	94	116	65	1891
1986	10.019	6.973	13.064	3.538	2.181	4.894	2.832	15	27	58	62.2	97	108	67	969
1987	13.126	8.428	17.824	4.821	2.926	6.716	2.723	15	29	56	60.8	97	108	69	1221
1988	14.543	10.508	18.577	7.409	4.736	10.082	1.963	15	25	43	53.4	95	107	73	1827
1989	10.141	7.736	12.546	4.252	3.095	5.409	2.385	15	25	59	61.4	94	109	74	1429
1990	7.183	5.184	9.183	5.087	2.657	7.517	1.412	15	27	41	49.9	91	105	67	1678
1991	6.965	4.012	9.918	3.239	1.979	4.499	2.150	17	29	54	58.6	93	107	57	1027
1992	5.988	3.369	8.607	5.208	0.635	9.780	1.150	15	23	42	46.2	82	106	51	1303
1993	4.761	3.392	6.131	4.305	2.561	6.049	1.106	15	25	42	46.5	82	103	62	1118
1994	1.421	0.990	1.852	1.673	1.150	2.196	0.849	20	32	43	46.5	69	99	49	519
1995	2.151	1.340	2.961	1.998	1.231	2.766	1.076	15	34	44	48.4	71	103	49	476
1996	4.547	2.499	6.594	4.470	2.384	6.556	1.017	15	34	46	49.0	68	96	56	1004
1997	3.065	1.325	4.806	1.834	0.987	2.680	1.672	15	23	51	53.5	78	93	39	458
1998	1.504	0.913	2.096	1.045	0.561	1.529	1.439	15	32	51	53.4	79	94	52	341
1999	2.968	1.303	4.632	1.876	0.870	2.883	1.582	16	27	54	54.9	79	100	52	482
2000	4.358	2.273	6.443	1.998	1.041	2.954	2.181	15	34	62	62.2	82	99	57	457

Table 3 Abundance and Biomass from NEFSC Autumn Surveys for Winter Skate for the Gulf of Maine to Mid-Atlantic Region

The mean index, 95% confidence intervals, individual fish weight, minimum, mean, and maximum length, 5th, 50th, and 95th percentiles of length, number of nonzero tows, and number of fish caught are presented for 1967-1999.

	weight/tow			number/tow			ind wt	length					nonzero		
	mean	lower	upper	mean	lower	upper		min	5%	50% mean	95% max	tows	no fish		
1967	2.159	1.248	3.070	0.825	0.544	1.106	2.617	15	32	56	57.0	83	107	35	213
1968	1.865	1.264	2.466	0.928	0.573	1.284	2.009	15	25	51	51.8	80	100	56	227
1969	1.315	0.856	1.774	0.540	0.351	0.730	2.435	16	37	58	58.3	78	90	36	161
1970	2.996	1.663	4.328	1.357	0.576	2.138	2.208	21	33	54	56.0	77	97	53	331
1971	1.078	0.542	1.615	0.588	0.238	0.938	1.833	18	27	50	50.5	77	93	35	163
1972	2.958	2.113	3.804	2.071	1.413	2.728	1.429	15	24	42	46.9	74	96	64	592
1973	4.686	3.348	6.024	2.238	1.510	2.967	2.093	21	32	54	55.1	78	101	48	662
1974	2.097	1.418	2.777	1.024	0.672	1.376	2.048	17	30	52	53.6	77	103	39	262
1975	1.315	0.682	1.948	0.420	0.260	0.580	3.130	16	24	62	60.9	84	103	31	115
1976	2.655	0.918	4.392	0.766	0.257	1.274	3.468	19	22	70	59.9	83	98	21	190
1977	4.095	2.814	5.376	1.617	1.049	2.185	2.533	15	25	47	54.8	87	100	51	662
1978	4.989	3.778	6.199	1.042	0.777	1.307	4.787	15	36	77	73.6	94	105	94	762
1979	5.121	3.768	6.475	1.290	0.976	1.603	3.971	20	31	75	66.0	93	113	89	975
1980	6.233	3.806	8.660	1.558	1.015	2.100	4.002	15	37	66	66.4	95	108	60	602
1981	5.668	3.726	7.610	1.505	0.916	2.094	3.766	15	25	61	62.3	99	110	54	516
1982	8.306	4.780	11.831	3.889	0.502	7.275	2.136	15	22	35	46.7	92	112	45	950
1983	12.852	5.693	20.012	2.590	1.447	3.733	4.962	16	28	78	70.5	95	108	42	843
1984	13.323	8.465	18.181	3.653	2.450	4.857	3.647	15	21	55	59.0	95	110	52	1187
1985	9.182	6.552	11.811	2.665	1.842	3.488	3.446	15	32	79	69.7	97	107	37	827
1986	15.800	7.184	24.415	4.196	2.496	5.895	3.766	15	34	75	71.5	97	110	46	1089
1987	11.063	8.200	13.925	4.291	2.783	5.800	2.578	15	25	58	60.1	97	109	49	1165
1988	7.564	4.961	10.167	3.126	2.223	4.028	2.420	15	23	49	57.4	97	110	45	888
1989	5.081	3.288	6.874	2.084	1.422	2.745	2.439	15	27	59	61.0	96	106	48	720
1990	7.145	4.658	9.632	2.451	1.397	3.505	2.915	22	33	68	66.5	97	107	44	895
1991	4.724	3.627	5.821	2.631	1.866	3.396	1.796	17	31	48	56.3	94	106	58	941
1992	3.582	2.140	5.024	1.862	1.116	2.608	1.923	22	33	51	57.4	91	103	39	509
1993	1.905	1.280	2.530	1.458	0.965	1.951	1.307	16	33	48	52.8	88	104	50	452
1994	2.120	1.432	2.808	1.925	1.217	2.633	1.101	15	26	44	47.6	84	106	52	503
1995	1.985	1.214	2.757	1.769	1.047	2.491	1.122	17	31	46	49.4	77	102	43	424
1996	2.276	1.615	2.937	1.426	0.985	1.867	1.596	17	35	51	54.9	83	104	44	370
1997	2.455	1.150	3.760	1.611	0.738	2.484	1.524	19	34	54	55.5	79	101	55	415
1998	3.753	2.488	5.018	2.140	1.438	2.843	1.753	19	27	55	56.8	83	101	50	609
1999	5.089	2.080	8.098	2.642	1.320	3.963	1.927	15	31	58	58.0	80	111	53	966

Table 4 Abundance and Biomass from NEFSC Winter Surveys for Winter Skate for the Georges Bank to Mid-Atlantic Region

The mean index, 95% confidence intervals, individual fish weight, minimum, mean, and maximum length, 5th, 50th, and 95th percentiles of length, number of nonzero tows, and number of fish caught are presented for 1992-1999.

	weight/tow			number/tow			ind wt	length					nonzero		
	mean	lower	upper	mean	lower	upper		min	5%	50% mean	95% max	tows	no fish		
1992	31.571	21.666	41.476	39.759	23.811	55.707	0.794	15	24	38	42.4	74	105	62	4042
1993	10.261	6.052	14.469	10.676	2.331	19.021	0.961	15	23	41	44.1	81	106	47	841
1994	14.439	10.586	18.293	14.216	8.465	19.966	1.016	15	29	40	45.4	81	102	33	1079
1995	23.268	14.507	32.029	35.528	18.060	52.996	0.655	15	27	40	42.2	59	104	53	3773
1996	25.239	7.110	43.369	43.515	7.434	79.596	0.580	15	25	40	41.2	56	99	59	4055
1997	11.643	7.287	15.999	12.565	7.109	18.022	0.927	15	27	45	46.9	71	98	46	1414
1998	22.464	15.878	29.050	19.950	13.556	26.344	1.126	15	26	48	49.4	74	105	60	2092
1999	21.089	13.628	28.549	18.380	10.899	25.860	1.147	15	24	49	49.0	74	101	52	1932
2000	11.315	4.814	17.815	5.697	2.799	8.596	1.986	18	27	56	57.6	88	101	33	486

Figure 3 Abundance and Biomass of Winter Skate from the NEFSC Spring (Circles) and Autumn (Squares) Bottom Trawl Surveys from 1967-2000 in the Gulf of Maine to Mid-Atlantic Offshore Region

