United States Department of Interior
Fish and Wildlife Service
Region 5
Wildlife and Sport Fish Restoration Program

2022 Annual Performance Report

State:	Massachusetts
Agency:	Division of Marine Fisheries
Project Title:	Massachusetts Fishery Resource Assessment
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Period Covered:	January 1, 2022 – December 31, 2022
Prepared By:	Steve Wilcox, Aquatic Biologist III Vincent Manfredi, Aquatic Biologist II Mark Szymanski, Aquatic Biologist II Gary Nelson, Environmental Analyst IV
Submitted By:	Stephanie Cunningham, Fiscal Administration & Operations Manager
Date Submitted:	2/13/2023

Sport Fish Program
Massachusetts Fishery Resource Assessment:
F-56-R-24 2022 Performance Report

List of Active Jobs:

Job No. 1: Fishery Resource Assessment, Coastal Massachusetts
The Massachusetts Division of Marine Fisheries Resource Assessment Project completed the forty-fourth annual spring and fall bottom trawl surveys of Massachusetts territorial waters in 2022. Detailed reports of the activities of each cruise follow.

Job No. 2: Winter Flounder Year-Class Strength
The Massachusetts Division of Marine Fisheries Resource Assessment Project completed the forty-seventh annual seine survey of Nantucket Sound estuaries on the south shore of Cape Cod to assess southern New England stock winter flounder YOY cohort abundance. A report of the 2022 seine survey follows.

Appendix A: Indices of biomass, abundance, and recruitment for select species.

Appendix B: Trends in observed bottom temperatures - Massachusetts bottom trawl survey, 1978 - 2022.

Appendix C: Corrections to the trawl survey database in 2022.

CRUISE RESULTS

R/V GLORIA MICHELLE

2022 Massachusetts Inshore Spring
Bottom Trawl Survey
Cruise No. 202291

CRUISE PERIOD AND AREA

From May 11 through May 26, 2022, the Massachusetts Division of Marine Fisheries (MDMF) conducted its 44th spring bottom trawl survey. The survey extended from New Hampshire to Rhode Island boundaries seaward to three nautical miles including Cape Cod Bay and Nantucket Sound.

OBJECTIVES

Cruise objectives were 1) to determine the spring distribution, relative abundance, and size composition of fish and select invertebrate species; and 2) to collect biological samples. Requested special collections were also undertaken.

METHODS

The study area is stratified based on five bio-geographic regions and six depth zones (Fig. 1). Trawl sites are allocated in proportion to stratum area and randomly chosen in advance within each sampling stratum. Randomly chosen stations in locations known to be untowable due to hard bottom are reassigned. Sampling intensity is approximately 1 station per 19 square nautical miles. A minimum of two stations are assigned to each stratum.

A standard tow of 20-minute duration at 2.5 knots was attempted at each station during daylight hours with a 3/4 size North Atlantic type two seam otter trawl (11.9 m headrope/15.5 m footrope) rigged with a 7.6 cm rubber disc sweep; 19.2 m, 9.5 mm chain bottom legs; 18.3 m, 9.5 mm wire top legs; and 1.8 X 1.0 m, 147 kg wooden trawl doors. The codend contains a 6.4 mm knotless liner to retain small fish. Prior to setting the net at each station, NOAA Corps officers surveyed the site by visually scanning for buoys marking fixed gear as well as determining the suitability of the bottom for towing the net based on the sounder image. Whenever necessary, sites were relocated due to untowable bottom or concentrations of fixed gear. Abbreviated tows of 13-19 minute duration were accepted as valid and expanded to the 20 minute standard.

Standard bottom trawl survey techniques were used when processing the catch. The total weight and length-frequency of each species were recorded directly into Fisheries Scientific Computer System (FSCS) data tables. From 2010 through 2018, FSCS version 1.6 was utilized for electronic data collection. Starting in 2019, we upgraded to FSCS version 2.0. Collections of age and growth material, and biological observations were

undertaken during the measuring operation. Specimens were also saved to fulfill requests. Bottom temperatures were continuously recorded with an Onset Water Temp Pro v2 attached to the doors.

To mitigate COVID-19 risks, the survey schedule was modified to reduce the number of crew changes and provide greater flexibility based on weather and survey progress. Twenty-four MADMF employees participated in the survey as part of the scientific party along with one biologist from University of Massachusetts Amherst and one biologist from Gloucester Marine Genomics Institute (Table 1).

CRUISE SUMMARY

There were 111 stations attempted in 16 sampling days (Figs 2 and 3, Table 2). One hundred and one completed stations were considered acceptable for assessment of all species (SHG <=136) an no substandard tows occurred this survey (SHG 141 – 166) (Tables 3 and 4). Ten attempted tows were aborted during the survey. Seven of the aborts were due to hard bottom and three attempts at two stations near L'Hommedieu Shoal in Nantucket Sound could not be landed due to abnormally large Scup catches (Table 5, Fig. 3).

The geographic distribution, relative abundance, relative biomass, and representative length frequencies of all fish and invertebrate species were documented (Tables 6a and 6b). Several records were set on the 2022 spring survey at individual stations. The largest tow for Yellowtail Flounder abundance (1553 individuals) and biomass (268.57 kg) was observed at station 19 east of Cape Ann. The first Spot observed in a spring survey was documented at Station 68 near Marion. The highest abundance of Smallmouth Flounder (33) was observed at station 89 west of Martha's Vineyard.

There were several other notable species trends observed during this survey. Throughout the survey Scup were observed at the highest percentage of stations in survey history. Scup were observed at several Gulf of Maine strata for the first time. Little Skate and Winter Skate were both observed at the lowest percentage of stations in timeseries history, while abundance and biomass trends also remained low. North of Cape Cod the survey observed moderate catches of Winter Flounder, Silver Hake, Red Hake, and Longhorn Sculpin. South of Cape Cod had moderate catches of Scup, Northern Searobin and juvenile Longfin Squid. This was the first spring survey with no Lobsters observed in Nantucket Sound, Vineyard Sound and Buzzard's Bay.

Additional sampling goals were achieved (Table 7). To aid cooperative fisheries assessments over 1,200 otolith samples and over 1,600 sex and maturity observations were taken from Atlantic Cod, Haddock, Summer Flounder, Yellowtail Flounder, Winter Flounder, Black Sea Bass, Scup, Tautog and American Lobster. Additional samples were collected to assist ongoing research by fisheries scientists from MDMF and other labs in the region.

For further information on this survey or others in the time series, contact Steve Wilcox at (508) 742-9731.

Table 1. Staffing list for spring cruise 202291.

Scientific Party

Name	Affiliation	Num. Days
Vincent Manfredi	MADMF	8
Brendan Reilly	MADMF	8
Mark Szymanski	MADMF	8
Steve Wilcox	MADMF	8
Ross Kessler	MADMF	6
Elise Koob	MADMF	5
Steve Voss	MADMF	5
Katrina Zarella-Smith	UMASS Boston	4
Nick Buchan	MADMF	3
Kim Fine	MADMF	3
Chrissy Pettipas	MADMF	3
Forest Shenck	MADMF	3
Scott Schaeffer	MADMF	3
Sam Truesdell	MADMF	3
Dave Chosid	MADMF	2
Amanda Meli	MADMF	2
Alex Boeri	MADMF	1
Dylan Comb	GMGI	1
Scott Elzey	MADMF	1
Siminetta Harrison	MADMF	1
Mark Rouseau	MADMF	1
Anna Webb	MADMF	1
Justin Wilson	MADMF	1
Total		81

R/V Gloria Michelle Crew

Name	Affiliation	Num. Days
Officers		
Ben Vandine	NOAA OIC	16
Alex Creed	NOAA JOIC	16
Mike Abbott	NOAA-CORPS (ret)	6
Steve Beckwith	NOAA-CORPS (ret)	6
Trevor Grams	NOAA-CORPS	6
Jay Dunn	NOAA-CORPS	4
Bryan Pestone	NOAA-CORPS	2
Deck Crew		
Troy Dwyer	Contract Fisherman	8
Tegan Murray	MA Maritime Cadet	7
Jack Gerrier	MA Maritime Cadet	7
Sarah Shea	NMFS-Woods Hole	4
Pete Plantamura	NMFS-Sandy Hook	3

Table 2. Station information for the spring cruise 202291.

Station	Stratum	Date	Time (est)	Depth (m)	Latitude	Longitude	Course	Distance (nmi)	Bottom temp °C
1	26	5/11/2022	9:46	12	41°49.13	-70°08.12	88	0.78	7.9
2	25	5/11/2022	11:13	7	41°48.30	-70°04.07	67	0.86	8.8
3	25	5/11/2022	13:14	8	41°49.89	-70°10.20	37	0.80	8.2
4	26	5/11/2022	14:22	13	41°49.53	-70°12.50	49	0.83	8.1
5	26	5/11/2022	15:51	18	41°47.59	-70°15.55	85	0.80	8.1
6	25	5/12/2022	8:11	10	42°02.57	-70°37.74	347	0.84	9.4
7	26	5/12/2022	9:52	17	42°09.18	-70°40.97	163	0.87	9.4
8	32	5/12/2022	12:25	13	42°17.75	-70°51.13	85	0.85	9.2
9	34	5/12/2022	14:14	30	42°26.34	-70°51.41	110	0.85	7.8
10	35	5/12/2022	16:18	39	42°27.49	-70°48.76	73	0.77	7.1
11	33	5/13/2022	7:37	28	42°51.01	-70°46.70	191	0.85	7.6
12	34	5/13/2022	8:46	39	42°49.51	-70°44.09	345	0.87	7.2
13	31	5/13/2022	10:24	9	42°42.95	-70°45.50	340	0.86	8.7
14	31	5/13/2022	11:29	9	42°41.52	-70°43.69	322	0.86	8.7
15	32	5/13/2022	12:29	14	42°42.69	-70°44.17	157	0.85	8.3
16	33	5/13/2022	14:23	23	42°42.83	-70°42.99	146	0.83	7.7
17	34	5/13/2022	15:49	32	42°42.37	-70°39.29	322	0.83	7.2
18	35	5/13/2022	17:05	40	42°43.39	-70°38.17	167	0.85	7.2
19	35	5/14/2022	6:40	54	42°40.24	-70°32.80	189	0.84	7.2
20	36	5/14/2022	7:53	88	42°40.29	-70°31.42	179	0.85	5.7
21	36	5/14/2022	10:12	71	42°29.10	-70°39.12	14	0.82	5.6
22	35	5/14/2022	11:41	62	42°28.91	-70°41.02	204	0.84	5.8
23	35	5/14/2022	13:08	56	42°27.37	-70°42.68	340	0.55	6.4
24	35	5/14/2022	14:09	54	42°30.55	-70°41.73	256	0.83	6.3
25	34	5/14/2022	15:21	35	42°32.93	-70°43.11	263	0.85	6.8
26	33	5/15/2022	7:04	21	42°27.01	-70°53.69	127	0.83	7.6
27	31	5/15/2022	8:14	11	42°26.12	-70°54.96	10	0.86	8.2
28	32	5/15/2022	9:33	13	42°24.80	-70°56.74	126	0.86	8.5
29	33	5/15/2022	11:47	26	42°23.65	-70°54.21	86	0.83	7.6
30	32	5/15/2022	13:04	12	42°26.11	-70°54.77	28	0.84	7.7
31	32	5/15/2022	14:14	11	42°26.20	-70°54.82	24	0.51	8.1
32	27	5/16/2022	6:03	23	41°49.97	-70°27.33	160	0.84	8.2
33	27	5/16/2022	7:05	27	41°50.92	-70°24.19	219	0.86	8.6
34	28	5/16/2022	8:51	36	41°57.49	-70°28.82	186	0.83	8.8
35	29	5/16/2022	10:23	45	42°02.29	-70°30.51	199	0.83	8.6
36	28	5/16/2022	11:53	33	42°03.73	-70°33.89	24	0.61	7.6
37	28	5/16/2022	12:52	37	42°06.01	-70°32.23	225	0.73	8.3
38	29	5/16/2022	14:13	49	42°04.01	-70°28.43	171	0.78	8.1
39	29	5/16/2022	15:47	46	41°59.91	-70°24.55	204	0.86	7.2
40	29	5/17/2022	6:34	50	42°01.57	-70°19.00	352	0.85	8.6
41	29	5/17/2022	7:43	50	42°01.02	-70°21.98	349	0.84	8.3
42	30	5/17/2022	9:06	59	42°04.86	-70°22.10	43	0.56	8.2

Table 2 continued.

Station	Stratum	Date	Time (est)	Depth (m)	Latitude	Longitude	Course	Distance (nmi)	Bottom temp °C
43	21	5/17/2022	10:53	63	42°05.50	-70°14.07	77	0.86	6.6
44	30	5/17/2022	12:17	65	42°06.09	-70°14.78	268	0.41	8.3
45	30	5/17/2022	13:19	63	42°06.02	-70°16.20	239	0.77	7.8
46	17	5/17/2022	15:20	9	42°02.96	-70°03.50	321	0.84	7.8
47	20	5/17/2022	16:30	34	42°03.33	-70°01.18	353	0.66	10.5
48	18	5/17/2022	17:27	17	42°01.77	-70°01.52	336	0.85	9.6
49	18	5/18/2022	5:26	13	41°54.90	-69°57.48	359	0.83	9.5
50	19	5/18/2022	6:35	21	41°54.10	-69°56.27	179	0.83	10.1
51	17	5/18/2022	7:53	8	41°50.32	-69°56.06	183	0.85	9.9
52	21	5/18/2022	9:15	42	41°48.52	-69°52.12	1	0.87	8.9
53	20	5/18/2022	10:45	33	41°46.16	-69°52.04	11	0.70	8.8
54	16	5/18/2022	14:55	15	41°20.39	-70°07.32	142	0.79	11.3
55	15	5/18/2022	15:55	10	41°19.21	-70°09.01	109	0.77	11.8
56	15	5/18/2022	16:53	9	41°19.92	-70°12.39	131	0.25	12.0
57	15	5/18/2022	17:15	9	41°19.87	-70°12.39	136	0.74	11.9
58	15	5/19/2022	7:15	7	41°20.90	-70°15.66	298	0.52	12.1
59	15	5/19/2022	8:18	7	41°23.64	-70°10.92	260	0.62	11.6
60	16	5/19/2022	9:34	13	41°20.47	-70°10.72	282	0.84	11.8
61	18	5/19/2022	12:10	16	41°26.11	-69°57.25	298	0.84	10.6
62	18	5/19/2022	13:16	16	41°27.88	-70°02.11	58	0.78	10.5
63	16	5/19/2022	15:00	15	41°20.48	-70°04.80	47	0.84	11.4
64	12	5/20/2022	6:52	15	41°29.40	-70°48.73	226	0.83	12.4
65	12	5/20/2022	8:40	17	41°28.84	-70°57.61	266	0.82	12.2
66	12	5/20/2022	9:44	16	41°29.19	-70°59.35	274	0.85	12.4
67	11	5/20/2022	12:14	11	41°38.26	-70°44.30	221	0.76	13.9
68	11	5/20/2022	13:17	8	41°39.98	-70°44.65	141	0.56	14.4
69	11	5/20/2022	14:14	9	41°39.88	-70°42.24	37	0.54	13.6
70	25	5/20/2022	17:37	10	41°46.09	-70°27.63	141	0.84	10.5
71	26	5/21/2022	6:14	19	41°46.56	-70°19.80	59	0.86	10.1
72	27	5/21/2022	7:27	25	41°50.92	-70°15.39	273	0.84	9.6
73	28	5/21/2022	8:43	28	41°53.90	-70°11.56	247	0.83	9.9
74	27	5/21/2022	10:07	23	41°56.36	-70°08.77	199	0.85	9.8
75	27	5/21/2022	11:07	24	41°58.03	-70°08.23	212	0.54	9.8
76	28	5/21/2022	12:19	35	41°56.37	-70°15.50	111	0.86	8.9
77	12	5/21/2022	16:39	15	41°33.41	-70°41.21	6	0.83	13.3
78	12	5/21/2022	17:37	14	41°32.44	-70°42.04	348	0.85	13.2
79	16	5/22/2022	7:00	17	41°28.02	-70°28.40	115	0.85	12.8
80	11	5/22/2022	8:22	8	41°23.55	-70°25.63	24	0.55	13.6
81	15	5/22/2022	9:41	8	41°26.12	-70°27.03	64	0.84	13.1
82	16	5/22/2022	11:20	13	41°29.52	-70°24.13	318	0.76	13.1
83	16	5/22/2022	12:35	18	41°29.31	-70°28.64	297	0.82	13.0
84	16	5/22/2022	14:42	16	41°30.64	-70°33.08	294	0.55	14.0

Table 2 continued.

Station	Stratum	Date	Time (est)	Depth (m)	Latitude	Longitude	Course	Distance (nmi)	Bottom temp °C
85	13	5/23/2022	6:12	22	41°24.24	-70°49.20	60	0.83	12.5
86	13	5/23/2022	7:13	19	41°22.97	-70°46.11	37	0.83	12.7
87	14	5/23/2022	8:23	31	41°22.38	-70°51.14	71	0.85	12.3
88	13	5/23/2022	9:22	26	41°22.80	-70°53.04	80	0.85	12.4
89	14	5/23/2022	10:38	32	41°18.61	-70°52.37	343	0.84	10.8
90	13	5/23/2022	12:31	22	41°17.51	-70°44.14	56	0.86	11.3
91	13	5/23/2022	13:50	23	41°18.28	-70°39.27	97	0.85	11.5
92	12	5/23/2022	14:53	16	41°19.66	-70°34.19	287	0.84	12.5
93	11	5/23/2022	16:05	9	41°19.11	-70°28.83	267	0.85	11.6
94	12	5/23/2022	16:58	14	41°16.94	-70°29.56	332	0.86	11.5
95	17	5/24/2022	6:41	10	41°17.01	-70°20.14	100	0.85	12.2
96	18	5/24/2022	7:43	15	41°16.87	-70°16.98	158	0.66	11.8
97	17	5/24/2022	9:06	10	41°15.43	-70°11.29	128	0.84	12.8
98	17	5/24/2022	10:20	11	41°14.33	-70°08.05	128	0.84	12.7
99	19	5/24/2022	11:28	23	41°12.30	-70°07.59	91	0.87	12.1
100	16	5/25/2022	7:36	14	41°26.25	-70°15.79	97	0.82	13.6
101	15	5/25/2022	9:29	10	41°35.65	-70°10.49	149	0.85	13.6
102	15	5/25/2022	10:36	7	41°36.66	-70°08.44	93	0.86	14.2
103	15	5/25/2022	11:39	8	41°38.22	-70°04.94	247	0.54	14.2
104	15	5/25/2022	12:34	8	41°36.79	-70°02.14	270	0.84	14.2
105	16	5/25/2022	13:31	9	41°34.95	-70°03.00	276	0.83	11.3
106	15	5/25/2022	14:32	8	41°31.80	-70°05.27	52	0.86	11.6
107	16	5/25/2022	16:32	17	41°24.07	-70°03.77	223	0.84	12
108	16	5/26/2022	7:42	11	41°27.13	-70°09.95	280	0.86	12.9
109	16	5/26/2022	8:50	17	41°30.19	-70°14.41	93	0.84	13.6
110	33	5/15/2022	10:40	27	42°23.68	-70°54.06		0.83	
111	16	5/26/2022	11:31	16	41°30.77	-70°33.95	123	0.84	14.5

Table 3. Sampling effort assigned and accomplished by stratum, cruise 202291.

Stratum	Region	Assigned Stations	Number of Stations Completed			Aborted Tows
			All Accepted	Sub-Standard	Standard	
11	1	5	5		5	
12	1	7	7		7	
13	1	5	5		5	
14	1	2	2		2	
15	2	10	10		10	1
16	2	11	10		10	3
17	3	5	5		5	
18	3	5	5		5	
19	3	2	2		2	
20	3	2	2		2	
21	3	2	2		2	
25	4	4	4		4	
26	4	5	5		5	
27	4	5	5		5	
28	4	5	5		5	
29	4	5	5		5	
30	4	2	2		2	1
31	5	3	3		3	
32	5	3	2		2	3
33	5	4	4		4	1
34	5	4	4		4	
35	5	5	5		5	1
36	5	2	2		2	
TOTALS		103	101	0	101	10

Note:
Standard Tows. SHG <=136. Recommended for use in all indices of abundance.
Sub-Standard Tows. SHG 141 - 166. Not recommended for use in indices other than spiny dogfish.
Aborted Tows. Catch data not recommended for use.

Table 4. Sub-standard tows (SHG 141-166) for cruise 202291. Not advised for indices of abundacnce other than Spiny Dogfish.

Station	Stratum	SHG	Location	Description
No sub-standard tows on cruise 202291				

Table 5. Aborted tows during the spring survey, cruise 202291.

Station	Stratum	SHG	Location	Description
22	35	179	Central Mass Bay	belly blown out of net
28	32	177	East of Nahant	large ball of rope in net
30	32	179	East of Nahant	caught rock in net tore codend
31	32	179	Nahant Bay	ball of clay ripped port wing
44	30	173	NE of Provincetown	hauled early due to sign on sounder
56	15	171	Nantucket Bight	hauled early due to hard hit on port wire
83	16	178	Nantucket Sound	released large catch of scup could not bring aboard
84	16	178	Nantucket Sound	released large catch of scup could not bring aboard
110	33	179	Mass Bay	took hit and slowed a bit, torn belly
111	16	178	Nantucket Sound	released large catch of scup could not bring aboard

Table 6a. Total catch by number and weight from 2022 spring survey sorted by number.

Species Code	Common Name	Count	Weight (kg)
143	SCUP	37,212	6,679.693
106	WINTER FLOUNDER	5,390	811.933
163	LONGHORN SCULPIN	4,722	652.086
503	LONGFIN SQUID	3,985	81.929
105	YELLOWTAIL FLOUNDER	3,328	651.020
171	NORTHERN SEAROBIN	3,301	700.146
72	SILVER HAKE	2,975	315.535
77	RED HAKE	2,049	223.374
181	NORTHERN SAND LANCE	1,806	13.133
74	HADDOCK	1,296	227.746
301	AMERICAN LOBSTER	982	317.937
102	AMERICAN PLAICE	664	82.688
131	BUTTERFISH	642	29.966
26	LITTLE SKATE	562	282.234
33	ALEWIFE	524	23.699
141	BLACK SEA BASS	505	169.247
193	OCEAN POUT	456	120.585
73	ATLANTIC COD	455	138.436
32	ATLANTIC HERRING	434	7.618
108	WINDOWPANE	416	87.218
317	SPIDER CRAB UNCL	379	50.005
313	ATLANTIC ROCK CRAB	367	48.158
78	SPOTTED HAKE	273	5.278
177	TAUTOG	220	164.272
23	WINTER SKATE	189	151.368
103	SUMMER FLOUNDER	181	91.741
104	FOURSPOT FLOUNDER	159	30.184
401	SEA SCALLOP	82	2.386
35	AMERICAN SHAD	61	3.746
155	ACADIAN REDFISH	59	6.247
176	CUNNER	55	9.365
343	BLUE MUSSEL	53	2.902
117	SMALLMOUTH FLOUNDER	37	0.408
348	NORTHERN MOONSNAIL	35	6.124
172	STRIPED SEAROBIN	34	12.044
318	HORSESHOE CRAB	33	31.386
164	SEA RAVEN	32	15.311
312	JONAH CRAB	25	3.029
197	GOOSEFISH	24	11.876
13	SMOOTH DOGFISH	24	63.821
182	SNAKEBLENNY	21	0.871
75	POLLOCK	14	1.544
34	BLUEBACK HERRING	12	0.515
336	CHANNELED WHELK	10	1.801
139	STRIPED BASS	9	18.734

Figure 6a continued.

Species Code	Common Name	Count	Weight (kg)
337	KNOBBED WHELK	7	1.375
76	WHITE HAKE	7	1.526
322	LADY CRAB	6	0.580
83	FOURBEARD ROCKLING	6	0.537
146	NORTHERN KINGFISH	4	0.764
314	BLUE CRAB	4	0.563
121	ATLANTIC MACKEREL	4	0.445
180	ROCK GUNNEL	3	0.046
162	SHORTHORN SCULPIN	3	1.612
323	MANTIS SHRIMP UNCL	3	0.146
45	RAINBOW SMELT	3	0.090
36	ATLANTIC MENHADEN	3	0.813
24	CLEARNOSE SKATE	2	3.101
183	DAUBED SHANNY	2	0.028
149	SPOT	1	0.756
107	WITCH FLOUNDER	1	0.265
43	BAY ANCHOVY	1	0.007
101	ATLANTIC HALIBUT	1	0.096
191	WRYMOUTH	1	0.114
145	WEAKFISH	1	0.553
116	NORTHERN PIPEFISH	1	0.011
109	GULF STREAM FLOUNDER	1	0.053
403	ATLANTIC SURFCLAM	1	0.033
Totals		74,158	12,362.853

Table 6b. Total catch by number and weight from 2022 spring survey sorted by weight.

SPP CODE	COMMON NAME	COUNT	WEIGHT(kg)
143	SCUP	37,212	6,679.693
106	WINTER FLOUNDER	5,390	811.933
171	NORTHERN SEAROBIN	3,301	700.146
163	LONGHORN SCULPIN	4,722	652.086
105	YELLOWTAIL FLOUNDER	3,328	651.020
301	AMERICAN LOBSTER	982	317.937
72	SILVER HAKE	2,975	315.535
26	LITTLE SKATE	562	282.234
74	HADDOCK	1,296	227.746
77	RED HAKE	2,049	223.374
141	BLACK SEA BASS	505	169.247
177	TAUTOG	220	164.272
23	WINTER SKATE	189	151.368
73	ATLANTIC COD	455	138.436
193	OCEAN POUT	456	120.585
103	SUMMER FLOUNDER	181	91.741
108	WINDOWPANE	416	87.218
102	AMERICAN PLAICE	664	82.688
503	LONGFIN SQUID	3,985	81.929
13	SMOOTH DOGFISH	24	63.821
317	SPIDER CRAB UNCL	379	50.005
313	ATLANTIC ROCK CRAB	367	48.158
318	HORSESHOE CRAB	33	31.386
104	FOURSPOT FLOUNDER	159	30.184
131	BUTTERFISH	642	29.966
33	ALEWIFE	524	23.699
139	STRIPED BASS	9	18.734
164	SEA RAVEN	32	15.311
181	NORTHERN SAND LANCE	1,806	13.133
172	STRIPED SEAROBIN	34	12.044
197	GOOSEFISH	24	11.876
176	CUNNER	55	9.365
32	ATLANTIC HERRING	434	7.618
155	ACADIAN REDFISH	59	6.247
348	NORTHERN MOONSNAIL	35	6.124
78	SPOTTED HAKE	273	5.278
35	AMERICAN SHAD	61	3.746
24	CLEARNOSE SKATE	2	3.101
312	JONAH CRAB	25	3.029
343	BLUE MUSSEL	53	2.902
401	SEA SCALLOP	82	2.386
336	CHANNELED WHELK	10	1.801
162	SHORTHORN SCULPIN	3	1.612

Table 6b continued.

SPP CODE	COMMON NAME	COUNT	WEIGHT(kg)
75	POLLOCK	14	1.544
76	WHITE HAKE	7	1.526
337	KNOBBED WHELK	7	1.375
182	SNAKEBLENNY	21	0.871
36	ATLANTIC MENHADEN	3	0.813
146	NORTHERN KINGFISH	4	0.764
149	SPOT	1	0.756
322	LADY CRAB	6	0.580
314	BLUE CRAB	4	0.563
145	WEAKFISH	1	0.553
83	FOURBEARD ROCKLING	6	0.537
34	BLUEBACK HERRING	12	0.515
121	ATLANTIC MACKEREL	4	0.445
117	SMALLMOUTH FLOUNDER	37	0.408
107	WITCH FLOUNDER	1	0.265
323	MANTIS SHRIMP UNCL	3	0.146
191	WRYMOUTH	1	0.114
101	ATLANTIC HALIBUT	1	0.096
45	RAINBOW SMELT	3	0.090
109	GULF STREAM FLOUNDER	1	0.053
180	ROCK GUNNEL	3	0.046
403	ATLANTIC SURFCLAM	1	0.033
183	DAUBED SHANNY	2	0.028
116	NORTHERN PIPEFISH	1	0.011
43	BAY ANCHOVY	1	0.007
Totals		74,158	12,362.853

Table 7. Total samples obtained for age, growth, maturity, and special studies during MDMF spring cruise 202291.

Species	Maturity Observation	Age and Growth Collection Scales	Otoliths	YOY
Atlantic Cod	80		80	1
Haddock	49		49	
Summer Flounder	74		74	
Yellowtail Flounder	201		201	
Winter Flounder	486		487	
Black Sea Bass	168		168	
Scup	135		135	
Weakfish	1		1	
Tautog	7		7	
American Lobster	411			
TOTAL	1,612	0	1,202	1

OTHER COLLECTIONS:

All jonah crabs measured to 0.1 cm carapace width and egg bearing female crabs status recorded for size at maturity study (Perry)
Atlantic Herring were saved for a UMASS Dartmouth graduate student (J. Warren)
Various fish species were saved for ichthyology class identification UMASS Amherst (A. Jordaan)
Winter Flounder fin clips were taken for UMASS Boston graduate student (K. Zarella-Smith)
Longfin squid were saved for Black Sea Bass rod and reel sampling (Glenn)
Various New England groundfish species for UMASS Dartmouth technician (C. Rillihan)
Water samples collected for eDNA analysis (GMGI)

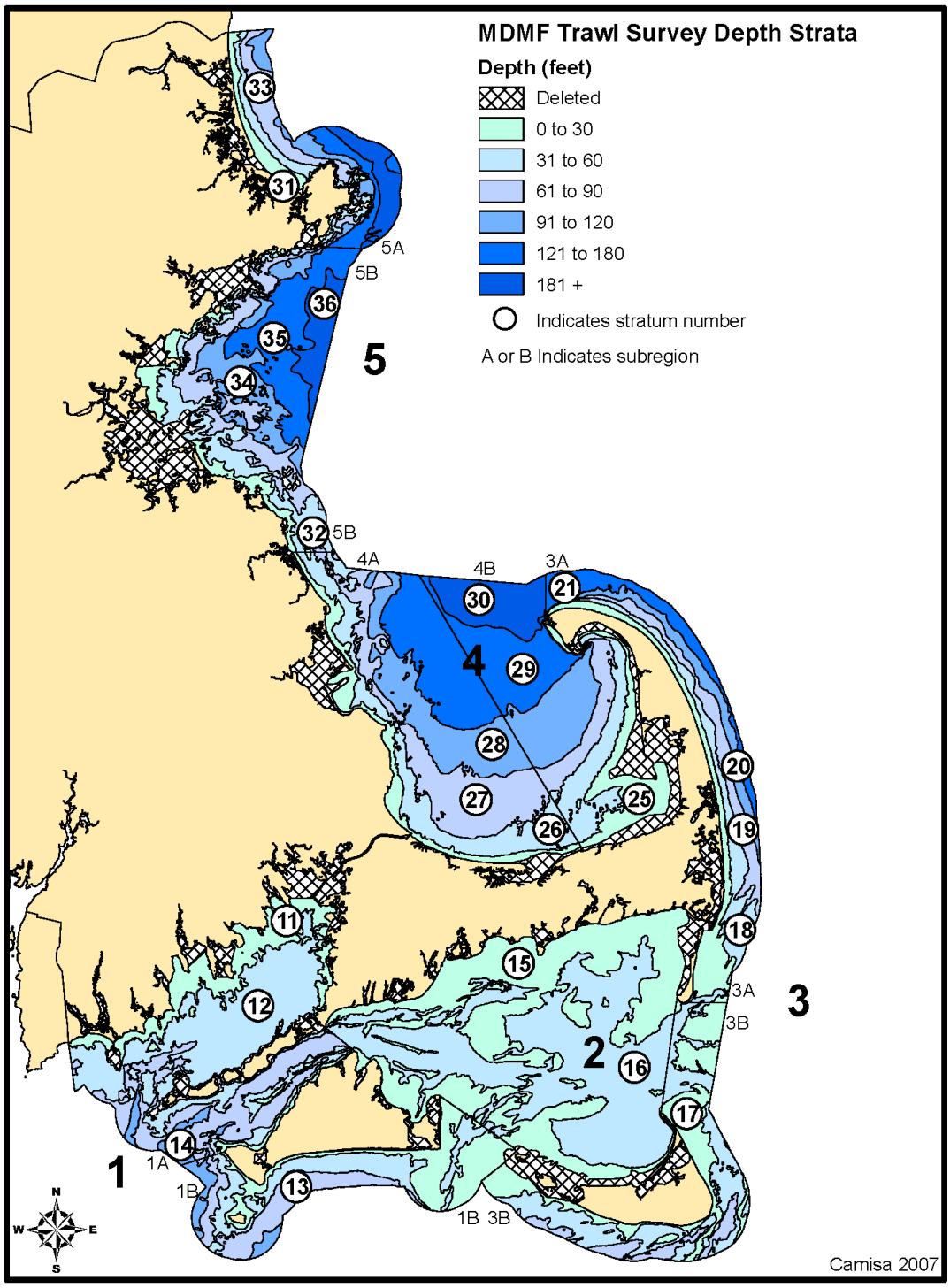


Figure 1. MDMF inshore bottom trawl survey region and strata map.

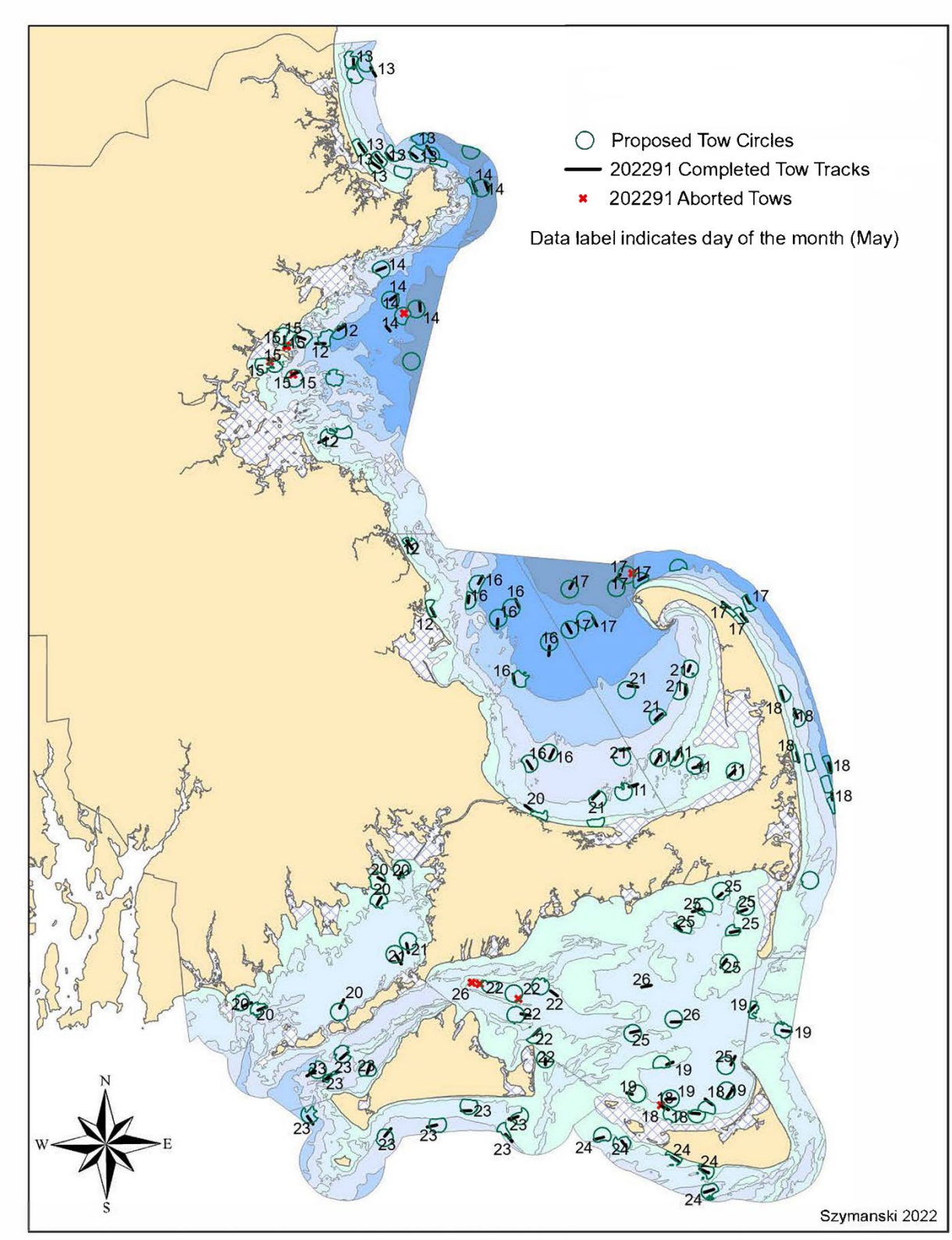


Figure 2. All proposed spring 2022 stations including completed and aborted tows by date.

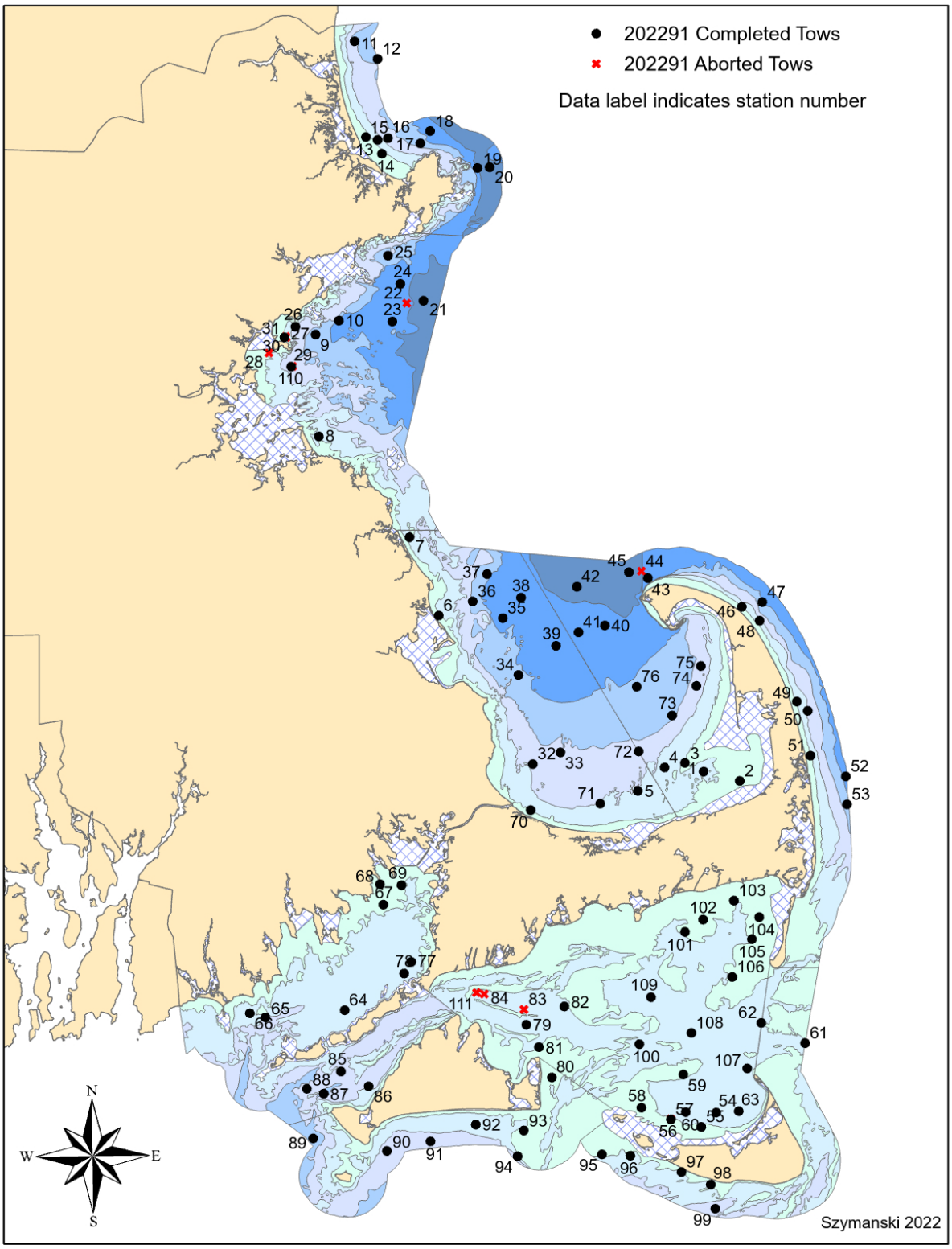


Figure 3. All attempted spring 2022 survey stations in chronological order.