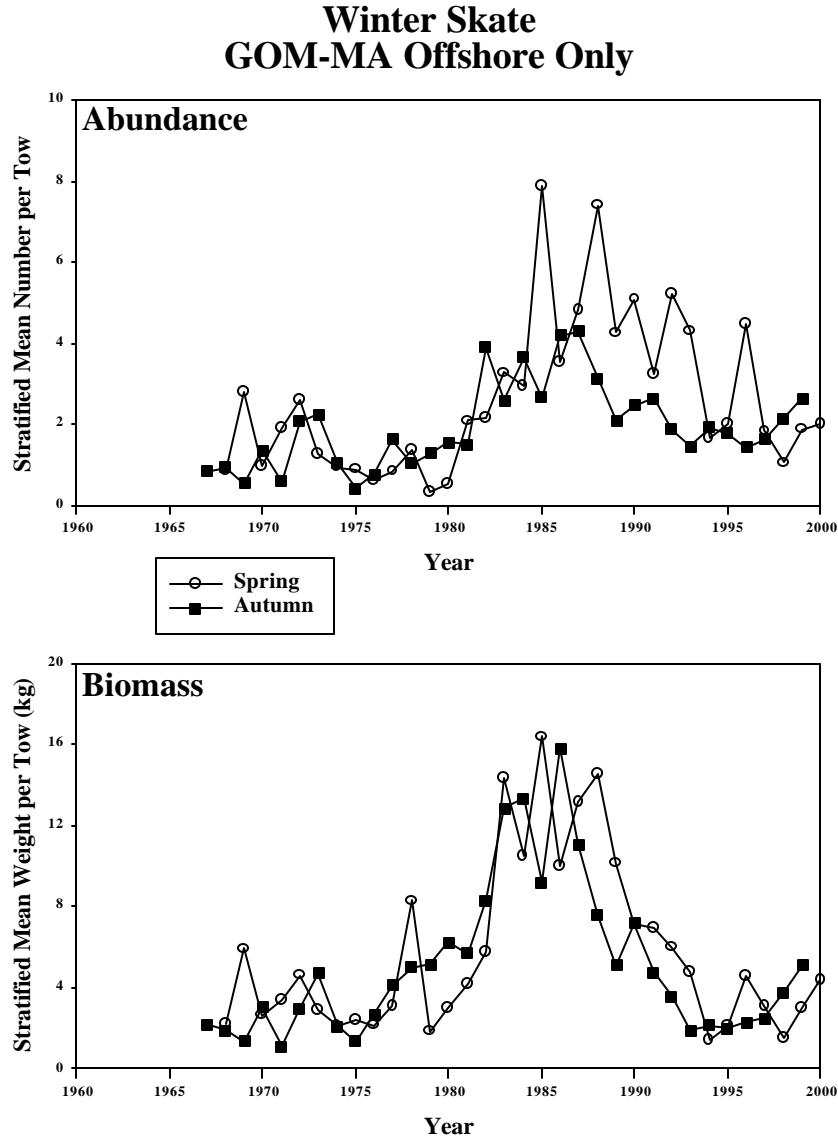


Figure 4 Abundance and Biomass of Winter Skate from the NEFSC Autumn Bottom Trawl Survey in the Gulf of Maine to Mid-Atlantic Region, Offshore Strata Only

Mean Index In Solid Squares, 95% Confidence Interval In Open Squares

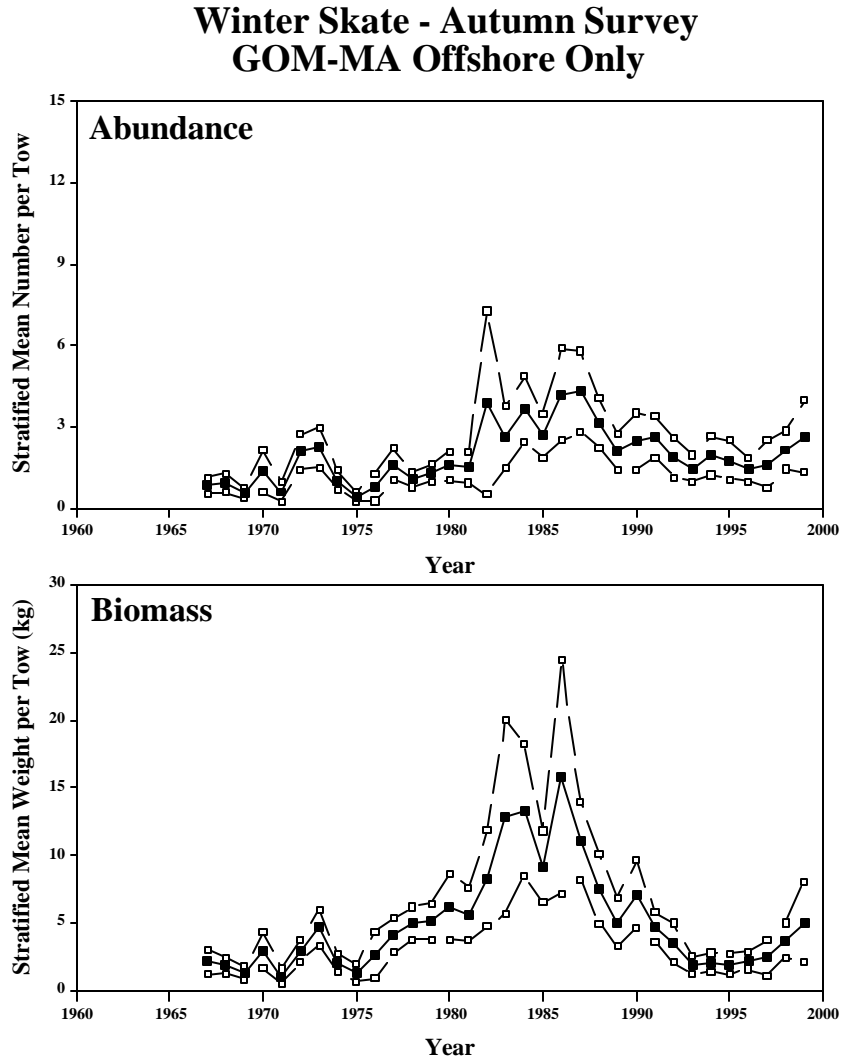
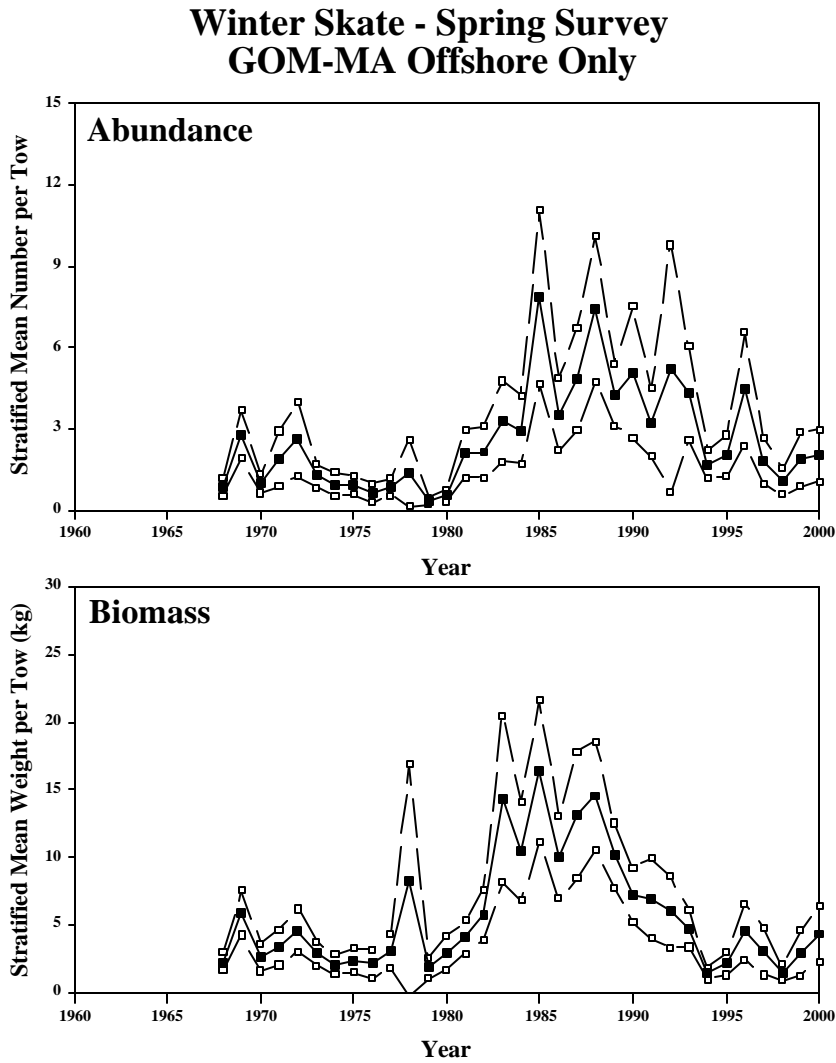


Figure 5 Abundance and Biomass of Winter Skate from the NEFSC Spring Bottom Trawl Survey in the Gulf of Maine to Mid-Atlantic Region, Offshore Strata Only

Mean Index In Solid Squares, 95% Confidence Interval In Open Squares



The minimum length of winter skate caught in NEFSC surveys is 15 cm (6 in), and the largest individual caught was 113 cm (44 in) total length, during the 1979 autumn survey on Georges Bank. The median length of the survey catch has ranged from 38 cm in the 1992 winter survey to 79 cm in the 1978 spring survey. The median length of the survey catch generally declined from 1979 to the mid-1990s in both the spring and autumn surveys, but has been increasing in recent years, and is currently about 57-58 cm (23 in) (Figure 6). Length frequency distributions from the NEFSC spring and autumn surveys are presented in the SAW 30 documents as figures B15 – B18 and are not reproduced in this SAFE Report. In general, the length frequency distributions show several modes, most often at 40, 60, and 80 cm. The spring survey length distributions show large modes at about 40 cm during the mid-1980s through the mid 1990s, suggesting strong recruitment during that period. Truncation of the length distributions is evident in the NEFSC spring and autumn series since 1990.

Indices of abundance for winter skate are available from the Massachusetts Division of Marine Fisheries (MADMF) spring and autumn research trawl surveys in the inshore waters of Massachusetts for the years 1978-1998. Winter skate are much more abundant in state waters south of Cape Cod and areas to the west, compared to state waters north of Cape Cod into the Gulf of Maine. MADMF biomass indices of winter skate were moderate to high from 1981 through 1987. Thereafter, both spring and autumn indices declined to time series lows in 1989-1991. The spring index rebounded to moderate levels during 1992-1996 before dropping 75% below the time series mean of 21.3 kg/tow during 1997 – 1999 (Figure 7). The autumn index shows an erratic, but generally increasing trend from 1991 – 1998. The 1998 autumn value of 24.7 kg/tow is 65% greater than the autumn mean of 14.9 kg/tow (Figure 7). The mean length of MADMF survey catches of winter skate has declined over the spring time series from greater than 60 cm in 1978-1979 to 40 cm in 1999 (Figure 8). The autumn mean length declined from greater than 55 cm in 1978-1980 to 43 cm in 1991, remained stable until 1995, then increased to 55 cm in 1998 (Figure 8). Length frequency distributions from the MADMF spring and autumn surveys generally show a dominant mode at 30 to 40 cm. Recent length distributions suggest recent recruitment of winter skate may have been relatively poor.

Indices of abundance for winter skate are available from the Connecticut Department of Environmental Protection (CTDEP) spring and autumn finfish trawl surveys in Long Island Sound for the years 1984-1998 (1992 and later only for biomass). Annual CTDEP survey catches have ranged from 0 to 115 skates. CTDEP survey indices suggest that after increasing to a time series high from 1984 through 1989, winter skate in Long Island Sound has been stable at about the time series mean during the 1990s (Figure 9).

Figure 6 Percentiles of Length Composition (5, 50, and 95) of Winter Skate from the NEFSC Spring and Autumn Bottom Trawl Surveys from 1967-2000 in the Gulf of Maine to Mid-Atlantic Offshore Region

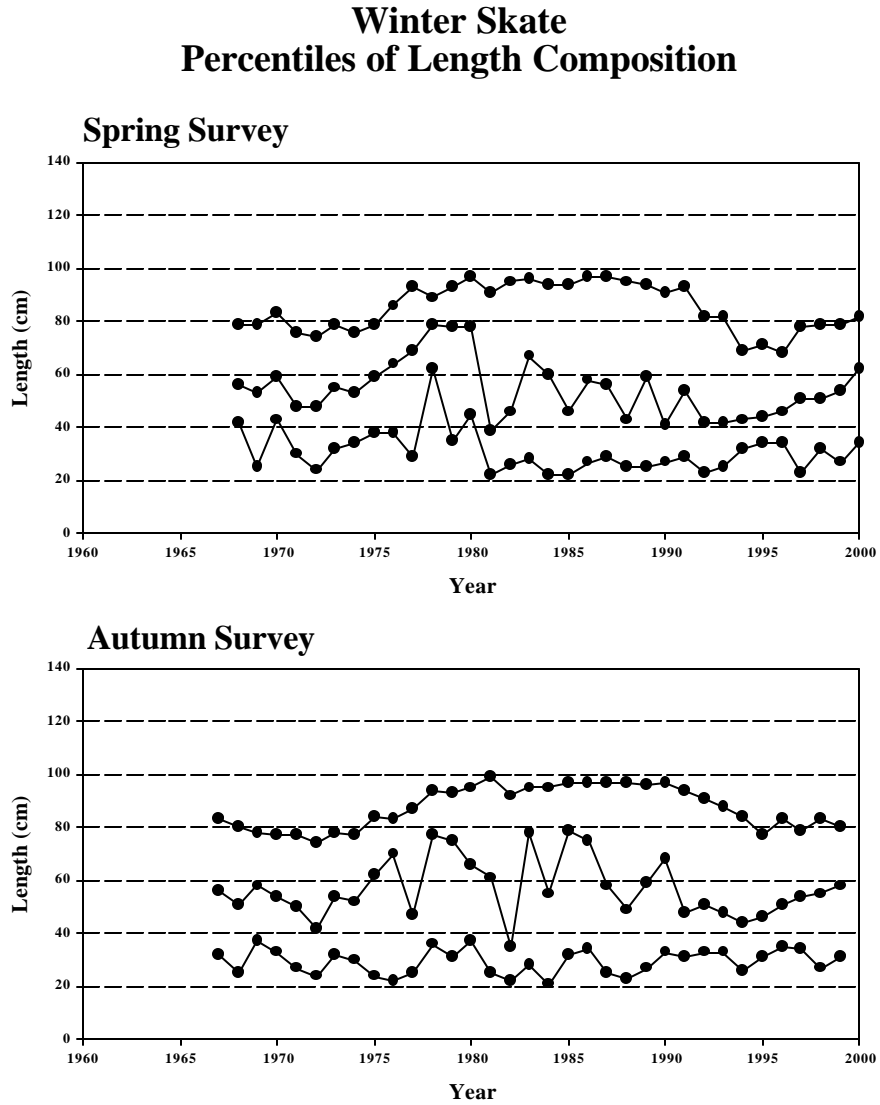


Figure 7 Abundance and Biomass of Winter Skate from the Massachusetts Spring (Circles) and Autumn (Squares) Finfish Bottom Trawl Survey in State Waters

Winter Skate - Massachusetts Trawl Survey

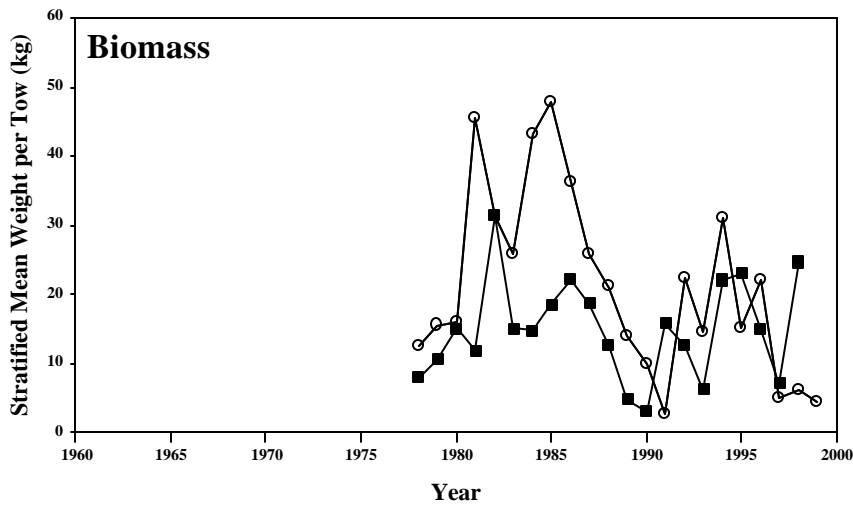
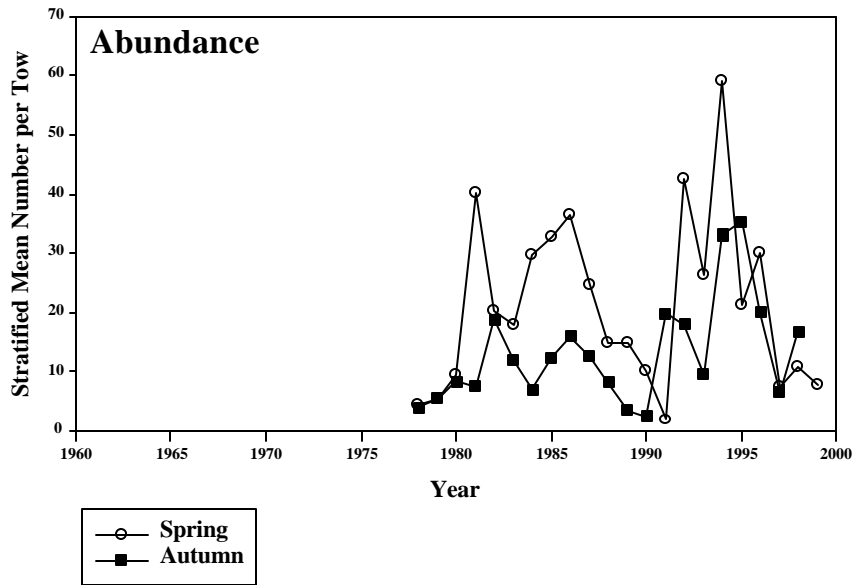