Spring Cruise 202291

CRUISE RESULTS

R/V GLORIA MICHELLE

2022 Massachusetts Inshore Fall
Bottom Trawl Survey
Cruise No. 202292

CRUISE PERIOD AND AREA

From September 6 through September 22, 2022 the Massachusetts Division of Marine Fisheries conducted its 44th fall bottom trawl survey. The survey extended from New Hampshire to Rhode Island boundaries seaward to three nautical miles including Cape Cod Bay and Nantucket Sound.

OBJECTIVES

Cruise objectives were 1) to determine the fall distribution, relative abundance, and size composition of fish and select invertebrate species; and 2) to collect biological samples. Requested special collections were also undertaken.

METHODS

The study area is stratified based on five bio-geographic regions and six depth zones (Fig. 1). Trawl sites are allocated in proportion to stratum area and randomly chosen in advance within each sampling stratum. Randomly chosen stations in locations known to be untowable due to hard bottom are reassigned. Sampling intensity is approximately 1 station per 19 square nautical miles. A minimum of two stations are assigned to each stratum.

A standard tow of 20-minute duration at 2.5 knots was attempted at each station during daylight hours with a 3/4 size North Atlantic type two seam otter trawl (11.9 m headrope/15.5 m footrope) rigged with a 7.6 cm rubber disc sweep; 19.2 m, 9.5 mm chain bottom legs; 18.3 m, 9.5 mm wire top legs; and 1.8 X 1.0 m, 147 kg wooden trawl doors. The codend contains a 6.4 mm knotless liner to retain small fish. Prior to setting the net at each station, NOAA Corps officers surveyed the site by visually scanning for buoys marking fixed gear as well as determining the suitability of the bottom for towing the net based on the sounder image. Whenever necessary, sites were relocated due to untowable bottom or concentrations of fixed gear. Abbreviated tows of 13-19 minute duration were accepted as valid and expanded to the 20 minute standard.

Standard bottom trawl survey techniques were used when processing the catch. The total weight and length-frequency of each species were recorded directly into Fisheries Scientific Computer System (FSCS) data tables. From 2010 through 2018, FSCS version 1.6 was utilized for electronic data collection. Starting in 2019, we upgraded to FSCS version 2.0. Collections of age and growth material, and biological observations were

undertaken during the measuring operation. Specimens were also saved to fulfill requests. Bottom temperatures were continuously recorded with an Onset Water Temp Pro v2 attached to the doors.

To mitigate COVID-19 risks, the survey schedule was modified to reduce the number of crew changes and provide greater flexibility based on weather and survey progress. Thirty-four MADMF employees participated in the survey as part of the scientific party along with three biologists from NOAA, one biologist from Gloucester Marine Genomics Institute, one biologist from University of Massachusetts Amherst, and one biologist from Responsible Offshore Science Alliance (Table 1).

CRUISE SUMMARY

109 stations were attempted in 17 sampling days (Figs 2 and 3, Table 2). One hundred completed stations were considered acceptable for assessment of all species (SHG <=136) an no substandard tows occurred this survey (SHG 141 – 166) (Tables 3 and 4). Two stations in stratum 16 were dropped, one north of Nantucket Harbor due to time constraints and one near Shovelful Shoal due to hard bottom. One station in stratum 15 was dropped due to a large volume of weed/algae. Nine attempted tows were aborted due to fixed gear, hard bottom, net problems, and weed/algae (Table 5, Fig. 3).

The geographic distribution, relative abundance, relative biomass, and representative length frequencies of all fish and invertebrate species were documented (Tables 6a and 6b). Several records were set on the 2022 fall survey at individual stations. The largest biomass of scup (603.8 kg) was recorded at station 100 just north of Nantucket Harbor. At station 81 south of Martha's Vineyard the largest abundance of scup (81,921) was recorded. The largest abundance of silver rag (25) was recorded at station 79 west of Martha's Vineyard.

There were also several species records for all stations combined in the fall of 2022. The highest stratified mean biomass of Scup was observed, which was driven mainly by catch in the deeper strata in Buzzards Bay, Vineyard Sound, and Nantucket Sound. The highest abundance and biomass of Red Hake occurred, driven largely by increases in catch within the Gulf of Maine in the two deepest strata. The lowest mean abundance and biomass of Little Skate occurred with low catches throughout the entire survey. Winter Skate abundance and biomass was low, and they were observed at the lowest percentage of stations in time series history.

There were several other notable species trends observed during this survey. North of Cape Cod tows regularly had moderate catches of Winter Flounder, Yellowtail Flounder, Silver Hake, and Longhorn Sculpin. The two deepest strata in Cape Cod Bay were characterized by record catches of Butterfish. South of Cape Cod was characterized by moderate catches of Longfin Squid and Butterfish. This was the second consecutive fall survey with no lobsters observed in Nantucket Sound, Vineyard Sound and Buzzard's Bay.

Additional sampling goals were achieved (Table 7). To aid cooperative fisheries assessments over 880 otolith samples and over 1,400 sex and maturity observations were

taken from Atlantic Cod, Haddock, Summer Flounder, Yellowtail Flounder, Winter Flounder, Black Sea Bass, Scup, Weakfish, and American Lobster. Additional samples were collected to assist ongoing research by fisheries scientists from MDMF and other labs in the region.

For further information on this survey or others in the time series, contact Steve Wilcox at (508) 742-9731.

Table 1. Staffing list for fall cruise 202292.

Scientific Party

Name	Affiliation	Num. Days
Vincent Manfredi	MADMF	9
Mark Szymanski	MADMF	9
Steve Wilcox	MADMF	9
Brendan Reilly	MADMF	5
Steve Voss	MADMF	5
Ross Kessler	MADMF	4
Amanda Meli	MADMF	4
John Sheppard	MADMF	4
Chrissy Petitpas	MADMF	3
Sam Truesdell	MADMF	3
Justin Wilson	MADMF	3
Julia Kaplan	MADMF	2
Derek Perry	MADMF	2
Forest Schenck	MADMF	2
Sandy Sutherland	NOAA-Woods Hole	2
Mike Blanco	MADMF	1
David Chosid	MADMF	1
Tara Dolan	MADMF	1
Amanda Davis	MADMF	1
Jacob Dorothy	MADMF	1
Kara Duprey	MADMF	1
Scott Elzey	MADMF	1
Kim Fine	MADMF	1
Kate Frew	MADMF	1
Bob Glenn	MADMF	1
Christine Kircum	NOAA-Woods Hole	1
Maggie Leary	MADMF	1
Wendy Mainardi	MADMF	1
Dave Martins	MADMF	1
Carly McCall	GMGI	1
Dan McKiernan	MADMF	1
Kyle Molton	NOAA-Gloucester	1
Mike Pol	ROSA	1
Tracy Pugh	MADMF	1
Mark Rousseau	MADMF	1
Brad Schondelmeier	MADMF	1
Iris Seto	MADMF	1
Jared Silva	MADMF	1
Amber Woolfenden	MADMF	1
Katrina Zarella-Smith	UMASS-Boston	1
Total		91

R/V Gloria Michelle Crew

Name	Affiliation	Num. Days
Officers		
Alex Creed	NOAA OIC	18
Trevor Grams	NOAA JOIC	18
Mike Abbott	NOAA-CORPS (ret)	2
Deck Crew		
Ian Butler	Contract Fisherman	17
Troy Dwyer	Contract Fisherman	15

Table 2. Station information for the fall cruise 202292.

Station	Stratum	Date	Time (est)	Depth (m)	Latitude	Longitude	Course	Distance (nmi)	Bottom temp °C
1	28	9/6/2022	7:33	36	41°56.79	-70°29.08	99	0.56	9.7
2	28	9/6/2022	8:58	31	41°57.85	-70°32.10	100	0.80	10.2
3	29	9/6/2022	10:44	44	41°57.78	-70°24.06	204	0.85	9.3
4	28	9/6/2022	12:10	35	41°54.97	-70°21.26	118	0.86	10.1
5	28	9/6/2022	13:25	31	41°53.68	-70°16.33	25	0.85	10.3
6	27	9/6/2022	14:58	23	41°49.41	-70°22.94	43	0.84	11.0
7	26	9/6/2022	16:28	17	41°45.44	-70°21.57	294	0.82	13.2
8	25	9/6/2022	17:33	12	41°44.82	-70°22.73	124	0.84	14.0
9	25	9/7/2022	6:32	11	41°44.70	-70°20.28	103	0.83	13.9
10	27	9/7/2022	7:52	24	41°47.99	-70°18.93	77	0.82	11.6
11	26	9/7/2022	9:12	18	41°47.73	-70°14.57	84	0.84	12.4
12	25	9/7/2022	10:48	10	41°49.61	-70°06.57	130	0.77	17.7
13	26	9/7/2022	12:44	14	41°50.18	-70°11.76	42	0.54	11.8
14	27	9/7/2022	13:36	24	41°51.76	-70°13.31	57	0.83	10.7
15	25	9/7/2022	15:15	8	41°55.76	-70°06.03	28	0.84	12.9
16	26	9/7/2022	16:22	13	41°53.34	-70°08.67	52	0.82	11.2
17	26	9/8/2022	5:47	16	41°47.61	-70°28.33	19	0.85	13.1
18	29	9/8/2022	8:49	53	42°05.27	-70°28.31	17	0.85	9.0
19	27	9/8/2022	10:35	30	42°05.19	-70°34.18	346	0.55	12.5
20	32	9/8/2022	13:10	14	42°17.40	-70°49.39	130	0.55	17.8
21	32	9/8/2022	14:10	15	42°18.01	-70°50.28	86	0.84	17.7
22	35	9/8/2022	15:59	52	42°22.54	-70°42.07	46	0.51	10.1
23	33	9/9/2022	6:37	23	42°23.59	-70°54.60	77	0.82	14.9
24	33	9/9/2022	7:53	23	42°27.05	-70°53.23	133	0.87	14.9
25	31	9/9/2022	9:09	10	42°26.21	-70°55.14	31	0.81	18.6
26	32	9/9/2022	9:59	16	42°26.22	-70°54.59	29	0.53	16.7
27	35	9/9/2022	11:30	40	42°27.27	-70°49.25	65	0.55	10.9
28	34	9/9/2022	13:07	30	42°26.57	-70°51.83	164	0.49	13.0
29	34	9/9/2022	13:48	28	42°26.53	-70°51.97	132	0.54	13.0
30	36	9/9/2022	16:21	68	42°29.88	-70°38.47	77	0.39	8.4
31	36	9/9/2022	17:34	61	42°31.53	-70°38.22	64	0.06	
32	34	9/10/2022	6:15	30	42°41.34	-70°35.50	340	0.83	11.8
33	34	9/10/2022	7:25	32	42°43.25	-70°40.99	165	0.85	11.8
34	33	9/10/2022	8:43	25	42°45.97	-70°45.42	164	0.86	13.8
35	32	9/10/2022	9:42	13	42°42.95	-70°44.83	346	0.72	17.0
36	31	9/10/2022	10:29	9	42°43.00	-70°45.56	348	0.83	17.7
37	31	9/10/2022	11:28	9	42°41.39	-70°43.70	330	0.73	17.4
38	33	9/10/2022	13:13	22	42°43.35	-70°43.92	136	0.84	13.6
39	35	9/10/2022	14:44	49	42°43.51	-70°37.08	330	0.80	10.6
40	36	9/11/2022	8:15	64	42°43.69	-70°36.23	339	0.81	9.4
41	35	9/11/2022	9:32	48	42°42.01	-70°34.84	319	0.51	10.5
42	36	9/11/2022	10:31	79	42°42.36	-70°33.15	338	0.83	8.7

Table 2 continued.

Station	Stratum	Date	Time (est)	Depth (m)	Latitude	Longitude	Course	Distance (nmi)	Bottom temp °C
43	35	9/11/2022	13:22	57	42°30.07	-70°42.07	327	0.66	10.2
44	34	9/12/2022	7:40	37	42°18.46	-70°43.19	357	0.82	10.5
45	30	9/12/2022	10:46	61	42°06.12	-70°24.92	19	0.84	9.1
46	29	9/12/2022	12:02	58	42°06.00	-70°27.11	345	0.85	9.4
47	29	9/12/2022	13:35	55	42°02.46	-70°21.74	358	0.85	9.6
48	29	9/12/2022	14:40	53	42°03.12	-70°25.78	99	0.83	9.6
49	28	9/13/2022	7:12	34	41°56.97	-70°14.29	241	0.86	11.2
50	27	9/13/2022	8:41	27	41°56.94	-70°09.23	42	0.82	12.9
51	30	9/13/2022	11:08	58	42°02.61	-70°16.63	21	0.82	9.7
52	21	9/13/2022	12:33	65	42°05.75	-70°13.72	79	0.85	10.9
53	21	9/13/2022	13:32	63	42°07.59	-70°10.58	266	0.83	11.0
54	18	9/13/2022	15:04	15	42°04.61	-70°06.47	325	0.84	17.8
55	20	9/13/2022	16:21	36	42°03.12	-70°00.91	333	0.81	11.9
56	17	9/14/2022	5:44	9	41°50.33	-69°56.04	353	0.83	16.0
57	20	9/14/2022	7:06	34	41°46.34	-69°52.03	7	0.86	12.5
58	19	9/14/2022	8:36	21	41°42.93	-69°52.48	228	0.84	14.3
59	18	9/14/2022	10:07	12	41°37.02	-69°54.15	206	0.85	15.6
60	17	9/14/2022	11:07	10	41°36.35	-69°56.03	244	0.84	16.9
61	17	9/14/2022	13:30	13	41°27.27	-70°00.68	26	0.84	20.2
62	17	9/14/2022	15:21	10	41°22.37	-69°59.37	11	0.64	21.2
63	18	9/15/2022	7:26	18	41°13.02	-70°04.76	77	0.53	21.1
64	19	9/15/2022	8:29	23	41°12.44	-70°09.69	103	0.84	20.7
65	18	9/15/2022	9:55	14	41°14.97	-70°12.81	313	0.83	20.6
66	18	9/15/2022	10:54	14	41°15.57	-70°14.89	299	0.83	20.2
67	17	9/15/2022	11:48	9	41°17.81	-70°17.82	156	0.86	20.2
68	11	9/15/2022	14:11	9	41°19.2	-70°28.61	269	0.85	19.6
69	12	9/16/2022	5:45	14	41°30.25	-70°45.86	344	0.84	21.7
70	12	9/16/2022	6:48	17	41°29.66	-70°51.47	66	0.66	20.9
71	13	9/16/2022	7:44	22	41°29.49	-70°54.35	86	0.66	21.2
72	12	9/16/2022	9:00	15	41°28.88	-71°00.35	83	0.86	21.0
73	11	9/16/2022	10:35	10	41°34.88	-70°54.06	201	0.55	21.6
75	11	9/16/2022	12:07	7	41°36.54	-70°49.03	155	0.86	21.9
76	11	9/16/2022	13:34	8	41°38.47	-70°42.72	343	0.31	22.2
77	11	9/16/2022	14:10	8	41°38.91	-70°43.77	62	0.82	22.3
78	12	9/16/2022	15:32	14	41°32.93	-70°42.49	11	0.86	21.9
79	14	9/17/2022	7:17	33	41°19.48	-70°54.05	136	0.85	19.0
80	12	9/17/2022	8:25	16	41°18.94	-70°49.71	160	0.84	20.0
81	13	9/17/2022	9:58	23	41°18.08	-70°39.67	267	0.88	18.3
82	11	9/17/2022	11:04	10	41°20.42	-70°40.69	285	0.84	19.4
83	13	9/17/2022	12:45	27	41°18.91	-70°51.00	174	0.84	20.2
84	14	9/17/2022	14:29	30	41°22.41	-70°54.88	227	0.82	17.8
85	13	9/17/2022	15:30	23	41°24.32	-70°53.49	257	0.84	19.7

Table 2 continued.

Station	Stratum	Date	Time (est)	Depth (m)	Latitude	Longitude	Course	Distance (nmi)	Bottom temp °C
86	15	9/18/2022	6:27	8	41°26.46	-70°29.02	272	0.05	
87	15	9/18/2022	6:43	8	41°26.44	-70°29.18	269	0.84	21.5
88	15	9/18/2022	7:45	9	41°24.19	-70°28.81	37	0.62	21.1
89	15	9/18/2022	9:08	7	41°25.33	-70°25.72	17	0.85	21.4
90	12	9/18/2022	10:28	12	41°23.36	-70°24.26	207	0.51	21.1
91	16	9/18/2022	11:54	19	41°26.42	-70°22.27	311	0.51	21.7
92	15	9/18/2022	14:53	8	41°31.98	-70°34.81	292	0.82	21.8
93	16	9/19/2022	8:28	15	41°23.44	-70°17.17	70	0.24	20.6
94	15	9/19/2022	10:36	10	41°21.02	-70°14.88	105	0.72	21.1
95	16	9/19/2022	11:53	13	41°19.83	-70°08.71	91	0.85	21.5
96	16	9/19/2022	12:40	15	41°21.74	-70°07.26	193	0.86	21.6
97	16	9/19/2022	13:31	12	41°22.11	-70°05.44	233	0.86	21.5
98	16	9/20/2022	13:40	14	41°29.21	-70°12.70	219	0.84	21.6
99	16	9/20/2022	14:52	16	41°30.45	-70°13.88	278	0.82	21.7
100	15	9/20/2022	17:21	9	41°19.10	-70°07.07	275	0.85	21.2
101	15	9/21/2022	6:59	9	41°36.77	-70°02.49	260	0.85	20.5
102	15	9/21/2022	8:30	9	41°32.35	-70°12.59	78	0.85	21.6
103	16	9/21/2022	9:35	13	41°31.49	-70°16.78	93	0.54	21.6
104	15	9/21/2022	10:48	7	41°31.72	-70°21.32	107	0.56	21.7
105	16	9/21/2022	12:14	17	41°29.96	-70°18.18	101	0.54	21.6
106	16	9/21/2022	13:18	11	41°32.82	-70°14.89	121	0.88	21.7
107	15	9/21/2022	15:03	7	41°34.68	-70°23.94	84	0.87	21.7
108	12	9/22/2022	7:04	19	41°22.33	-70°46.42	230	0.86	20.0
109	13	9/22/2022	8:34	26	41°23.12	-70°52.26	228	0.84	19.3

Table 3. Sampling effort assigned and accomplished by stratum, cruise 202292.

Stratum	Region	Assigned Stations	Number of Stations Completed			Aborted Tows
			All Accepted	Sub-Standard	Standard	
11	1	5	5		5	1
12	1	7	7		7	
13	1	5	5		5	
14	1	2	2		2	
15	2	10	9		9	2
16	2	11	9		9	1
17	3	5	5		5	
18	3	5	5		5	
19	3	2	2		2	
20	3	2	2		2	
21	3	2	2		2	
25	4	4	4		4	
26	4	5	5		5	
27	4	5	5		5	
28	4	5	5		5	
29	4	5	5		5	
30	4	2	2		2	
31	5	3	3		3	
32	5	3	3		3	1
33	5	4	4		4	
34	5	4	4		4	1
35	5	5	5		5	
36	5	2	2		2	2
TOTALS		103	100	0	100	8

Note:
Standard Tows. SHG <=136. Recommended for use in all indices of abundance.
Sub-Standard Tows. SHG 141 - 166. Not recommended for use in indices other than spiny dogfish.
Aborted Tows. Catch data not recommended for use.

Table 4. Sub-standard tows (SHG 141-166) for cruise 202292. Not advised for indices of abundacnce other than Spiny Dogfish.

Station	Stratum	SHG	Location	Description
No sub-standard tows on cruise 202292				

Table 5. Aborted tows during the fall survey, cruise 202292.

Station	Stratum	SHG	Location	Description
20	32	179	East of Nantasket Beach	Rock went through codend
28	34	173	East of Nahant	Fixed Gear Interaction
30	36	176	Outer Massachusetts Bay	Fixed Gear Interaction
31	36	173	Outer Massachusetts Bay	Hangset
76	11	171	Upper Buzzards Bay	Hard hit after 7mins towing
86	15	171	Edgartown Harbor entrance	Hangset
93	16	179	Shoveful Shoal off Nantucket	Hard hit after 7mins towing
104	15	172	Horseshoe Shoal	Large catch of Weed/Algae

Table 6a. Total catch by number and weight from 2022 fall survey sorted by number.