Figure 8 Stratified Mean Total Length (cm) of Winter Skate from the Massachusetts Spring and Autumn Bottom Trawl Surveys from 1978-1999 in Three Regions

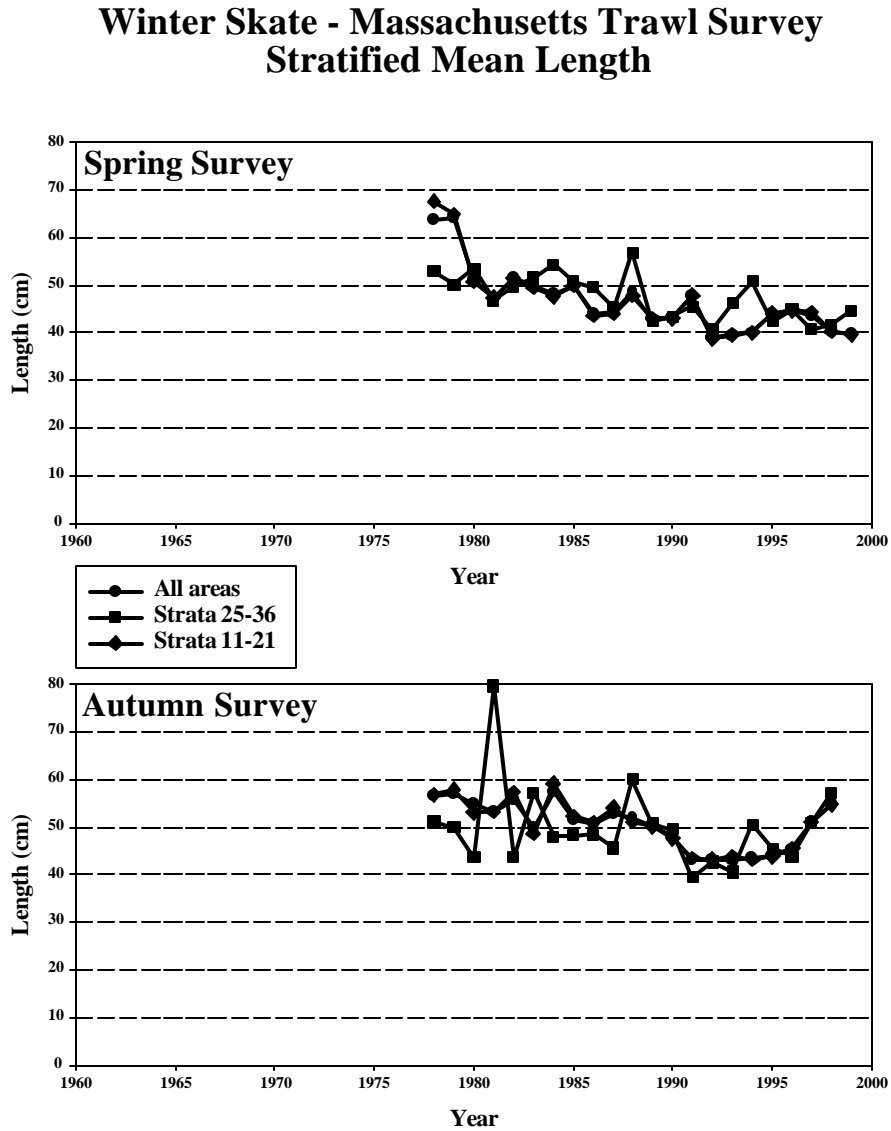
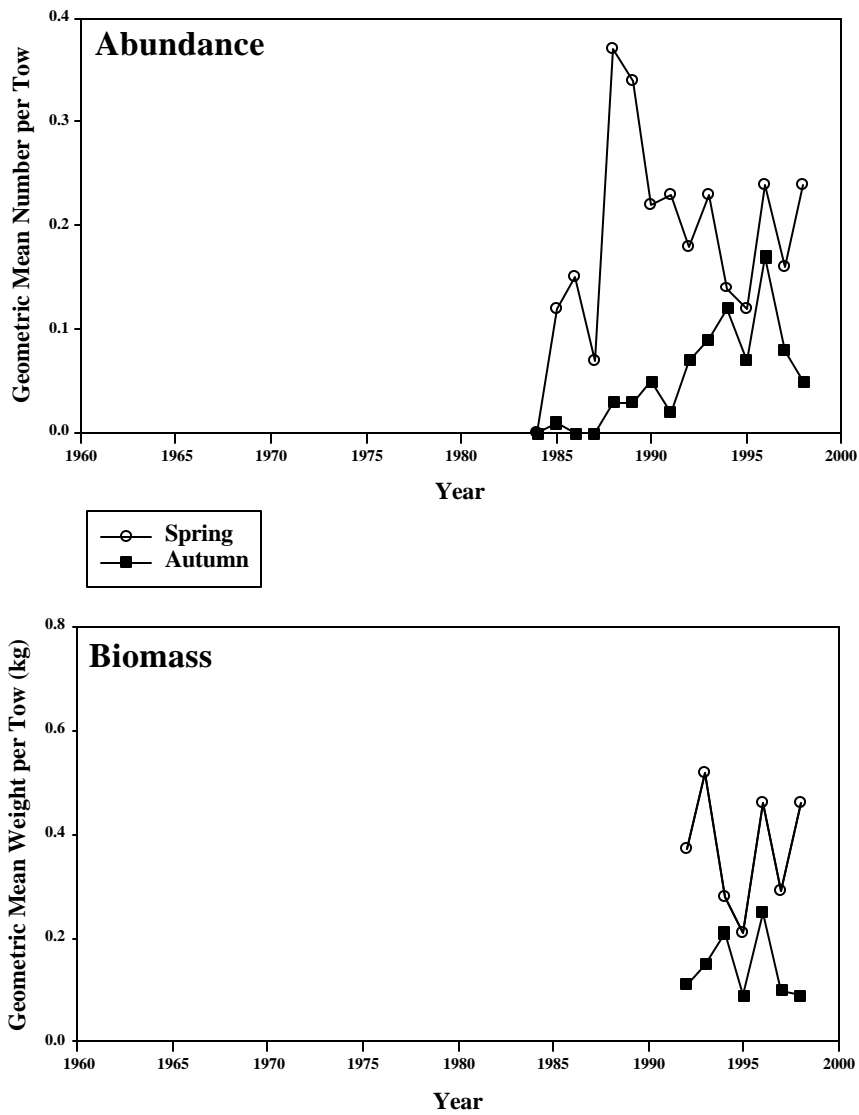


Figure 9 Abundance and Biomass of Winter Skate from the CTDEP Spring and Autumn Finfish Bottom Trawl Survey in Connecticut State Waters

Winter Skate - CTDEP Finfish Survey



2.3.1.2 Little Skate

NEFSC bottom trawl surveys indicate that little skate are abundant in the inshore and offshore strata in all regions of the northeast US coast, but are most abundant on Georges Bank and in Southern New England (**Appendix I**). In the NEFSC spring surveys (1976-2000), the annual total catch of little skate has ranged from 3,512 fish in 1986 to 16,406 fish in 1999. In the NEFSC autumn surveys (1975-1999), the annual total catch of little skate in offshore strata has ranged from 1,124 fish in 1993 to 3,848 fish in 1982 and 4,597 fish in 1978. Calculated on a per tow basis, these spring survey catches equate to maximum stratified mean number per tow indices for the GOM-MA inshore and offshore strata of about 28 fish, or 10 kg, per tow during 1999; autumn maximum catches equate to indices of 6 fish, or 3 kg, per tow in 1978, and 15 fish, or 6 kg, per tow in 1982 (due to high variance in survey catch in 1982; see Table 5 and Table 6).

The catchability of little skate in the recently instituted NEFSC winter bottom trawl survey (which substitutes a chain sweep with small cookies for the large rollers used in the spring and autumn surveys, to better target flatfish) is significantly higher than in the spring and autumn series. NEFSC winter survey (1992-1999) annual catches of little skate have ranged from 10,113 fish in 1994 to 18,418 fish in 1992, equating to a maximum stratified mean catch per tow of 170 fish or 66 kg per tow in 1992 (Table 7). The winter survey is focused in the Southern New England and Mid-Atlantic offshore regions, with a limited number of samples on Georges Bank, and no sampling in the Gulf of Maine.

Indices of little skate abundance and biomass from the NEFSC spring and autumn surveys were stable, but below the time series mean, during the 1970s. Little skate spring survey indices began to increase in 1982, and have reached a peak in 1999. Autumn survey indices have been relatively stable over the duration of the time series (Figure 10 – Figure 12). The application of the NEFSC gear conversion factors to spring survey indices decreased the indices in 1981 and earlier years by about 75 percent.

Table 5 Abundance and Biomass from NEFSC Spring Surveys for Little Skate for the Gulf of Maine to Mid-Atlantic Region

The mean index, 95% confidence intervals, individual fish weight, minimum, mean, and maximum length, 5th, 50th, and 95th percentiles of length, number of nonzero tows, and number of fish caught are presented for 1976-2000.

	weight/tow			number/tow			ind wt	length					nonzero		
	mean	lower	upper	mean	lower	upper		min	5%	50%	mean	95%	max	tows	no fish
1976	1.308	0.861	1.755	3.218	2.136	4.301	0.406	8	12	40	36.9	48	58	172	4202
1977	1.347	0.882	1.811	3.336	2.177	4.494	0.404	6	19	41	38.7	48	57	160	4218
1978	1.391	0.962	1.821	3.286	2.363	4.209	0.423	8	11	42	37.5	48	62	160	3945
1979	0.650	0.501	0.799	2.182	1.429	2.934	0.298	4	12	31	32.7	48	56	204	5684
1980	2.206	1.705	2.707	5.898	4.384	7.413	0.374	8	12	37	36.0	48	57	224	9031
1981	1.501	1.200	1.803	3.426	2.714	4.137	0.438	6	15	41	38.3	49	55	175	4113
1982	3.627	2.644	4.611	7.214	5.351	9.076	0.503	9	18	43	40.7	49	55	153	3564
1983	5.718	4.017	7.420	13.024	9.215	16.832	0.439	6	16	42	37.9	48	57	167	6365
1984	4.094	2.615	5.574	10.023	6.787	13.258	0.409	7	11	40	35.8	48	55	139	4573
1985	6.265	4.628	7.901	15.175	10.575	19.775	0.413	8	11	40	36.8	48	57	148	6535
1986	2.753	1.712	3.795	8.554	3.399	13.709	0.322	6	14	33	34.5	48	57	153	3512
1987	4.625	3.149	6.102	16.031	10.222	21.839	0.289	8	12	32	33.1	47	55	145	9584
1988	5.083	3.444	6.721	14.593	9.688	19.498	0.348	8	11	36	34.5	48	55	130	4195
1989	6.634	3.434	9.834	21.643	9.844	33.441	0.307	8	13	34	33.4	46	55	144	10760
1990	4.993	2.397	7.589	14.979	5.250	24.708	0.333	8	11	37	34.7	47	56	132	7085
1991	5.990	4.672	7.308	18.731	14.059	23.403	0.320	8	13	34	34.2	47	58	178	11986
1992	5.297	2.477	8.118	16.793	5.234	28.352	0.315	8	16	33	34.1	46	57	136	6392
1993	7.524	5.187	9.862	22.361	15.110	29.611	0.336	9	12	36	35.0	47	54	160	9574
1994	3.622	2.425	4.819	9.365	6.297	12.434	0.387	9	19	39	37.3	46	54	154	8548
1995	2.872	2.024	3.720	7.574	5.215	9.933	0.379	8	10	39	36.1	47	59	148	3801
1996	7.574	5.522	9.626	18.185	12.647	23.722	0.417	7	17	41	38.3	48	58	168	9086
1997	2.708	2.231	3.184	6.671	5.504	7.837	0.406	9	13	40	37.8	48	54	151	4840
1998	7.471	6.156	8.787	20.938	16.232	25.644	0.357	7	17	37	35.8	47	56	195	15710
1999	9.978	7.688	12.267	28.377	20.345	36.409	0.352	8	12	38	35.4	47	56	157	16406
2000	8.596	6.647	10.545	19.677	15.270	24.083	0.437	9	21	41	38.9	47	57	179	15367

Table 6 Abundance and Biomass from NEFSC Autumn Surveys for Little Skate for the Gulf of Maine to Mid-Atlantic Region

The mean index, 95% confidence intervals, individual fish weight, minimum, mean, and maximum length, 5th, 50th, and 95th percentiles of length, number of nonzero tows, and number of fish caught are presented for 1975-1999.

	weight/tow			number/tow			ind wt	length					nonzero		
	mean	lower	upper	mean	lower	upper		min	5%	50%	mean	95% max	tows	no fish	
1975	2.379	1.508	3.249	4.858	3.063	6.654	0.490	10	18	43	40.3	49	56	118	1386
1976	2.185	1.582	2.788	4.576	3.278	5.875	0.477	8	22	43	40.6	48	58	74	1421
1977	3.172	2.271	4.072	6.589	4.683	8.495	0.481	9	22	43	40.7	49	56	122	2438
1978	2.938	2.140	3.736	5.613	3.947	7.279	0.523	10	22	44	42.0	49	62	144	3171
1979	2.902	2.343	3.461	5.944	4.790	7.098	0.488	8	21	44	41.0	49	58	177	4597
1980	2.312	1.768	2.855	5.055	4.102	6.008	0.457	9	13	43	37.9	49	55	142	2451
1981	2.779	2.175	3.382	5.847	4.479	7.215	0.475	9	19	43	39.9	49	58	111	1728
1982	5.799	2.673	8.925	15.391	6.979	23.803	0.377	9	18	36	36.4	48	56	123	3848
1983	1.990	1.340	2.639	5.244	3.268	7.219	0.379	8	17	38	36.6	49	55	100	1313
1984	2.483	1.688	3.279	5.487	3.789	7.185	0.453	10	13	43	38.3	49	56	95	1350
1985	2.423	1.629	3.217	6.103	4.006	8.199	0.397	9	17	40	37.5	49	58	119	2761
1986	1.502	1.125	1.879	4.203	2.759	5.648	0.357	10	16	36	35.7	49	55	96	1240
1987	2.311	1.532	3.090	8.104	4.084	12.124	0.285	10	14	31	32.4	48	55	96	2093
1988	1.177	0.663	1.692	3.524	2.144	4.903	0.334	9	13	34	33.8	48	56	80	1128
1989	2.321	1.091	3.552	6.698	3.574	9.823	0.347	5	13	38	35.2	48	56	100	2288
1990	1.242	0.802	1.681	3.204	1.913	4.495	0.388	9	17	40	37.3	48	54	98	1183
1991	3.552	1.494	5.610	8.854	3.301	14.408	0.401	11	24	40	39.3	47	55	102	2866
1992	1.542	1.126	1.958	4.294	2.993	5.595	0.359	6	14	38	36.0	49	63	107	1460
1993	1.180	0.805	1.555	3.136	2.174	4.099	0.376	10	14	41	36.3	49	55	115	1124
1994	1.906	1.349	2.463	4.329	3.102	5.556	0.440	9	18	42	39.4	49	59	131	1729
1995	2.682	1.795	3.569	5.527	3.739	7.316	0.485	9	21	43	41.2	48	56	118	2058
1996	2.239	1.504	2.973	5.146	3.582	6.711	0.435	9	13	42	38.1	49	60	112	1878
1997	2.148	1.533	2.763	4.825	3.407	6.243	0.445	10	21	43	40.0	49	60	109	1757
1998	2.704	1.968	3.441	5.914	4.237	7.591	0.457	10	20	43	40.2	49	57	129	1713
1999	3.210	5.042	10.355	7.698	5.042	10.355	0.417	6	21	41	38.4	48	58	143	2289

Table 7 Abundance and Biomass from NEFSC Winter Surveys for Little Skate for the Georges Bank to Mid-Atlantic Region

The mean index, 95% confidence intervals, individual fish weight, minimum, mean, and maximum length, 5th, 50th, and 95th percentiles of length, number of nonzero tows, and number of fish caught are presented for 1992-1999.

	weight/tow			number/tow			ind wt	length					nonzero		
	mean	lower	upper	mean	lower	upper		min	5%	50% mean	95% max	tows	no fish		
1992	66.321	50.335	82.306	170.155	127.459	212.852	0.390	9	21	39	38.0	47	62	89	18418
1993	56.377	43.992	68.761	166.927	120.808	213.045	0.338	9	19	36	35.8	46	53	94	16026
1994	49.812	37.387	62.236	131.570	95.199	167.940	0.379	10	20	39	37.5	47	60	67	10113
1995	57.368	39.311	75.424	138.769	87.458	190.081	0.413	8	24	40	39.1	47	53	95	14530
1996	64.056	47.616	80.495	150.579	108.945	192.213	0.425	9	15	41	38.7	47	62	102	15701
1997	51.901	39.986	63.816	117.751	92.288	143.214	0.441	9	23	42	40.2	47	58	92	12084
1998	57.512	49.249	65.775	138.503	111.869	165.136	0.415	9	20	41	38.7	47	57	105	14492
1999	58.566	46.296	70.837	138.876	104.459	173.292	0.422	6	22	41	39.3	48	55	99	14740
2000	50.725	37.806	63.643	115.572	87.597	143.547	0.439	8	20	42	39.5	47	53	92	10722