Species Code	Common Name	Count	Weight (kg)
143	SCUP	360,635	3,759.130
503	LONGFIN SQUID	45,064	314.294
131	BUTTERFISH	32,631	777.301
43	BAY ANCHOVY	26,581	28.292
141	BLACK SEA BASS	10,727	68.493
77	RED HAKE	7,514	1,120.763
72	SILVER HAKE	5,128	479.934
106	WINTER FLOUNDER	4,694	936.468
163	LONGHORN SCULPIN	1,418	178.760
105	YELLOWTAIL FLOUNDER	1,390	272.968
181	NORTHERN SAND LANCE	1,269	4.927
301	AMERICAN LOBSTER	1,213	456.662
74	HADDOCK	896	140.678
322	LADY CRAB	791	54.083
211	ROUND SCAD	749	4.194
313	ATLANTIC ROCK CRAB	602	46.346
317	SPIDER CRAB UNCL	567	9.285
26	LITTLE SKATE	546	302.939
401	SEA SCALLOP	523	20.593
343	BLUE MUSSEL	432	4.168
108	WINDOWPANE	297	66.440
13	SMOOTH DOGFISH	261	319.067
135	BLUEFISH	243	3.884
23	WINTER SKATE	185	247.966
103	SUMMER FLOUNDER	180	122.057
193	OCEAN POUT	173	25.365
104	FOURSPOT FLOUNDER	151	25.843
171	NORTHERN SEAROBIN	131	9.519
102	AMERICAN PLAICE	121	18.326
145	WEAKFISH	97	6.318
117	SMALLMOUTH FLOUNDER	86	1.083
132	ATLANTIC MOONFISH	85	0.486
78	SPOTTED HAKE	83	8.619
33	ALEWIFE	80	3.473
176	CUNNER	73	3.736
15	SPINY DOGFISH	70	122.747
116	NORTHERN PIPEFISH	68	0.248
146	NORTHERN KINGFISH	54	7.430
107	WITCH FLOUNDER	54	12.791
312	JONAH CRAB	51	10.848
164	SEA RAVEN	50	23.227
32	ATLANTIC HERRING	40	5.264
177	TAUTOG	39	16.111
155	ACADIAN REDFISH	35	1.539
196	NORTHERN PUFFER	32	1.256
213	SILVER RAG	28	0.455

Table 6a continued.

Species Code	Common Name	Count	Weight (kg)
435	INSHORE LIZARDFISH	28	0.446
172	STRIPED SEAROBIN	20	8.551
197	GOOSEFISH	19	3.368
318	HORSESHOE CRAB	16	19.893
35	AMERICAN SHAD	16	0.365
36	ATLANTIC MENHADEN	14	4.269
212	ROUGH SCAD	8	0.317
348	NORTHERN MOONSNAIL	8	1.311
73	ATLANTIC COD	8	9.688
76	WHITE HAKE	6	0.790
34	BLUEBACK HERRING	6	0.099
556	GLASSEYE SNAPPER	5	0.178
208	MACKEREL SCAD	5	0.059
120	BLUESPOTTED CORNETFISH	4	0.098
694	NORTHERN SENNET	4	0.772
657	DWARF GOATFISH	4	0.100
139	STRIPED BASS	4	12.837
45	RAINBOW SMELT	3	0.093
403	ATLANTIC SURFCLAM	3	0.796
337	KNOBBED WHELK	3	0.600
314	BLUE CRAB	3	0.609
109	GULF STREAM FLOUNDER	3	0.108
24	CLEARNOSE SKATE	3	3.408
201	PLANEHEAD FILEFISH	2	0.071
439	SNAKEFISH	2	0.031
502	NORTHERN SHORTFIN SQUID	2	0.373
180	ROCK GUNNEL	2	0.037
568	AFRICAN POMPANO	2	0.217
209	BIGEYE SCAD	2	0.103
203	GREATER AMBERJACK	1	0.349
185	OYSTER TOADFISH	1	0.924
409	OCEAN QUAHOG	1	0.021
162	SHORTHORN SCULPIN	1	0.349
118	HOGCHOKER	1	0.241
195	SMOOTH PUFFER	1	0.067
166	GRUBBY	1	0.029
83	FOURBEARD ROCKLING	1	0.019
204	BANDED RUDDERFISH	1	0.191
165	ALLIGATORFISH	1	0.010
37	HICKORY SHAD	1	0.146
75	POLLOCK	1	0.075
129	BLUE RUNNER	1	0.056
336	CHANNELED WHELK	1	0.046
121	ATLANTIC MACKEREL	1	0.240
202	GRAY TRIGGERFISH	1	0.057
Totals		506,358	10,116.783

Table 6b. Total catch by number and weight from 2022 fall survey sorted by weight.

Species Code	Common Name	Count	Weight (kg)
143	SCUP	360,635	3,759.130
77	RED HAKE	7,514	1,120.763
106	WINTER FLOUNDER	4,694	936.468
131	BUTTERFISH	32,631	777.301
72	SILVER HAKE	5,128	479.934
301	AMERICAN LOBSTER	1,213	456.662
13	SMOOTH DOGFISH	261	319.067
503	LONGFIN SQUID	45,064	314.294
26	LITTLE SKATE	546	302.939
105	YELLOWTAIL FLOUNDER	1,390	272.968
23	WINTER SKATE	185	247.966
163	LONGHORN SCULPIN	1,418	178.760
74	HADDOCK	896	140.678
15	SPINY DOGFISH	70	122.747
103	SUMMER FLOUNDER	180	122.057
141	BLACK SEA BASS	10,727	68.493
108	WINDOWPANE	297	66.440
322	LADY CRAB	791	54.083
313	ATLANTIC ROCK CRAB	602	46.346
43	BAY ANCHOVY	26,581	28.292
104	FOURSPOT FLOUNDER	151	25.843
193	OCEAN POUT	173	25.365
164	SEA RAVEN	50	23.227
401	SEA SCALLOP	523	20.593
318	HORSESHOE CRAB	16	19.893
102	AMERICAN PLAICE	121	18.326
177	TAUTOG	39	16.111
139	STRIPED BASS	4	12.837
107	WITCH FLOUNDER	54	12.791
312	JONAH CRAB	51	10.848
73	ATLANTIC COD	8	9.688
171	NORTHERN SEAROBIN	131	9.519
317	SPIDER CRAB UNCL	567	9.285
78	SPOTTED HAKE	83	8.619
172	STRIPED SEAROBIN	20	8.551
146	NORTHERN KINGFISH	54	7.430
145	WEAKFISH	97	6.318
32	ATLANTIC HERRING	40	5.264
181	NORTHERN SAND LANCE	1,269	4.927
36	ATLANTIC MENHADEN	14	4.269
211	ROUND SCAD	749	4.194
343	BLUE MUSSEL	432	4.168
135	BLUEFISH	243	3.884
176	CUNNER	73	3.736
33	ALEWIFE	80	3.473
24	CLEARNOSE SKATE	3	3.408

Table 6b continued.

Species Code	Common Name	Count	Weight (kg)
197	GOOSEFISH	19	3.368
155	ACADIAN REDFISH	35	1.539
348	NORTHERN MOONSNAIL	8	1.311
196	NORTHERN PUFFER	32	1.256
117	SMALLMOUTH FLOUNDER	86	1.083
185	OYSTER TOADFISH	1	0.924
403	ATLANTIC SURFCLAM	3	0.796
76	WHITE HAKE	6	0.790
694	NORTHERN SENNET	4	0.772
314	BLUE CRAB	3	0.609
337	KNOBBED WHELK	3	0.600
132	ATLANTIC MOONFISH	85	0.486
213	SILVER RAG	28	0.455
435	INSHORE LIZARDFISH	28	0.446
502	NORTHERN SHORTFIN SQUID	2	0.373
35	AMERICAN SHAD	16	0.365
203	GREATER AMBERJACK	1	0.349
162	SHORTHORN SCULPIN	1	0.349
212	ROUGH SCAD	8	0.317
116	NORTHERN PIPEFISH	68	0.248
118	HOGCHOKER	1	0.241
121	ATLANTIC MACKEREL	1	0.240
568	AFRICAN POMPANO	2	0.217
204	BANDED RUDDERFISH	1	0.191
556	GLASSEYE SNAPPER	5	0.178
37	HICKORY SHAD	1	0.146
109	GULF STREAM FLOUNDER	3	0.108
209	BIGEYE SCAD	2	0.103
657	DWARF GOATFISH	4	0.100
34	BLUEBACK HERRING	6	0.099
120	BLUESPOTTED CORNETFISH	4	0.098
45	RAINBOW SMELT	3	0.093
75	POLLOCK	1	0.075
201	PLANEHEAD FILEFISH	2	0.071
195	SMOOTH PUFFER	1	0.067
208	MACKEREL SCAD	5	0.059
202	GRAY TRIGGERFISH	1	0.057
129	BLUE RUNNER	1	0.056
336	CHANNELED WHELK	1	0.046
180	ROCK GUNNEL	2	0.037
439	SNAKEFISH	2	0.031
166	GRUBBY	1	0.029
409	OCEAN QUAHOG	1	0.021
83	FOURBEARD ROCKLING	1	0.019
165	ALLIGATORFISH	1	0.010
Totals		506,358	10,116.783

Table 7. Total samples obtained for age, growth, maturity, and special studies during MDMF fall cruise 202292.

Species	Maturity Observation	Age and Growth Collection Scales	Otoliths	YOY
Atlantic Cod	6		6	
Haddock	35		35	
Summer Flounder	127		127	
Yellowtail Flounder	203		203	
Winter Flounder	364		364	
Black Sea Bass	75		75	
Scup	63		63	
Weakfish	16		16	
American Lobster	550			
TOTAL	1,439	0	889	0

OTHER COLLECTIONS:

All jonah crabs measured to 0.1 cm carapace width and egg bearing female crabs status recorded for size at maturity study (Perry).
Sea herring saved for an energetics study (Warren).
Longfin squid were saved for Black Sea Bass rod and reel sampling (Glenn).
Assorted species saved for Umass fisheries lab (Jordaan).
Water samples collected for eDNA analysis (GMGI)

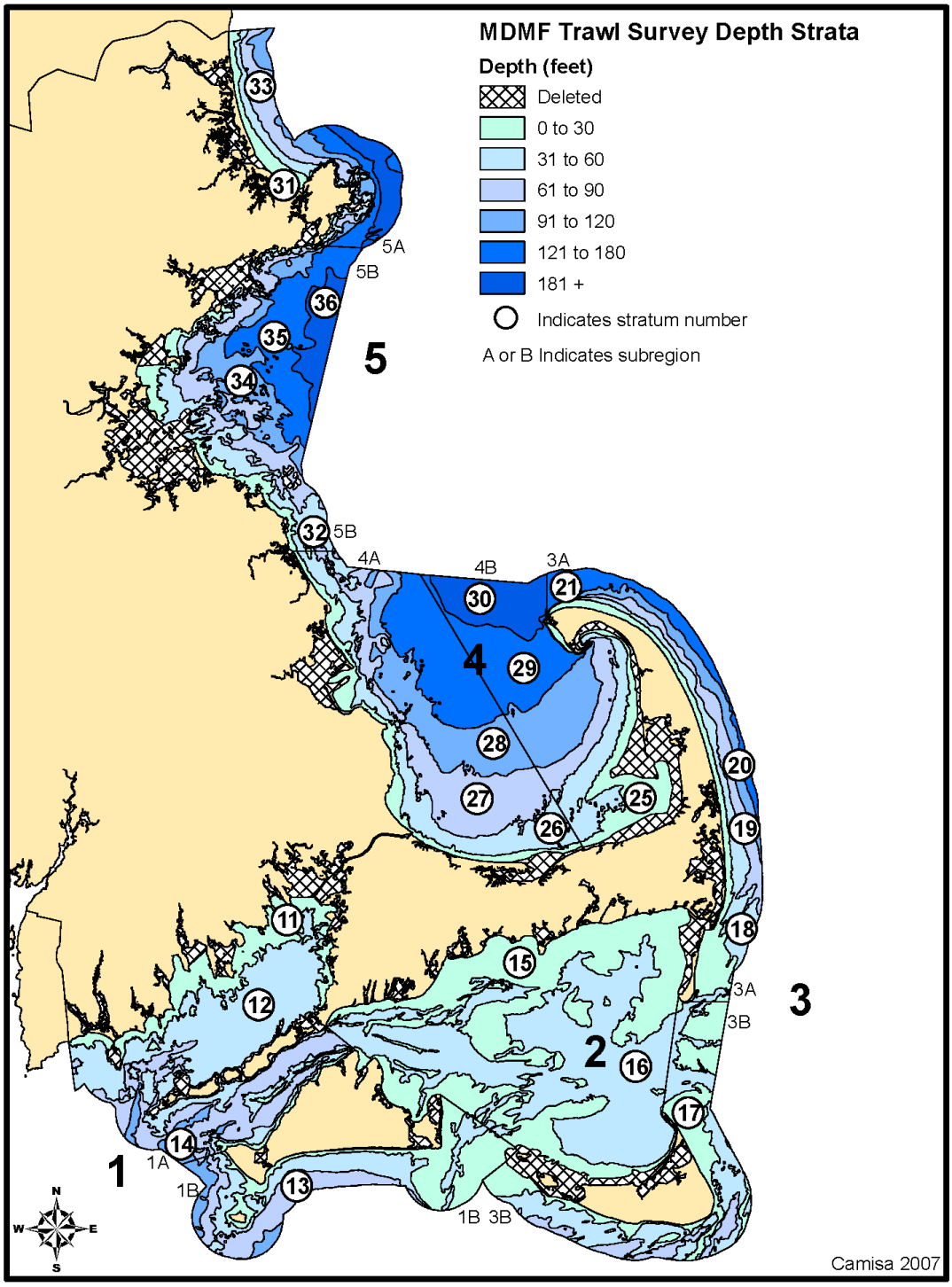


Figure 1. MDMF inshore bottom trawl survey region and strata map.

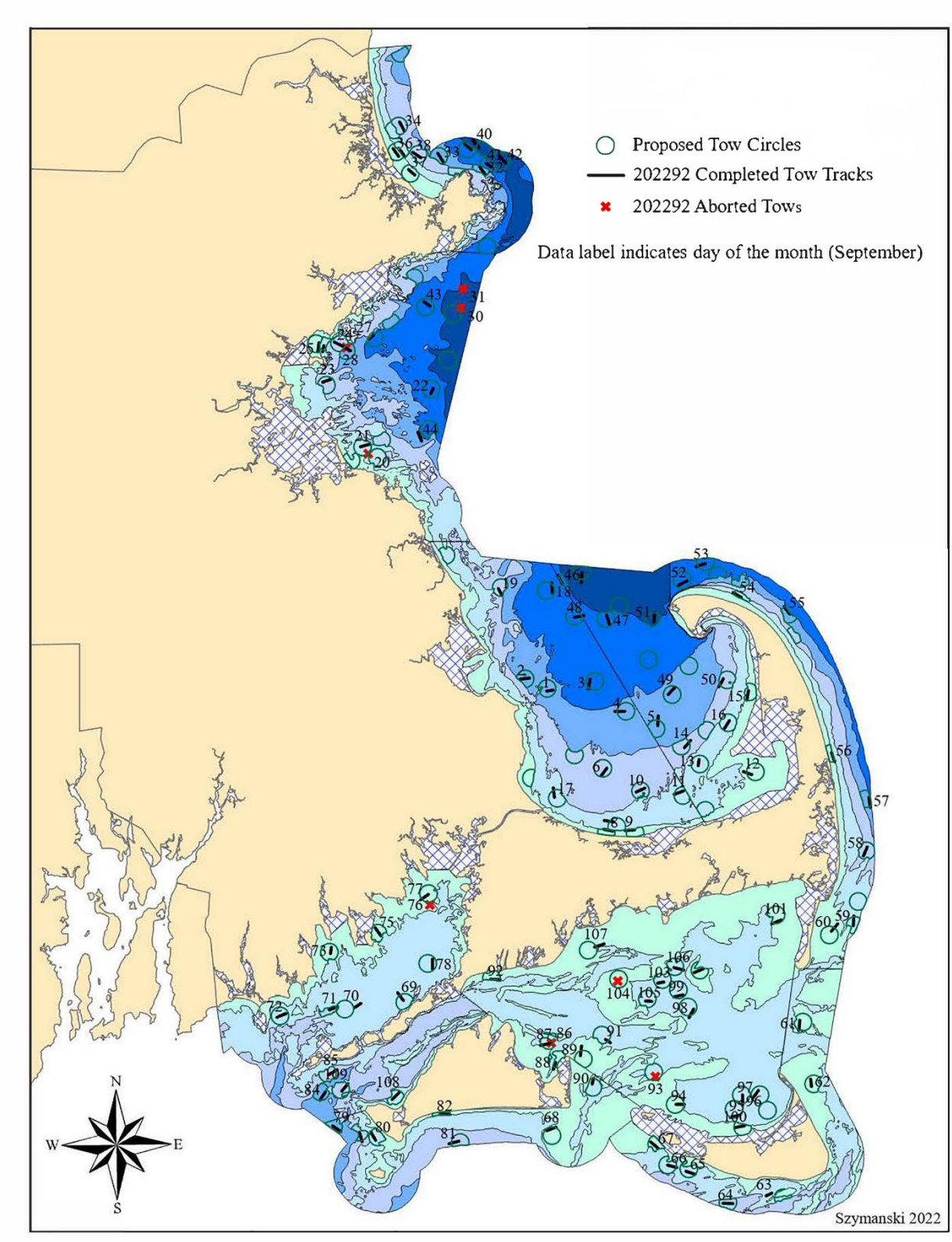


Figure 2. All proposed fall 2022 stations including completed and aborted tows by date.

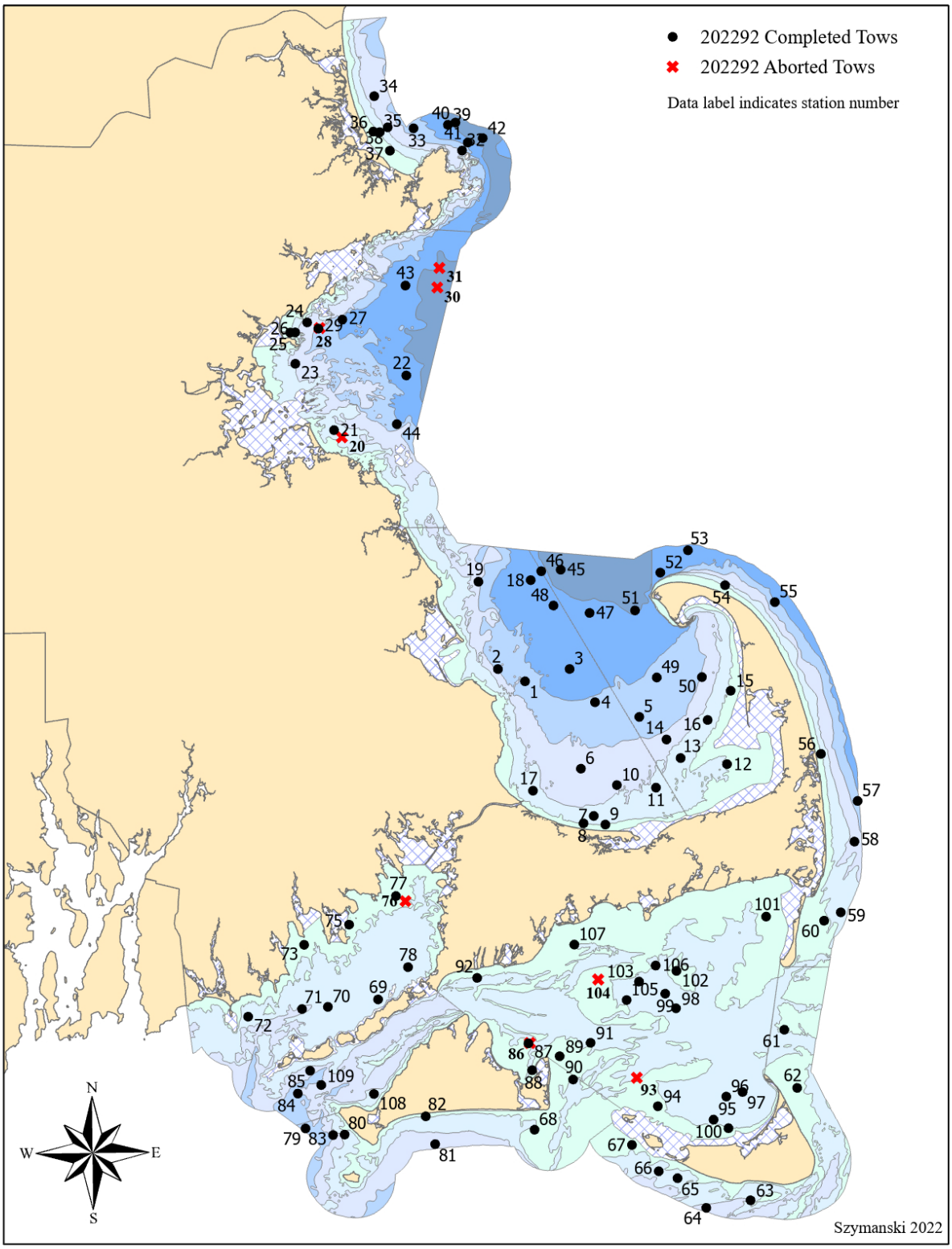


Figure 3. All attempted fall 2022 survey stations in chronological order.