Figure 10 Abundance and Biomass of Little Skate from the NEFSC Spring (Circles) and Autumn (Squares) Bottom Trawl Surveys from 1975-2000 in the Gulf of Maine to Mid-Atlantic Offshore and Inshore Regions

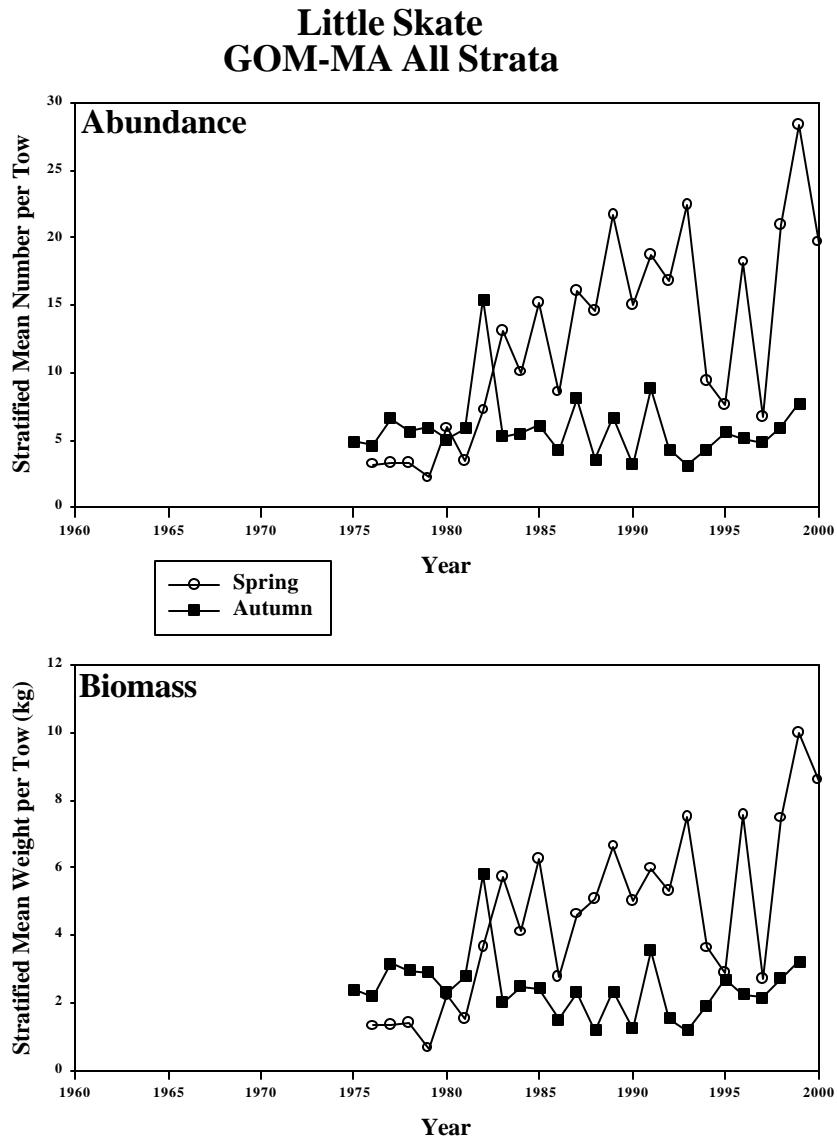


Figure 11 Abundance and Biomass of Little Skate from the NEFSC Spring Bottom Trawl Survey in the Gulf of Maine to Mid-Atlantic Region, All Strata

Mean Index in Solid Squares, 95% Confidence Interval in Open Squares

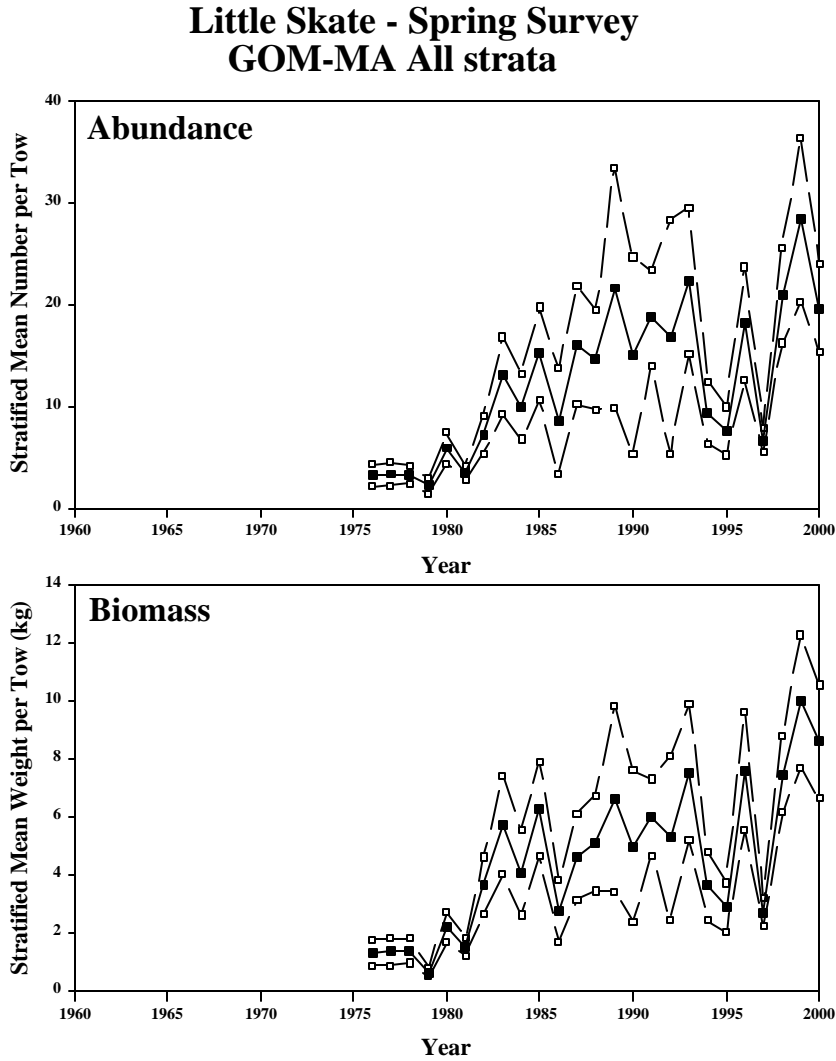
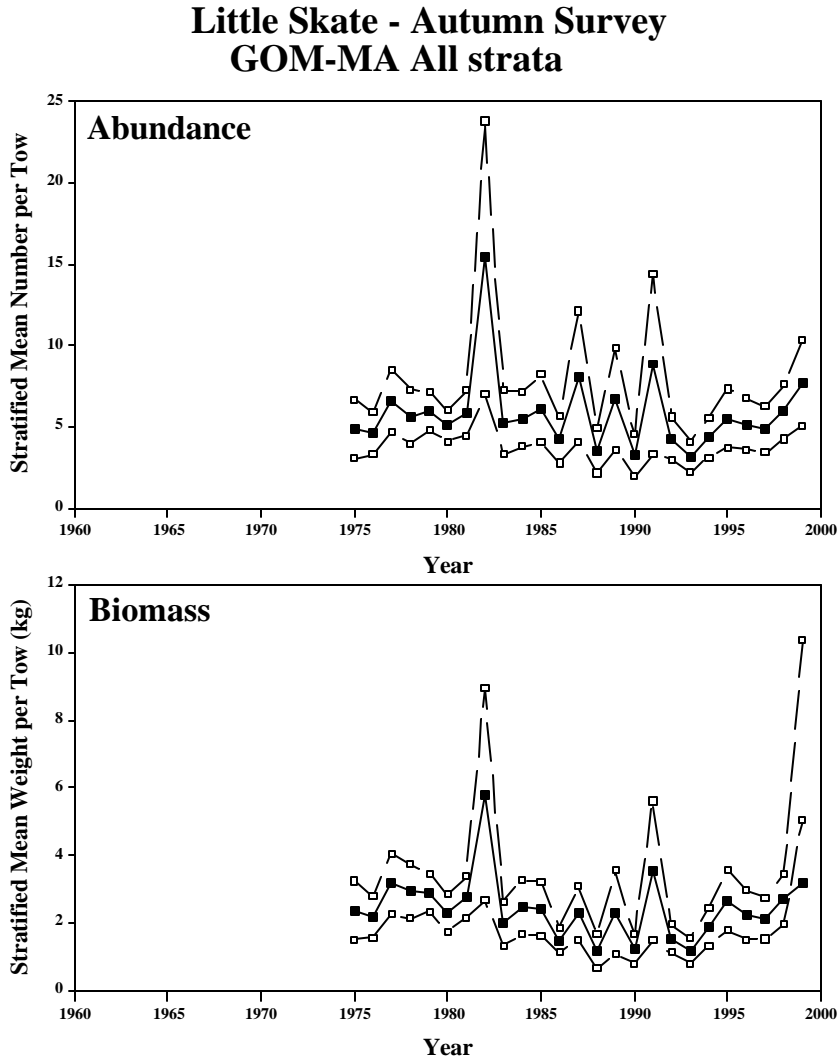


Figure 12 Abundance and Biomass of Little Skate from the NEFSC Autumn Bottom Trawl Survey in the Gulf of Maine to Mid-Atlantic Region, All Strata.