Fall Cruise 202292


2022/09/12


2022/09/11


FRESH WATER


2022/

SURVEY REPORT
2022 Nantucket Sound Estuarine Winter Flounder Young of the Year (YOY) Seine Survey

SURVEY PERIOD AND AREA

From June 20 – July 8, 2022 the Massachusetts Division of Marine Fisheries (MDMF) conducted its 47th Nantucket Sound estuarine Winter Flounder young of the year (YOY) seine survey. The survey covers six Nantucket Sound estuaries on the south side of Cape Cod – Great Pond, Waquoit Bay, Cotuit Bay, Lewis Bay, Bass River and Stage Harbor (Figure 1).

OBJECTIVES

Survey objectives were 1) to provide a winter flounder YOY abundance index for the Southern New England stock; and 2) count all commercially and recreationally important finfish and invertebrate species encountered. All species not counted are noted for presence.

METHODS

Sampling occurs between the Monday of the first full week of June (Julian dates 160-166) and the Friday of the first full week of July (Julian dates 187-193). Sampling takes place during daylight hours Monday through Friday within two hours of the earliest morning high tide. Weekends, holidays, and afternoons are avoided to reduce recreational use conflicts at site locations. Sampling is accomplished on the first 9 days that meet the protocol during this timeframe.

Forty-nine fixed stations are sampled annually. Each station was originally selected based on availability of 0-group Winter Flounder and preferred habitat to successfully seine. At each station, three replicate seine hauls are made using a 6.4 m x 2.4 m seine net with 4.8 mm mesh and a lead line weighted footrope. The net is set parallel to the shoreline in waist deep water. Depth is measured with a weighted and marked line. Distance between the net and the shoreline is measured using a sonic digital rangefinder (SONIN Multi-Measure Combo Pro™). Distance from shore to net is estimated using standardized pacing when conditions prevent the rangefinder from functioning properly. Once set, the ends of the seine are pulled toward the beach at a consistent and steady pace until the net is entirely on land. The entire catch is sorted by species, counted, and immediately released back into the water. The next replicate haul is made down the shoreline into the prevailing current. On occasion, factors such as sediment transport, vegetation growth, or anthropogenic disturbance (construction of seawalls and docks, watercraft, dredging, beachgoers, etc.) can interfere with the completion of all three hauls.

Winter Flounder density (# YOY per square meter) was determined by aggregating catch from all replicate hauls at each station. Haul distance was calculated as the hypotenuse of

a right triangle, using the distance from net to shore as one side and the depth as another. Area fished is calculated by using the haul distance and net width, which is consistently maintained using a restrictor line extended between the ends of the headrope. Each estuary was considered a stratum and each station's replicate hauls were treated as an individual sample. Stratified mean density and confidence limits were derived from standard and modified formulae for mean and variance.

RESULTS

One hundred thirty-seven seine hauls were conducted at 49 stations over 9 sampling days by eleven MDMF scientists (Table 1). Replicate hauls were dropped at nine stations due to decreased beach area, shoreline vegetation, coastal armor installations, obstructions, and excessive algal biomass: Fairfield, Washburn Island 2, Ropes #1, Seapuit #2, Follin's Pond, Heirs Landing, Mill Pond, Sear's Point and Vineyard Avenue. Thirty-nine species were encountered in 2022 (Table 2). The 2022 pooled (all estuaries combined) Winter Flounder YOY index was (0.231 YOY / m^2), just above the timeseries median (Figure 2, Table 3). The 2022 Age 1+ Winter Flounder index remained below the timeseries median for the 14th consecutive year with no fish encountered (Figure 3). Waquoit Bay's estuary-specific Winter Flounder index decreased in 2022 but remained above the timeseries median. All other estuary-specific Winter Flounder indices increased and were above their respective medians (Figure 4). The pooled YOY Summer Flounder index decreased but remained above the median level (Figure 5). The pooled Blue Crab index decreased from 2021, though it remained above the median (Figure 6). All bottom temperature monitors were collected and successfully downloaded (Figure 7). For further information on this survey or additional data, please contact Vincent M. Manfredi (508)-742-9732.

Table 1. 2022 Seine Survey Staffing List

Name	Affiliation	Num. Days
Mike Blanco	MDMF	1
Amanda Davis	MDMF	3
Emma Gallagher	MDMF / SMAST	3
Maggie Leary	MDMF	2
Vincent Manfredi	MDMF	9
Dave Martins	MDMF	1
Amanda Meli	MDMF / SMAST	1
Brendan Reilly	MDMF	1
Taylor Stoni	MDMF	1
Mark Szymanski	MDMF	3
Steve Wilcox	MDMF	2

Table 2. Species observed in 2022 seine survey, species without total number are only noted for presence at each station.

Common Name	Taxonomic Name	Total Number	% Occurrence
YOY Winter Flounder	*Pseudopleuronectes americanus*	1873	97.8%
Atlantic Silverside	*Menidia menidia*		95.6%
Sand Shrimp	*Crangon septemspinosa*		75.9%
Blue Crab	*Callinectes sapidus*	406	65.0%
Mud Snail	*Nassarius obsoletus*		59.1%
Striped Killifish	*Fundulus majalis*		57.7%
Northern Pipefish	*Sygnathus fuscus*		44.5%
Grass Shrimp	*Paelmonetes pugio*		30.7%
Northern Kingfish	*Menticirrihitus saxatilis*	232	24.1%
Mummichog	*Fundulus heteroclitus*		23.4%
Lady Crab	*Ovalipes ocellatus*	765	21.9%
Northern Puffer	*Sphoeroides maculatus*	56	19.0%
Rainwater Killifish	*Lucania parva*	463	17.5%
Green Crab	*Carcinus maenus*	48	16.1%
Fourspine Stickleback	*Apeltes quadracus*		16.1%
YOY Summer Flounder	*Paralichthys dentatus*	32	16.1%
Spider Crab Uncl.	*Majidae*	47	13.9%
Sheepshead Minnow	*Cyprinodon variegatus*		8.0%
Striped Searobin	*Prionotus evolans*	60	7.3%
White Mullet	*Mugil curema*	13	5.8%
Spot	*Leiostomus xanthurus*	43	5.1%
Atlantic Rock Crab	*Cancer irroratus*	15	4.4%
Black Sea Bass	*Centropristis striata*	18	3.6%
Horseshoe Crab	*Limulus polyphemus*	6	3.6%
Atlantic Needlefish	*Strongylura marina*	5	3.6%
Alewife / Blueback Herring	*Alosa spp.*	179	2.9%
Tautog	*Tautoga onitis*	5	2.2%
Blue Mussel	*Mytilus edulis*		2.2%
Ribbed Mussel	*Guekensia demissus*	3	2.2%
Oyster	*Crassostrea virginica*	6	2.2%
Grubby	*Myoxocephalus aeneus*	2	1.5%
Atlantic Herring	*Clupea harengus*	1	0.7%
Atlantic Menhaden	*Brevorrtia tyrannus*	10	0.7%
Bay Anchovy	*Anchoa mitchilli*	1	0.7%
Red Hake	*Urophycis chuss*	1	0.7%
Age 1+ Summer Flounder	*Paralichthys dentatus*	2	0.7%
Threespine Stickleback	*Gasterosteus aculeatus*		0.7%
Northern Sand Lance	*Ammodytes dubius*	1	0.7%
American Eel	*Anguilla rostrata*	1	0.7%
Mottled Dog Whelk	*Nassa vibex*	1	0.7%

Table 3. YOY Winter Flounder Abundance, All Estuaries. MDMF Seine Survey 1976-2022.

Year	Stratified Mean	Standard Error	Lower CI	Upper CI
1976	0.344	0.042	0.236	0.452
1977	0.641	0.062	0.508	0.774
1978	0.366	0.057	0.235	0.498
1979	0.507	0.060	0.366	0.648
1980	0.432	0.057	0.306	0.559
1981	0.340	0.056	0.208	0.471
1982	0.370	0.055	0.246	0.494
1983	0.231	0.027	0.176	0.287
1984	0.323	0.036	0.248	0.399
1985	0.335	0.039	0.254	0.415
1986	0.325	0.039	0.244	0.406
1987	0.274	0.032	0.208	0.340
1988	0.184	0.024	0.133	0.234
1989	0.421	0.046	0.325	0.518
1990	0.325	0.038	0.247	0.402
1991	0.267	0.038	0.188	0.346
1992	0.294	0.047	0.196	0.392
1993	0.067	0.009	0.047	0.086
1994	0.148	0.019	0.108	0.188
1995	0.154	0.023	0.107	0.201
1996	0.221	0.027	0.165	0.277
1997	0.392	0.053	0.278	0.506
1998	0.165	0.029	0.104	0.226
1999	0.201	0.028	0.143	0.258
2000	0.347	0.043	0.258	0.435
2001	0.214	0.028	0.157	0.272
2002	0.100	0.011	0.077	0.122
2003	0.197	0.032	0.128	0.267
2004	0.095	0.012	0.070	0.120
2005	0.075	0.010	0.054	0.096
2006	0.164	0.018	0.126	0.202
2007	0.167	0.021	0.125	0.210
2008	0.092	0.011	0.069	0.115
2009	0.083	0.013	0.056	0.109
2010	0.092	0.014	0.063	0.122
2011	0.247	0.026	0.194	0.301
2012	0.135	0.014	0.106	0.163
2013	0.250	0.025	0.198	0.302
2014	0.186	0.028	0.130	0.242
2015	0.127	0.018	0.090	0.163
2016	0.187	0.020	0.146	0.228
2017	0.291	0.050	0.182	0.400
2018	0.111	0.021	0.065	0.156
2019	0.145	0.019	0.104	0.185
2020	0.238	0.049	0.133	0.342
2021	0.223	0.031	0.160	0.286
2022	0.231	0.028	0.175	0.287

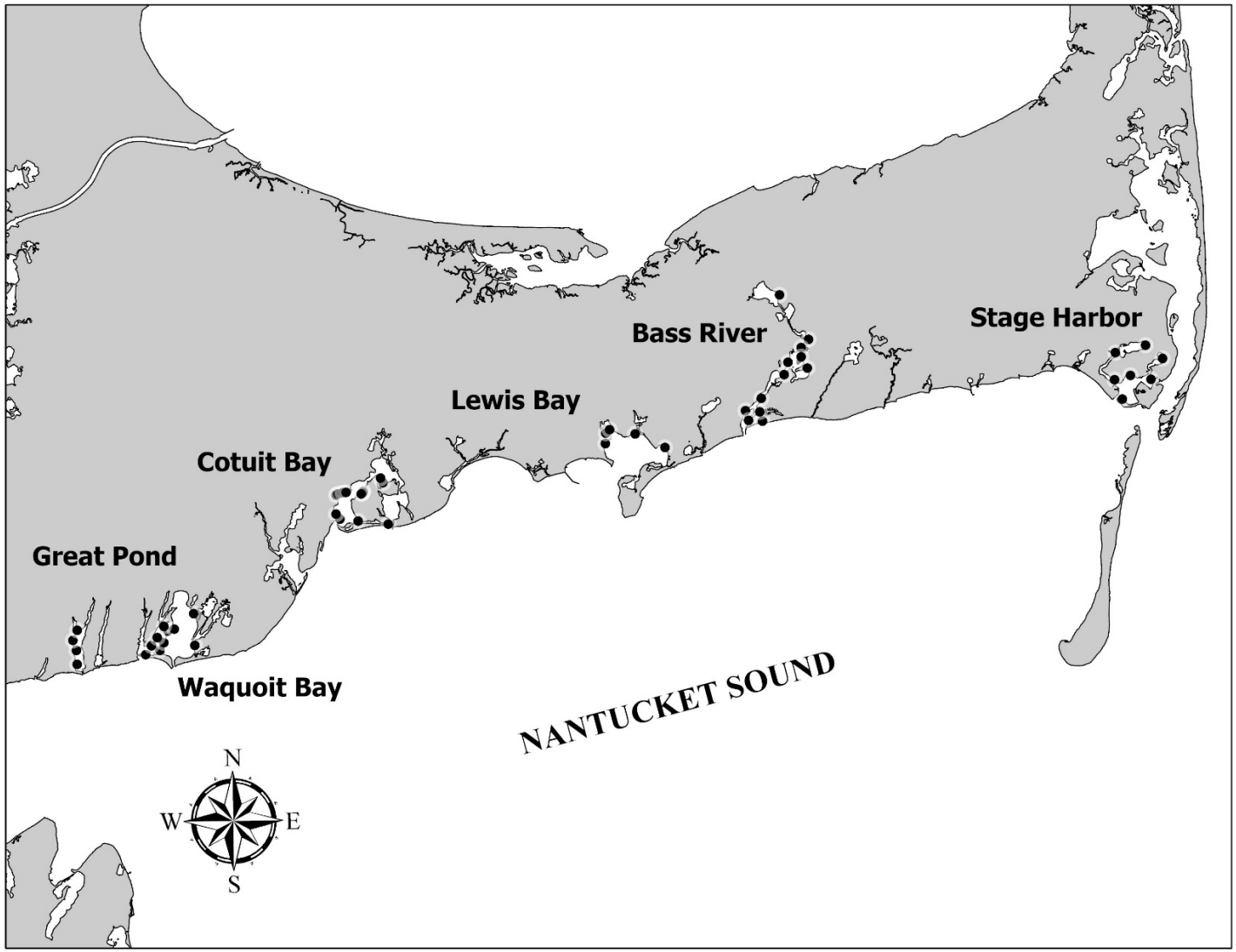


Figure 1. MDMF seine survey station locations.

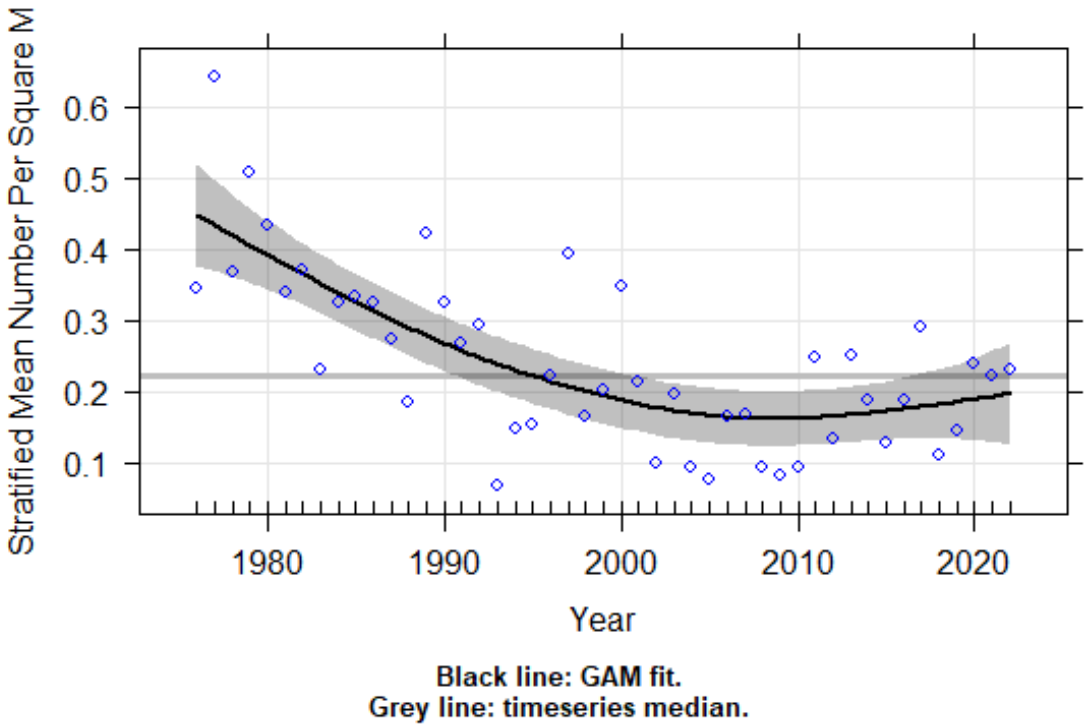


Figure 2. Seine survey cumulative YOY Winter Flounder abundance.

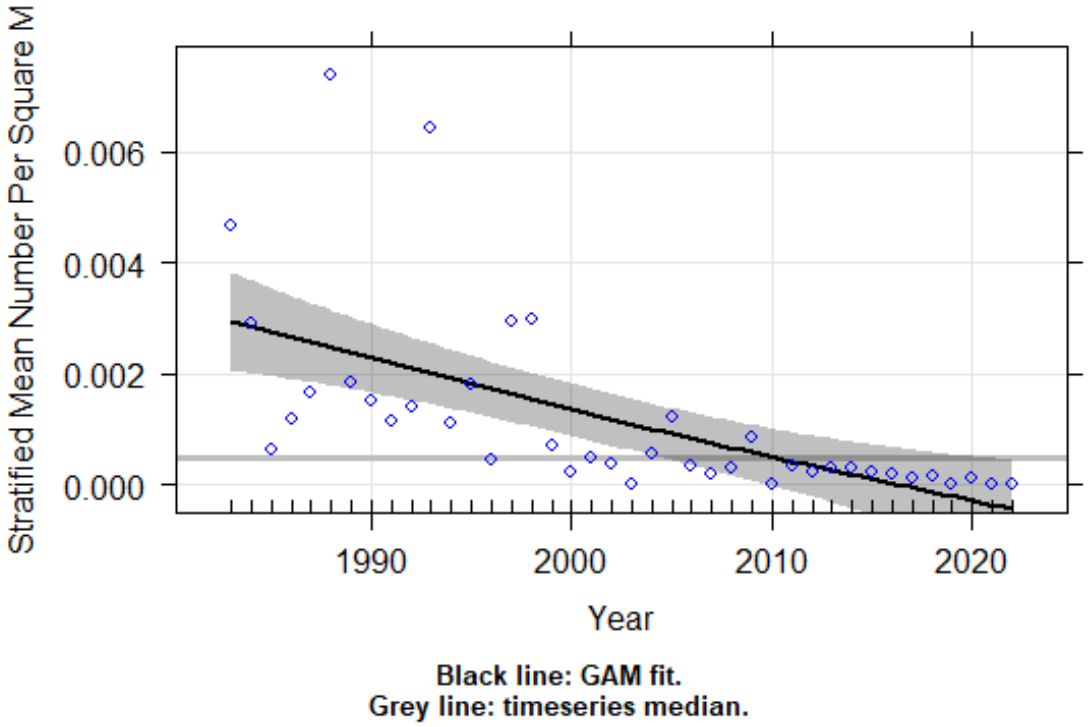
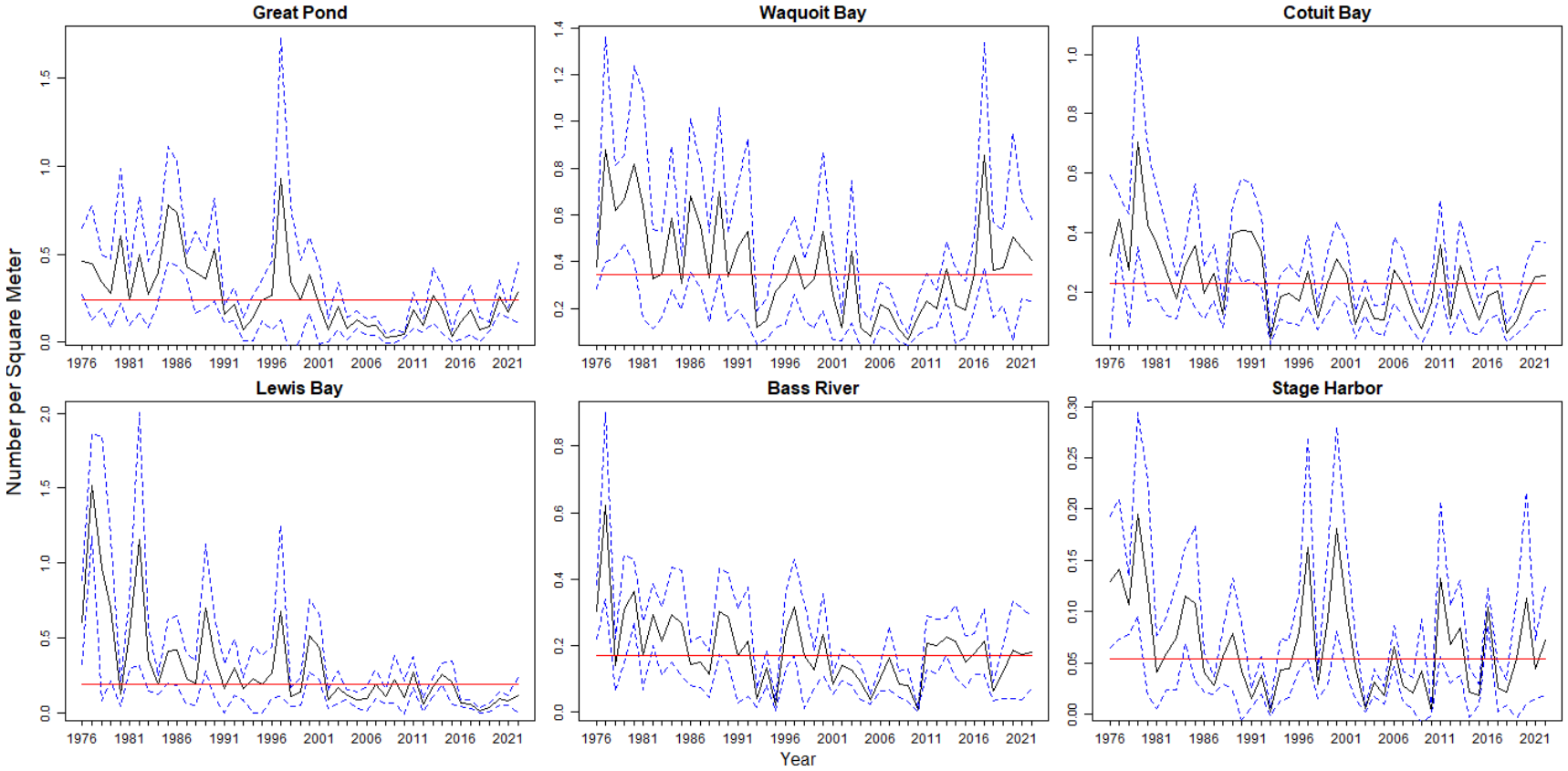


Figure 3. Seine survey cumulative age 1+ Winter Flounder abundance.



Dashed Lines = 95% Confidence Intervals
Horizontal Line = Timeseries Median for each Estuary
Note: y-axis scales differ in magnitude.

Figure 4. Abundance of YOY Winter Flounder by estuary, MDMF Seine Survey 1976 – 2022.

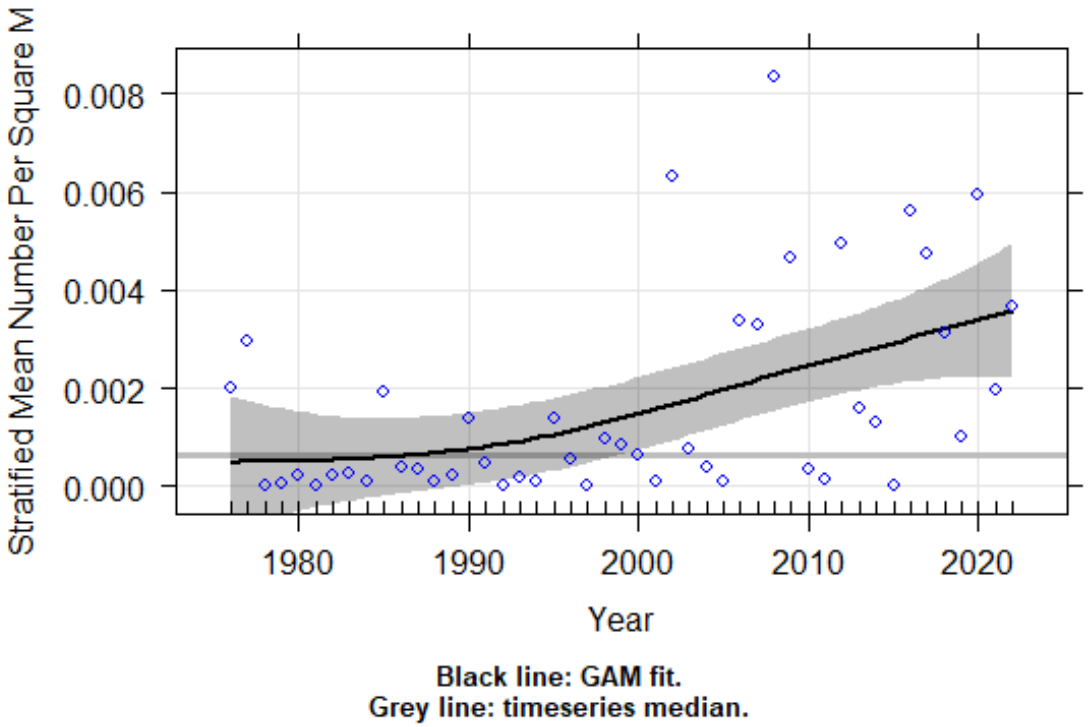


Figure 5. Seine Survey cumulative YOY Summer Flounder abundance.

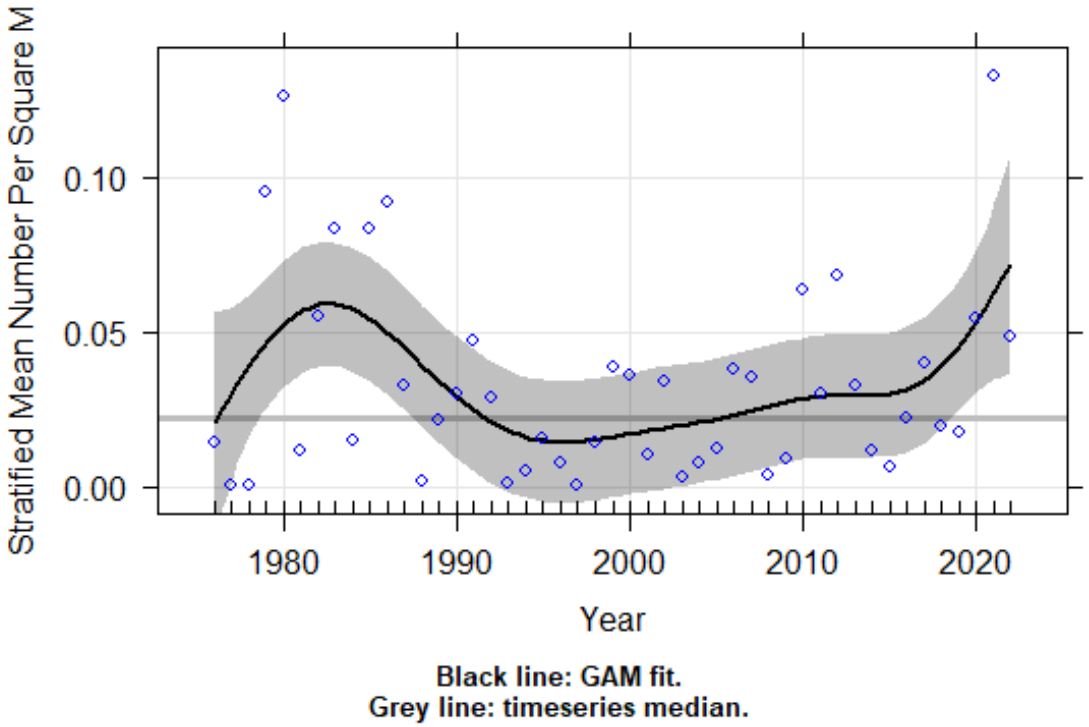


Figure 6. Seine Survey cumulative Blue Crab abundance.

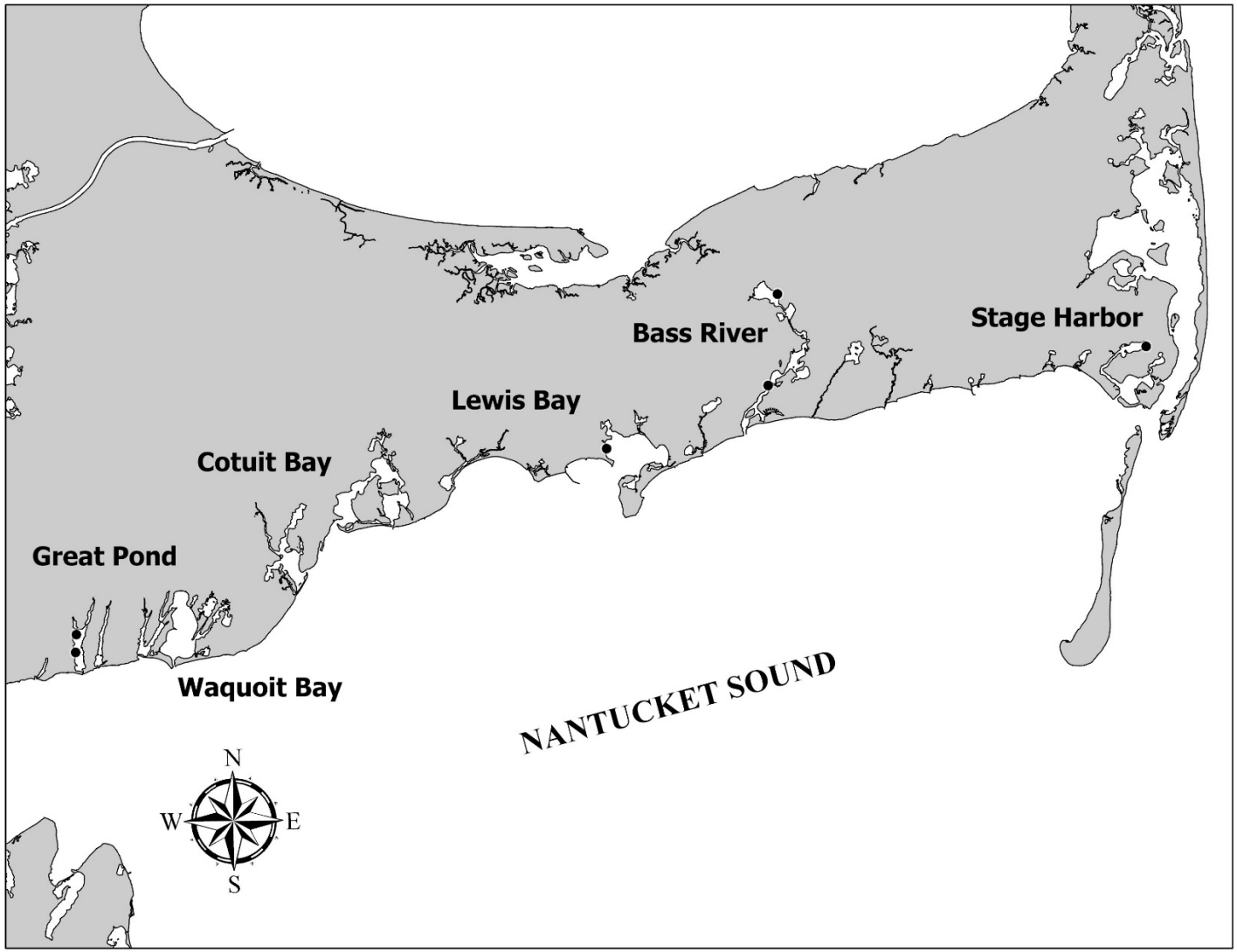


Figure 7. MDMF seine survey temperature monitor locations.

Appendix A: Massachusetts Inshore Bottom Trawl Survey Indices of Biomass, Abundance, Recruitment, and Abundance at Age for Select Species

The Massachusetts Division of Marine Fisheries has been conducting a bottom trawl survey of Massachusetts territorial waters every spring and fall since 1978. Survey indices provide a useful fishery-independent metric for tracking the relative abundance or biomass of many demersal fish and invertebrates in the survey area. Updated survey indices are presented here for 1) species or stocks routinely requested by staff from within the Massachusetts Division of Marine Fisheries as well as by other governmental and non-governmental scientific bodies, academic researchers, and consultants and/or 2) those species which have been a large part of the survey biomass and/or demonstrate a particularly strong trend over the time series.

Additional survey data can be requested by contacting Steve Wilcox at 508-742-9731 or steve.wilcox@mass.gov.

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Figure 1. Massachusetts trawl survey regions.

Figure 2 (a-ff). Stratified mean weight per tow (kg) 1978–2022 MDMF trawl survey.

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(b.) Spring **Yellowtail Flounder** Regions 3 - 5
(c.) Spring **Winter Flounder** Regions 4 - 5
(d.) Fall **Winter Flounder** Regions 4 - 5
(e.) Spring **Summer Flounder** Regions 1 - 5
(f.) Fall **Summer Flounder** Regions 1 - 5
(g.) Spring **Windowpane** Regions 1 - 3
(h.) Fall **Windowpane** Regions 1 - 3
(i.) Spring **Windowpane** Regions 4 - 5
(j.) Fall **Windowpane** Regions 4 - 5
(k.) Spring **Little Skate** Regions 1 - 3
(l.) Fall **Little Skate** Regions 1 - 3
(m.) Spring **Little Skate** Regions 4 - 5
(n.) Fall **Little Skate** Regions 4 - 5
(o.) Spring **Winter Skate** Regions 1 - 3
(p.) Fall **Winter Skate** Regions 1 - 3
(q.) Spring **Winter Skate** Regions 4 - 5
(r.) Fall **Winter Skate** Regions 4 - 5
(s.) Spring **Atlantic Cod** Regions 4 - 5
(t.) Fall **Red Hake** Regions 4 - 5
(u.) Spring **Ocean Pout** Regions 1 - 5
(v.) Spring **Northern Sea Robin** Regions 1 - 5
(w.) Spring **Longhorn Sculpin** Regions 3 - 5
(x.) Fall **Longhorn Sculpin** Regions 3 - 5
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(z.) Spring **Black Sea Bass** Regions 1 - 3
(aa.) Spring **Tautog** Regions 1 - 3
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(cc.) Fall **Butterfish** Regions 1 - 2
(dd.) Spring **American Plaice** Regions 4 - 5
(ee.) Fall **Lobster** Regions 4 - 5
(ff.) Spring **Haddock** Regions 4 - 5

Figure 3 (a – b). Stratified mean number per tow 1978 – 2022 MDMF trawl survey.

(a) Spring **Channeled Whelk** Regions 1 - 2
(b) Fall **Channeled Whelk** Regions 1 - 2
(c) Fall **Knobbed Whelk** Regions 1 - 2
(d) Spring **Spotted Hake** Regions 1 - 5

Figure 4 (a – b). Pre-recruit stratified mean number per tow 1978 – 2022 MDMF trawl survey.

(a) Fall **Age-0 Scup** (<13 cm) Regions 1 – 3
(b) Fall **Age-0 Black Sea Bass** (<12 cm) Regions 1 - 3

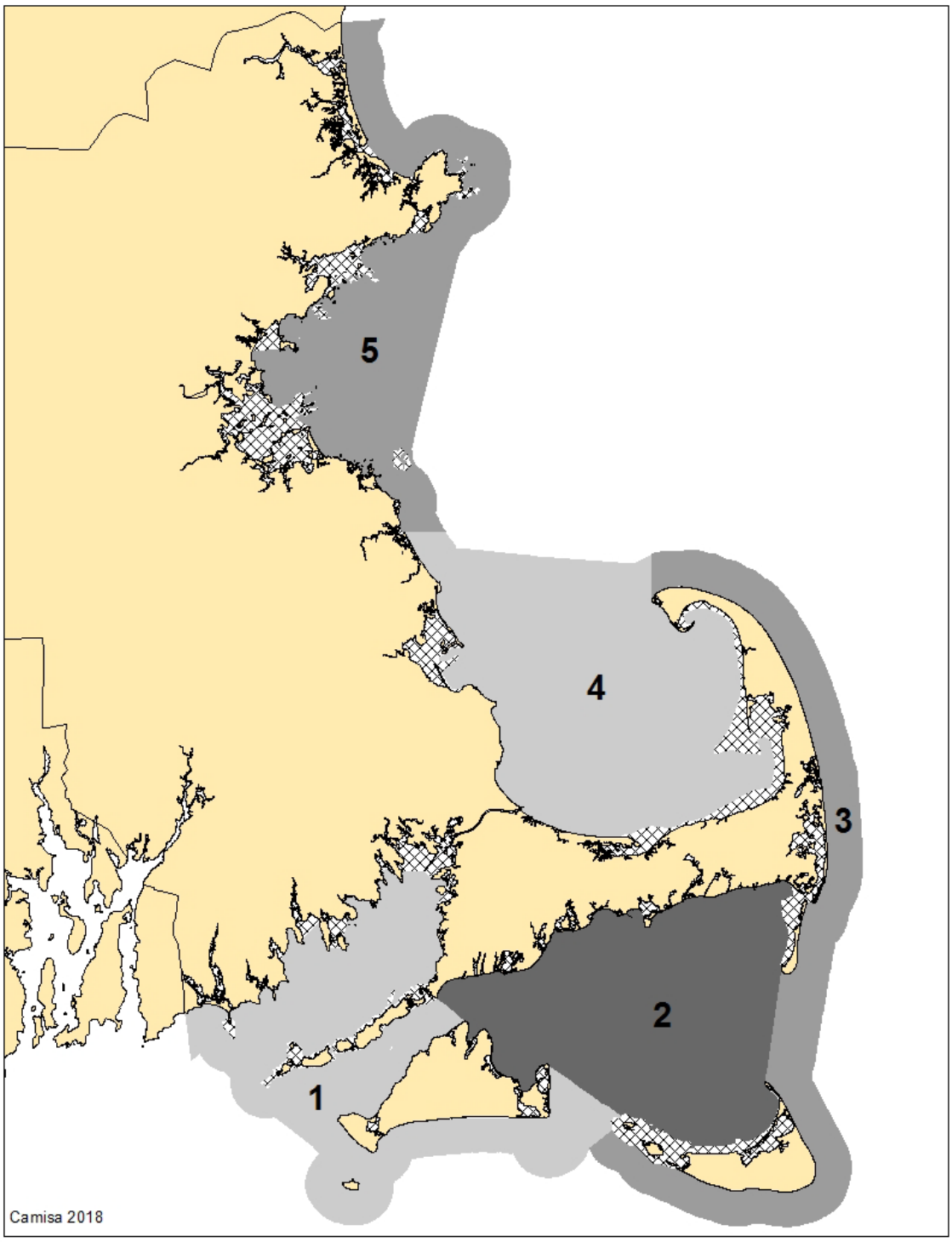

Figure 1. MDMF trawl survey regions. Gulf of Maine (GOM) = Regions 4-5. Southern New England (SNE) = Regions 1-3.