Mean Index in Solid Squares, 95% Confidence Interval in Open Squares



The minimum length of little skate caught in NEFSC surveys is 6 cm (3 in), and the largest individual caught was 62 cm (24 in) total length, during the 1978 autumn survey on Georges Bank. The median length of the survey catch has ranged from 31 cm in the 1979 and 1987 spring surveys to 43 cm, most recently in the 1998 autumn survey. The median length of the survey catch has been generally stable over the duration of the spring and autumn surveys and is currently about 38 cm in the spring and 43 cm in the autumn (15 to 17 in)(Figure 13). Length frequency distributions from the NEFSC spring and autumn surveys are presented in the SAW 30 documents as Figures B32 – B34 and are not reproduced in this SAFE Report. In general, the length frequency distributions for little skate show several modes, most often at 10, 20, 30, and 45 cm, which may represent ages 0, 1, 2, and 3 and older little skate.

Indices of abundance for little skate are available from MADMF spring and autumn research trawl surveys in the inshore waters of Massachusetts for the years 1978-1998. Little skate are abundant in state waters south of Cape Cod and areas to the west and in waters north of Cape Cod into the Gulf of Maine. MADMF biomass indices of little skate declined through the 1980s to time series lows in 1989 (autumn) and 1991 (spring). Biomass indices quickly rose to high levels in the early 1990s, but have steadily declined since then. The 1998 autumn biomass index fell to 40% below the autumn time series mean of 9.9 kg/tow, while the 1999 spring biomass index fell to 22% below the spring time series mean of 14.8 kg/tow (Figure 14). The mean length of MADMF survey catches of little skate show a modest increasing trend in the spring time series while the autumn mean length has fluctuated without trend (Figure 15). Length frequency distributions from the MADMF spring and autumn surveys often show a large mode at 45 cm, which may represent ages 3 and older little skate.

Indices of abundance for little skate are available from CTDEP spring and autumn finfish trawl surveys in Long Island Sound for the years 1984-1998 (1992 and later only for biomass). Little skate are the most abundant species in the skate complex in Long Island Sound, with annual CTDEP survey catches ranging from 142 to 837 skates. CTDEP survey indices suggest an increase in abundance of little skate in Long Island Sound over the 1984-1998 time series (Figure 16).

Figure 13 Percentiles of Length Composition (5, 50, and 95) of Little Skate from the NEFSC Spring and Autumn Bottom Trawl Surveys from 1975-2000 in the Gulf of Maine to Mid-Atlantic Offshore and Inshore Regions

**Little Skate: GOM-MA All strata
Percentiles of Length Composition**

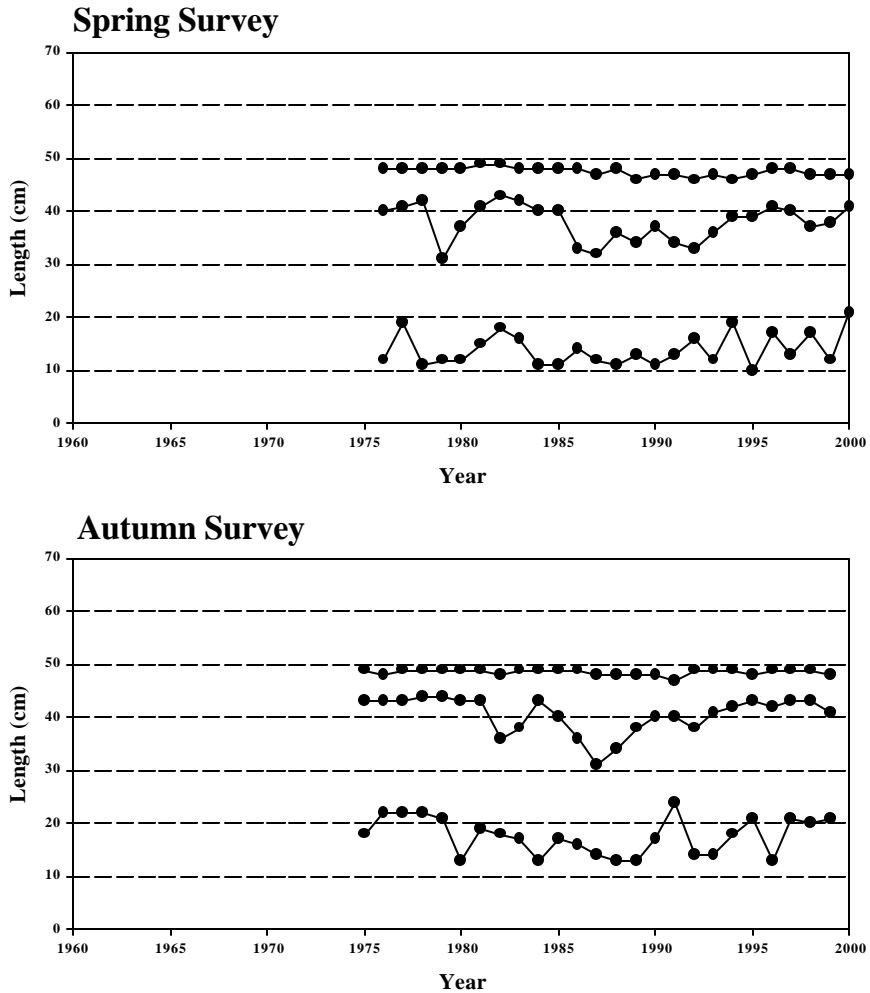


Figure 14 Abundance and Biomass of Little Skate from the Massachusetts Spring (Circles) and Autumn (Squares) Finfish Bottom Trawl Survey in State Waters

Little Skate - Massachusetts Trawl Survey

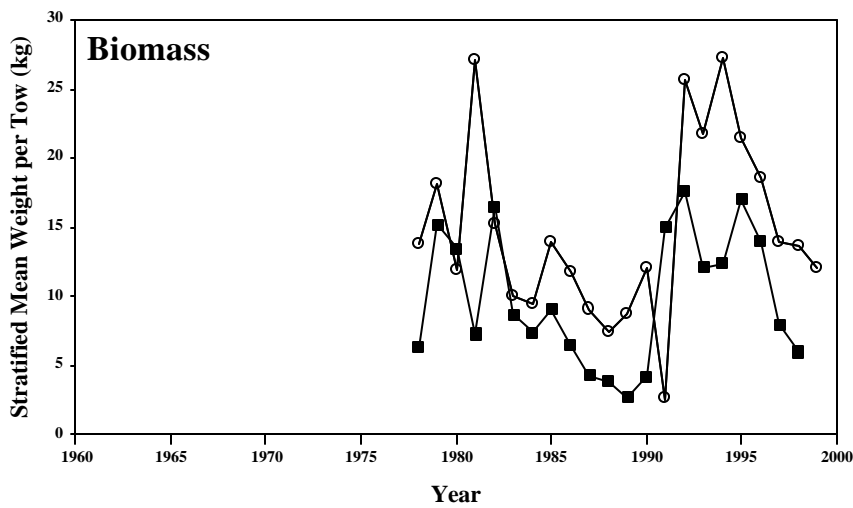
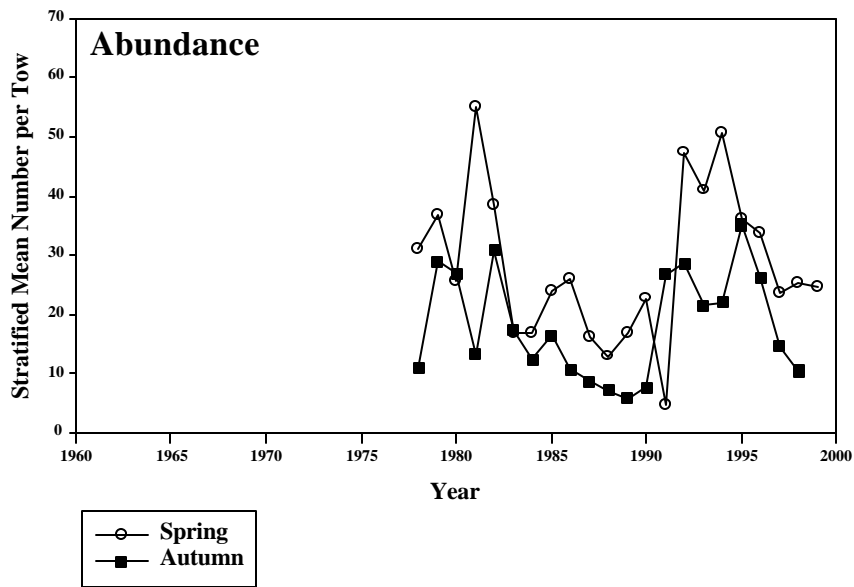