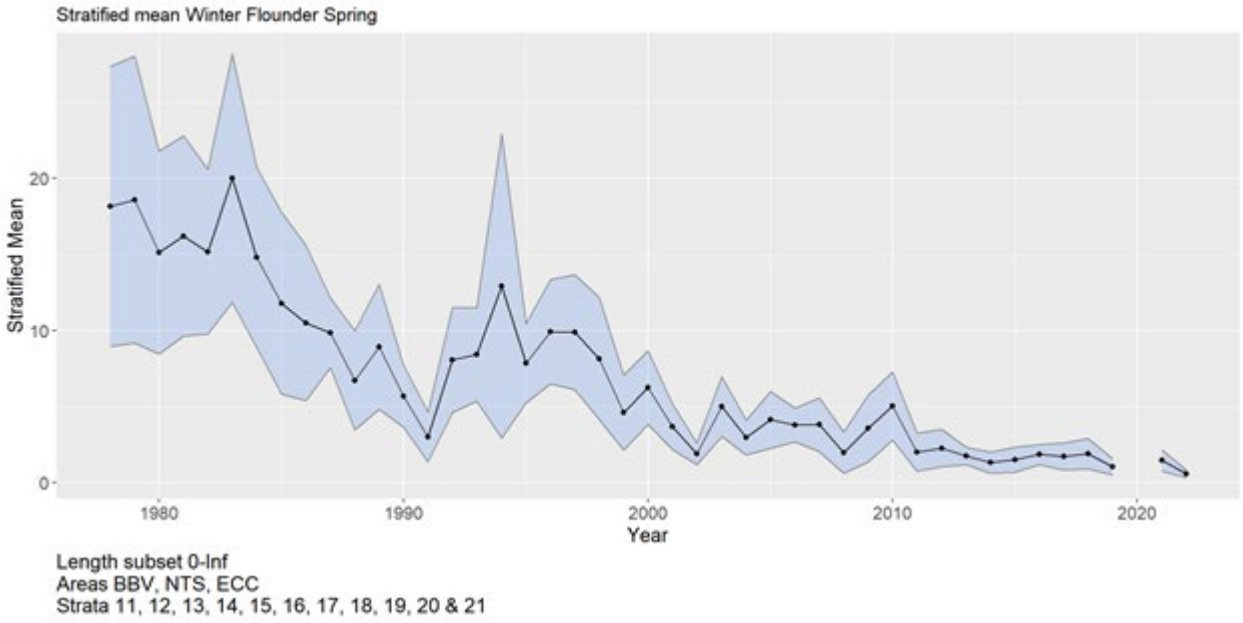

Figure 2a. Stratified mean weight per tow (kg) 1978 – 2022 spring Winter Flounder SNE.

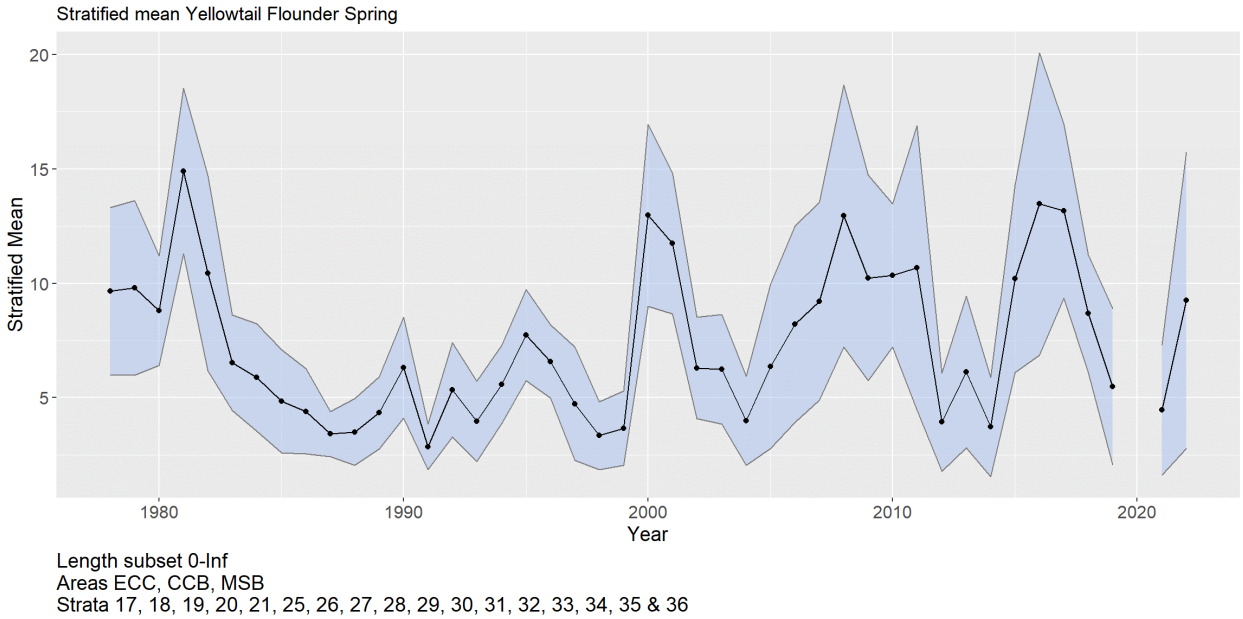

Figure 2b. Stratified mean weight per tow (kg) 1978 – 2022 spring Yellowtail Flounder in regions 3, 4, & 5.

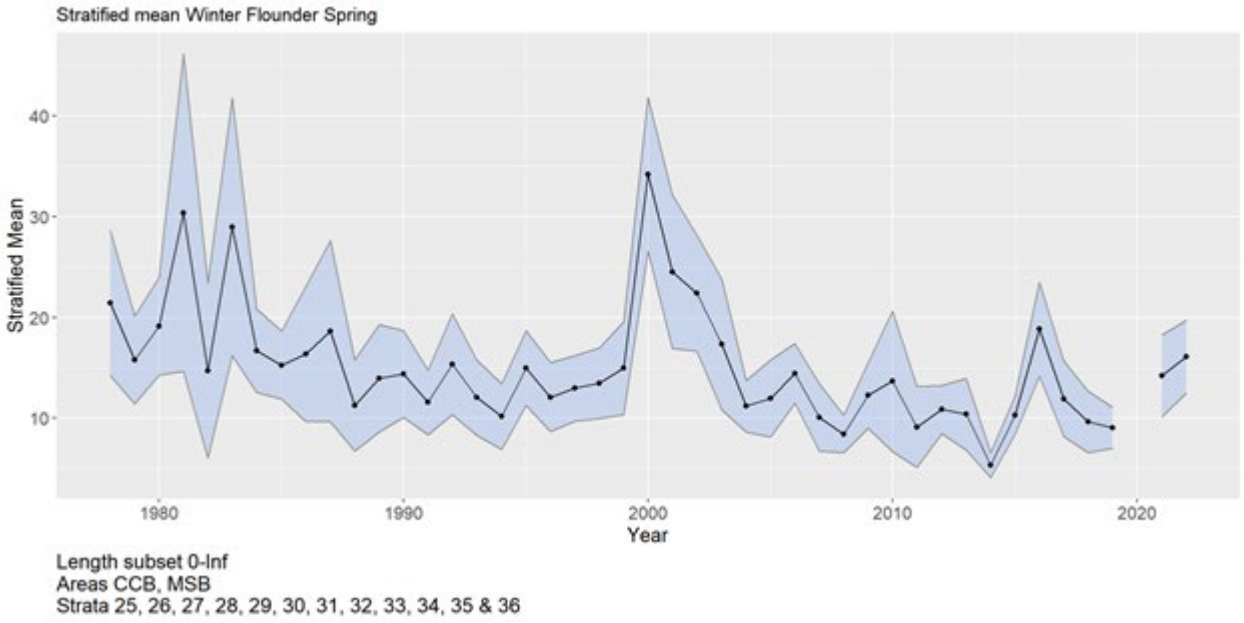

Figure 2c. Stratified mean weight per tow (kg) 1978 – 2022 spring Winter Flounder GOM.

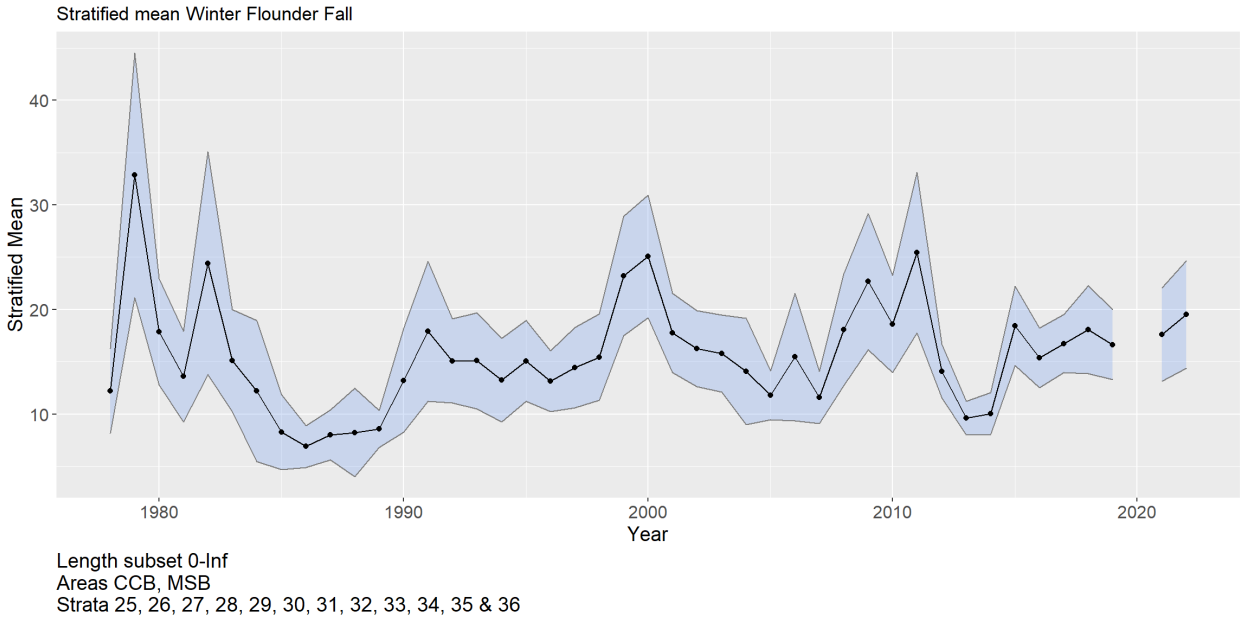

Figure 2d. Stratified mean weight per tow (kg) 1978 – 2022 fall Winter Flounder GOM.

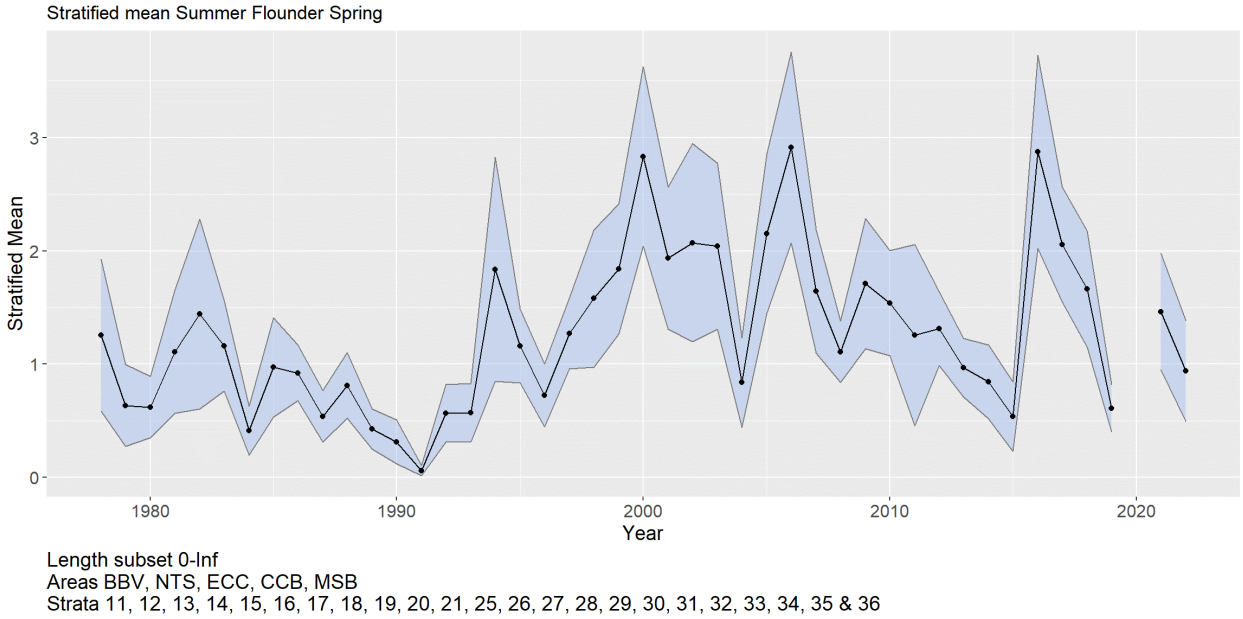

Figure 2e. Stratified mean weight per tow (kg) 1978 – 2022 spring Summer Flounder.

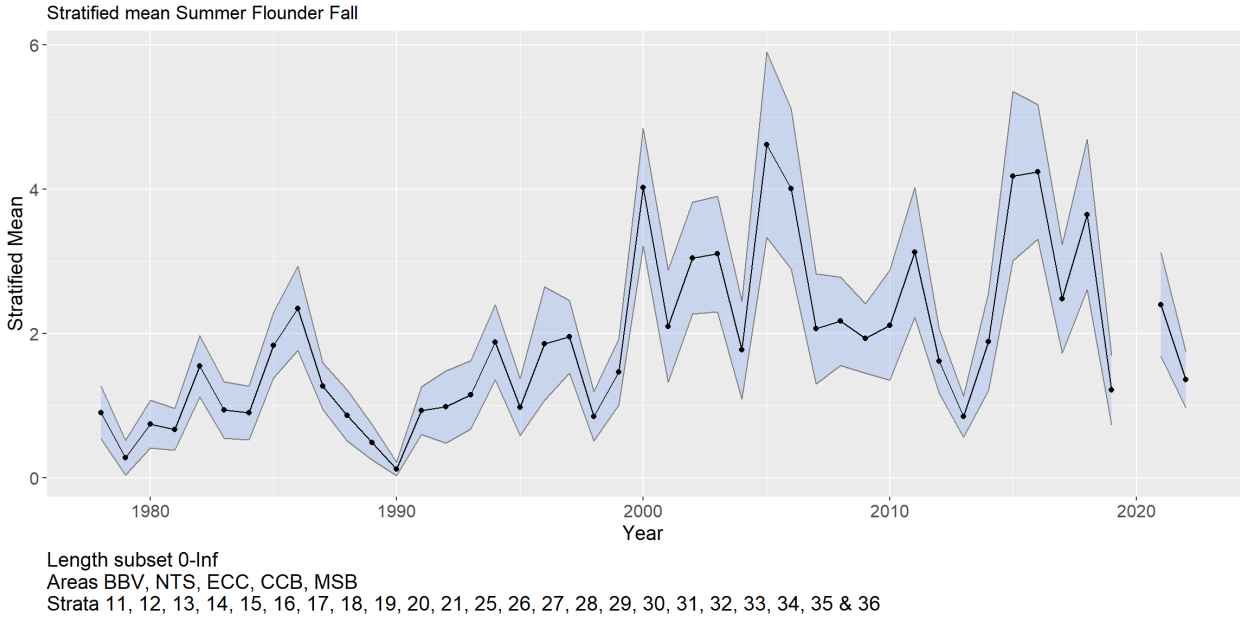

Figure 2f. Stratified mean weight per tow (kg) 1978 – 2022 fall Summer Flounder.

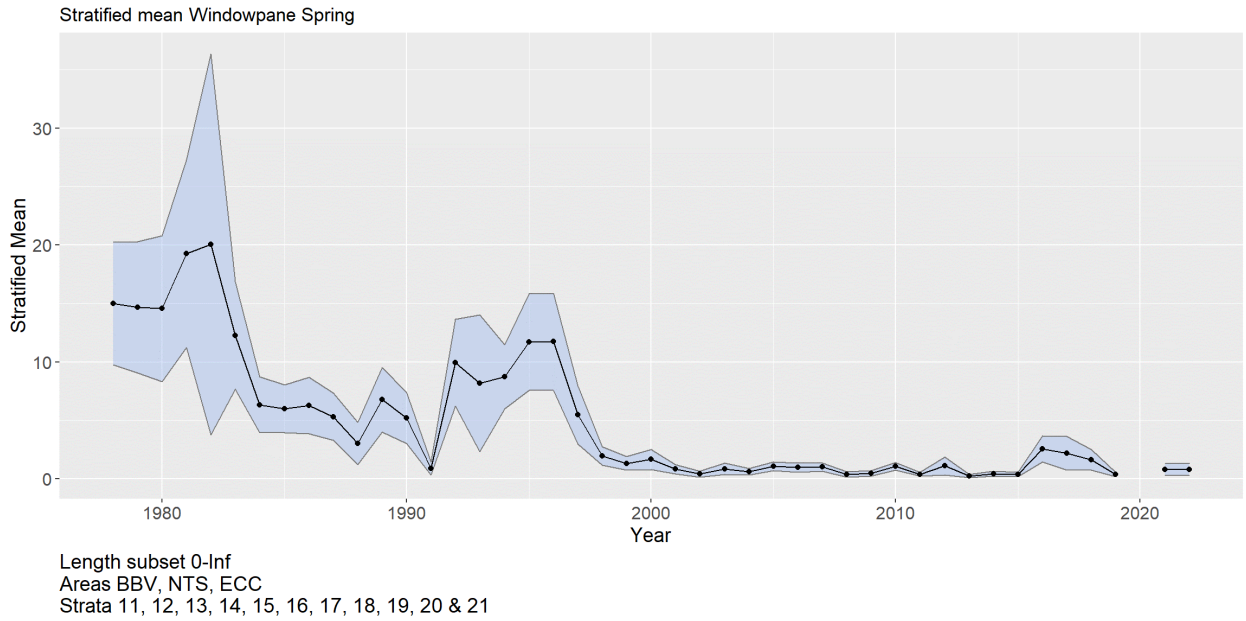

Figure 2g. Stratified mean weight per tow (kg) 1978 – 2022 spring Windowpane SNE.

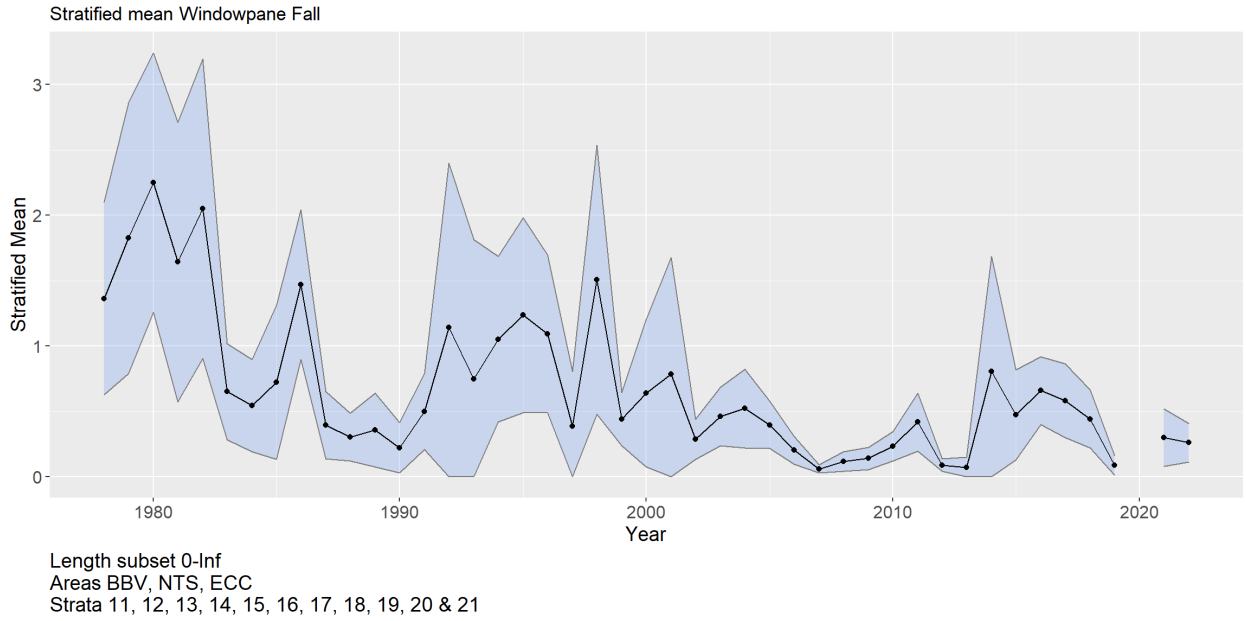

Figure 2h. Stratified mean weight per tow (kg) 1978 – 2022 fall Windowpane SNE.