Figure 15 Stratified Mean Total Length (cm) of Little Skate from the Massachusetts Spring and Autumn Bottom Trawl Surveys from 1978-1999 in Three Regions

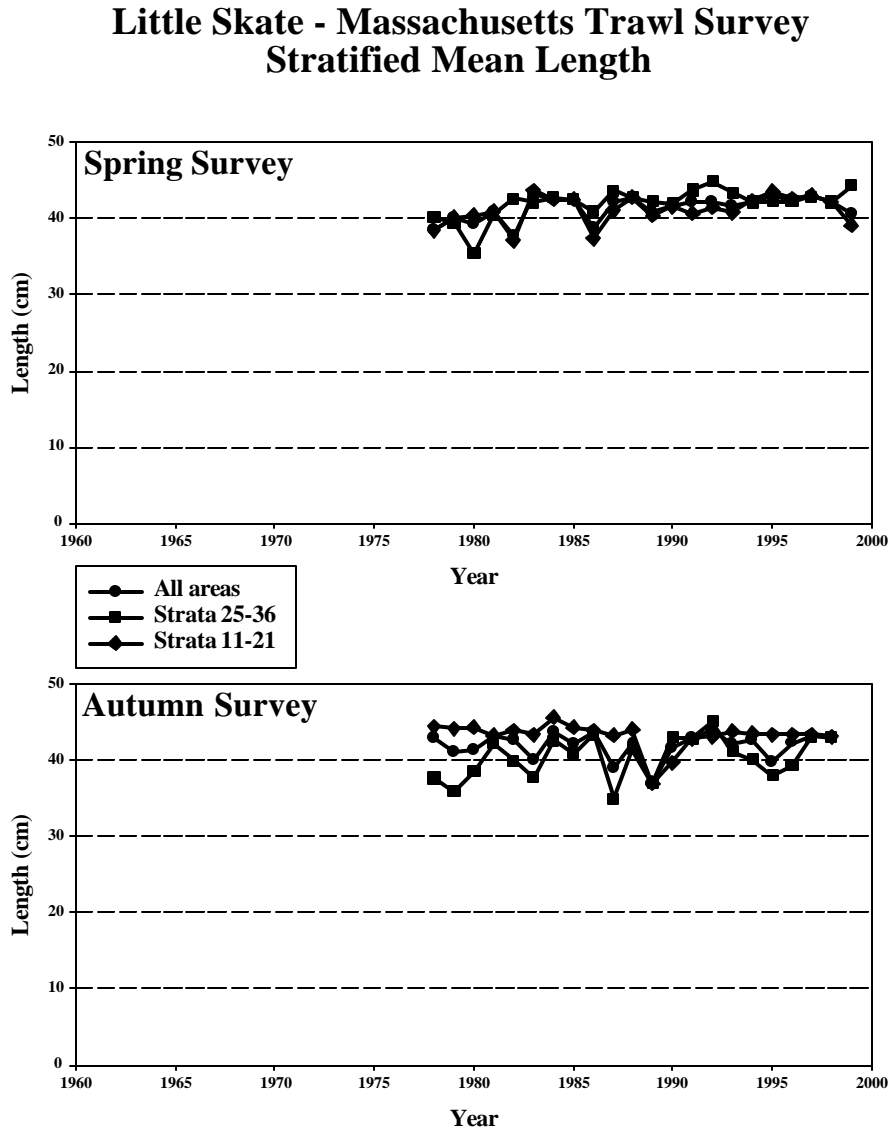
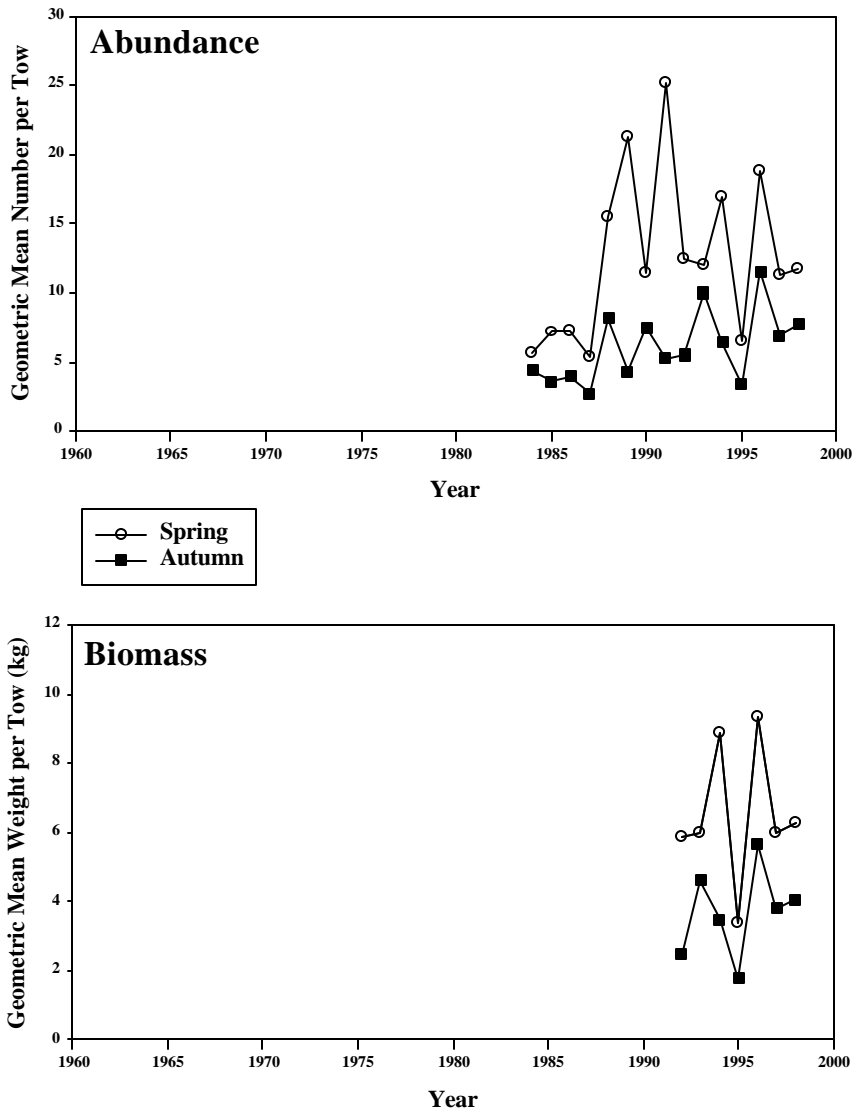


Figure 16 Abundance and Biomass of Little Skate from the CTDEP Spring and Autumn Finfish Bottom Trawl Survey in Connecticut State Waters

Little Skate - CTDEP Finfish Survey



2.3.1.3 Barndoor Skate

Barndoor skate are most abundant in the Gulf of Maine, Georges Bank, and Southern New England offshore strata regions, with very few fish caught in inshore (< 27 meters depth) or Mid-Atlantic regions (**Appendix I**). Bigelow and Schroeder (1953), however, noted that historically, barndoor skate were found in inshore waters to the tide-line, and in depths as great as 400 meters off Nantucket. In the NEFSC spring surveys (1968-2000), the annual total catch of barndoor skate has ranged from 0 fish (several years during the 1970s and 1980s) to 22 fish in 1969. In the NEFSC autumn surveys (1963-1999), the annual total catch of barndoor skate has ranged from 0 fish (several years in the 1970s and 1980s) to 120 fish in 1963. Calculated on a per tow basis, the autumn survey catches equate to maximum stratified mean number per tow indices for the GOM-SNE offshore strata of about 0.8 fish, or 2.6 kg, per tow in 1963 (Table 8 and Table 9).

The catchability of barndoor skate in the recently instituted NEFSC winter bottom trawl survey (which substitutes a chain sweep with small cookies for the large rollers used in the spring and autumn surveys, to better target flatfish) is significantly higher than in the spring and autumn series and may be particularly higher for smaller skates. NEFSC winter survey (1992-1999) annual catches of barndoor skate have ranged from 0 fish in 1992 to 81 in 1999, equating to a maximum stratified mean catch per tow of 0.7 fish or 1.0 kg per tow in 1999 (Table 10). The winter survey is focused in the Southern New England and Mid-Atlantic offshore regions, with a limited number of samples on Georges Bank, and no sampling in the Gulf of Maine.

Indices of barndoor skate abundance and biomass from the NEFSC spring survey were at their highest values during early 1960s, and then declined to 0 fish per tow during the early 1980s. Since 1990, both spring and autumn survey indices have steadily increased, but are still only <10% (spring) to 25% (autumn survey) of the peak values observed in the 1960s (Figure 17 – Figure 19).