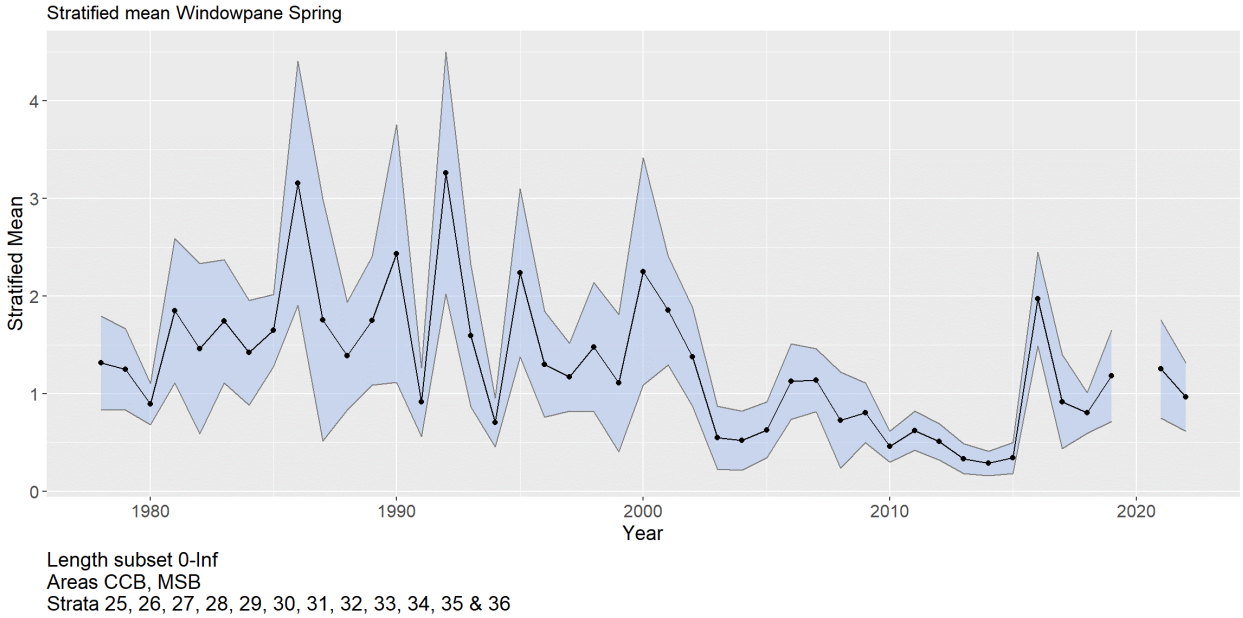

Figure 2i. Stratified mean weight per tow (kg) 1978 – 2022 spring Windowpane GOM.

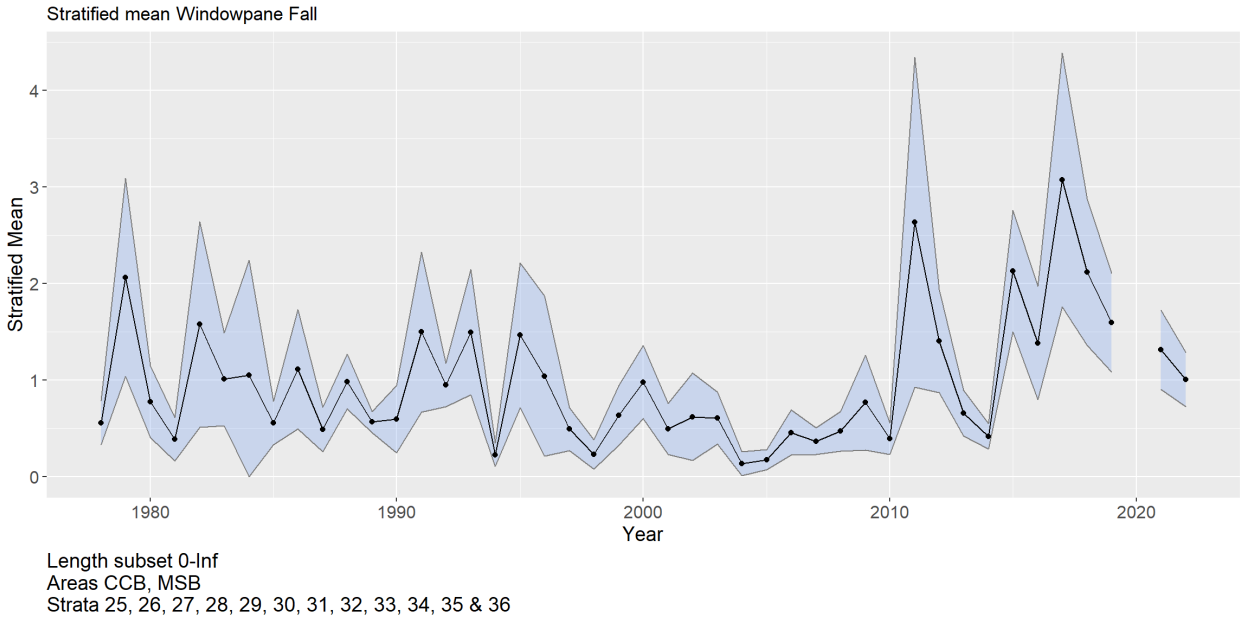

Figure 2j. Stratified mean weight per tow (kg) 1978 – 2022 fall Windowpane GOM

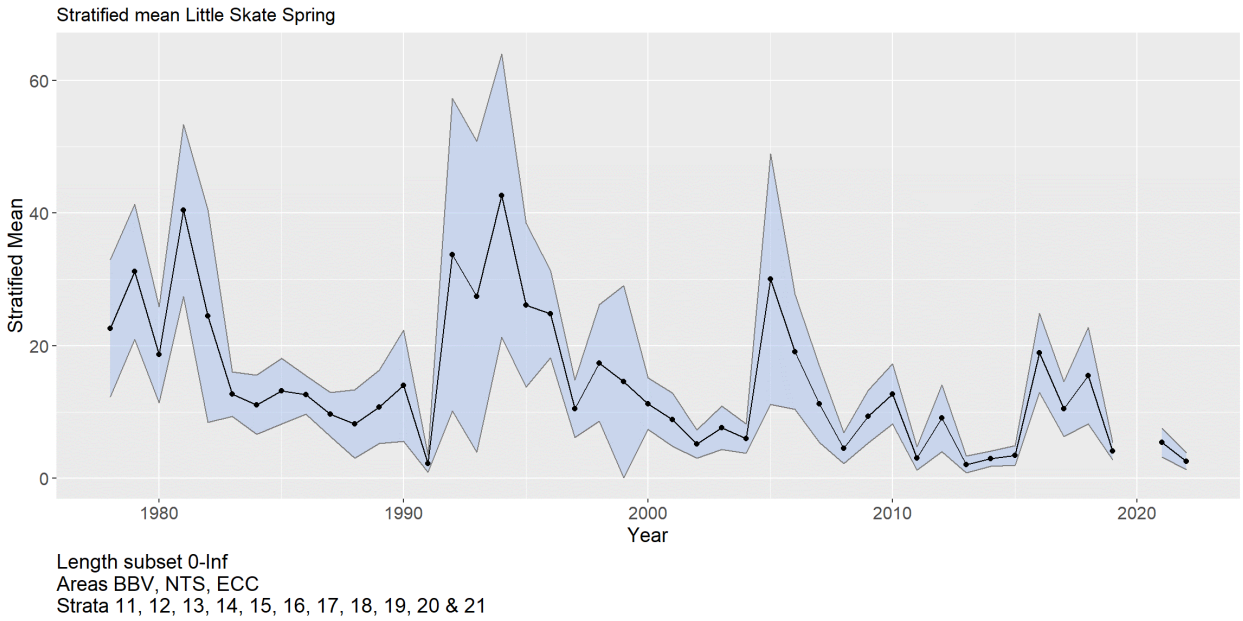

Figure 2k. Stratified mean weight per tow (kg) 1978 – 2022 spring Little Skate SNE.

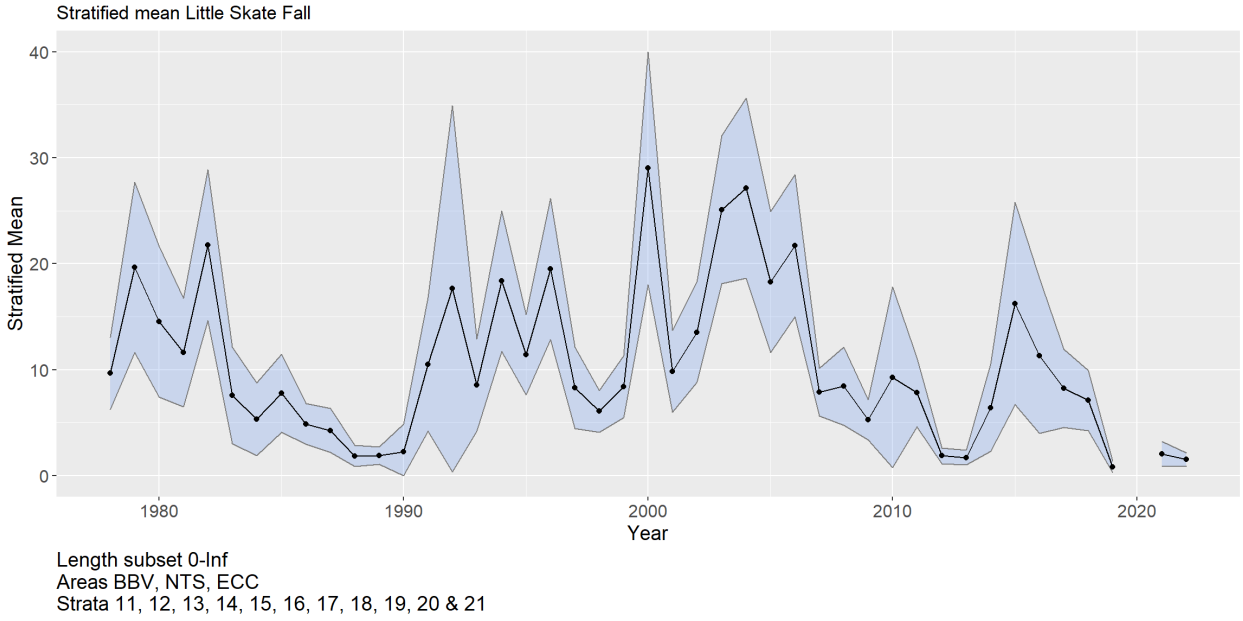

Figure 2l. Stratified mean weight per tow (kg) 1978 – 2022 fall Little Skate SNE.

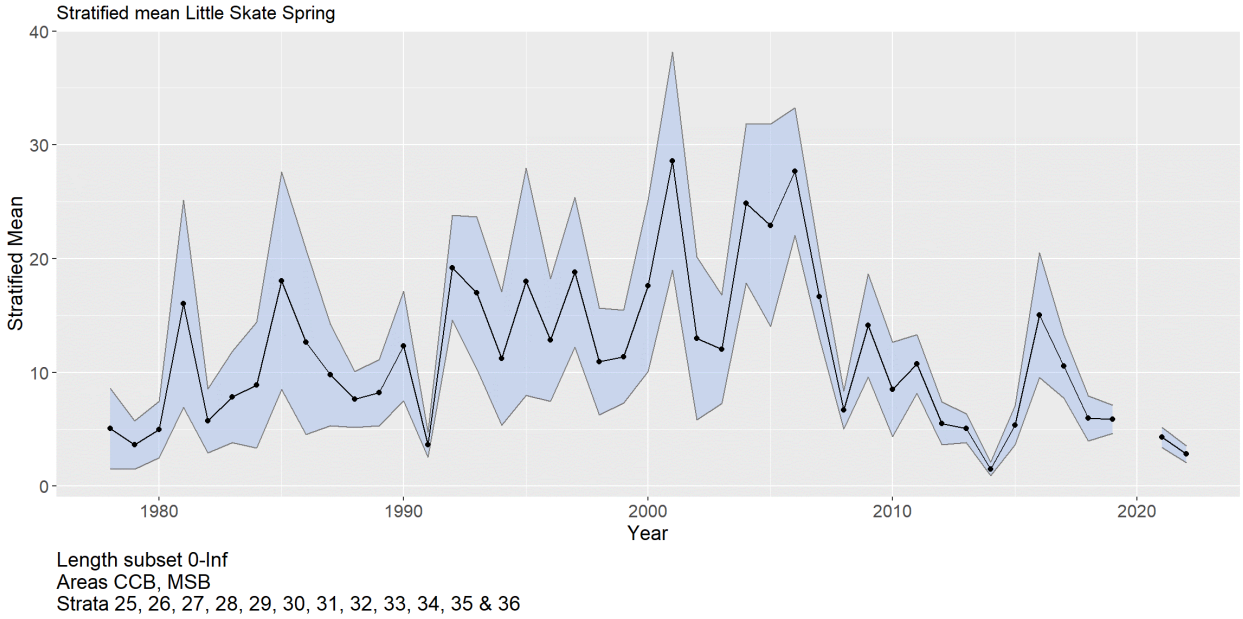

Figure 2m. Stratified mean weight per tow (kg) 1978 – 2022 spring Little Skate GOM.

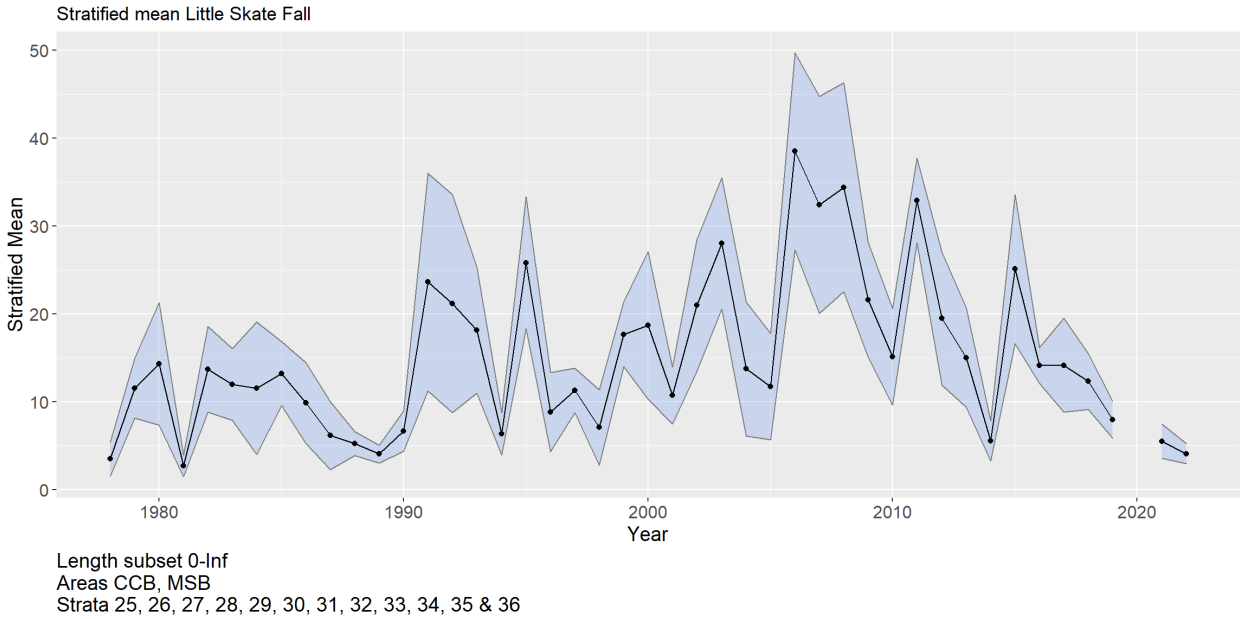

Figure 2n. Stratified mean weight per tow (kg) 1978 – 2022 fall Little Skate GOM

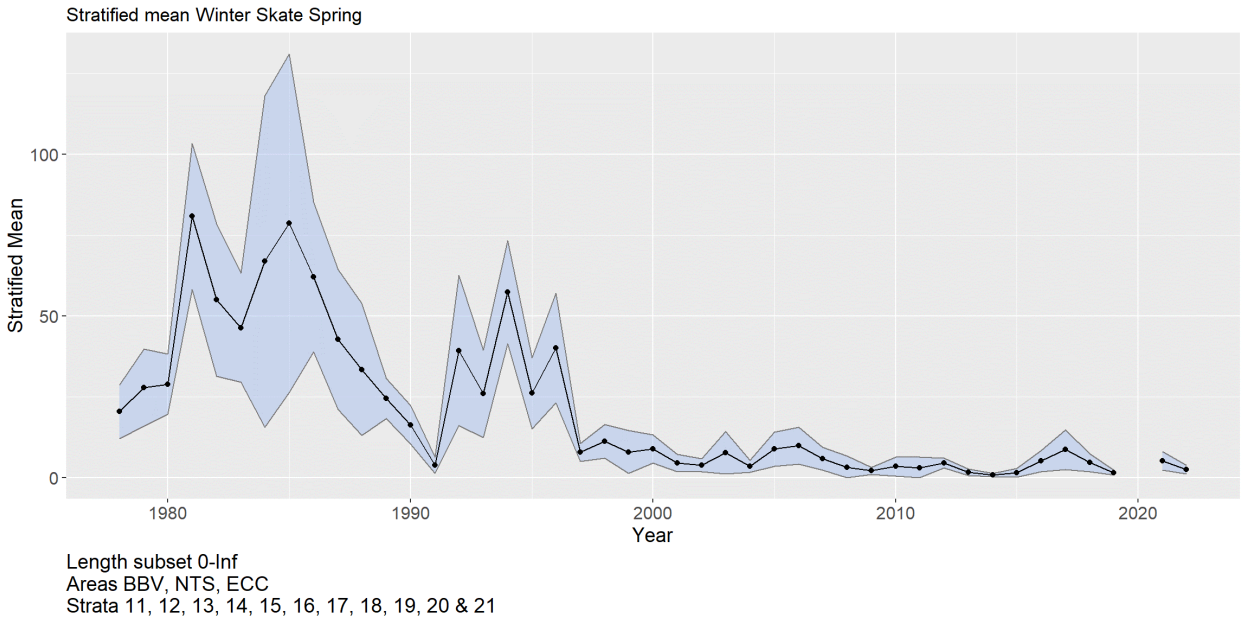

Figure 2o. Stratified mean weight per tow (kg) 1978 – 2022 spring Winter Skate SNE.

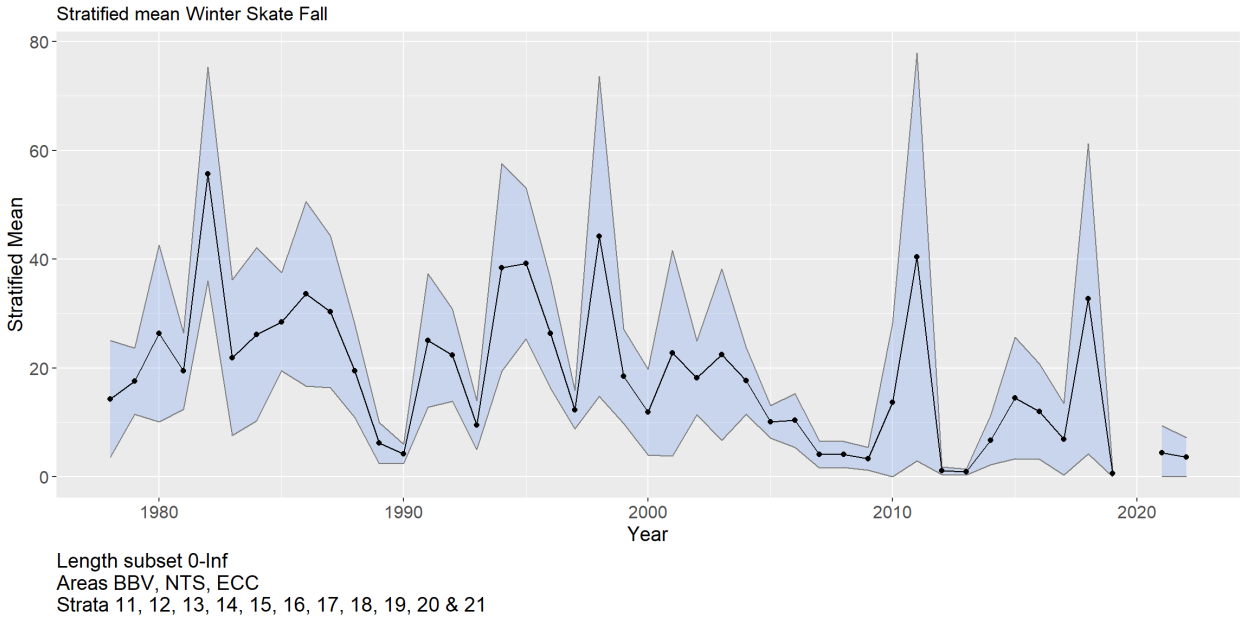

Figure 2p. Stratified mean weight per tow (kg) 1978 – 2022 fall Winter Skate SNE.

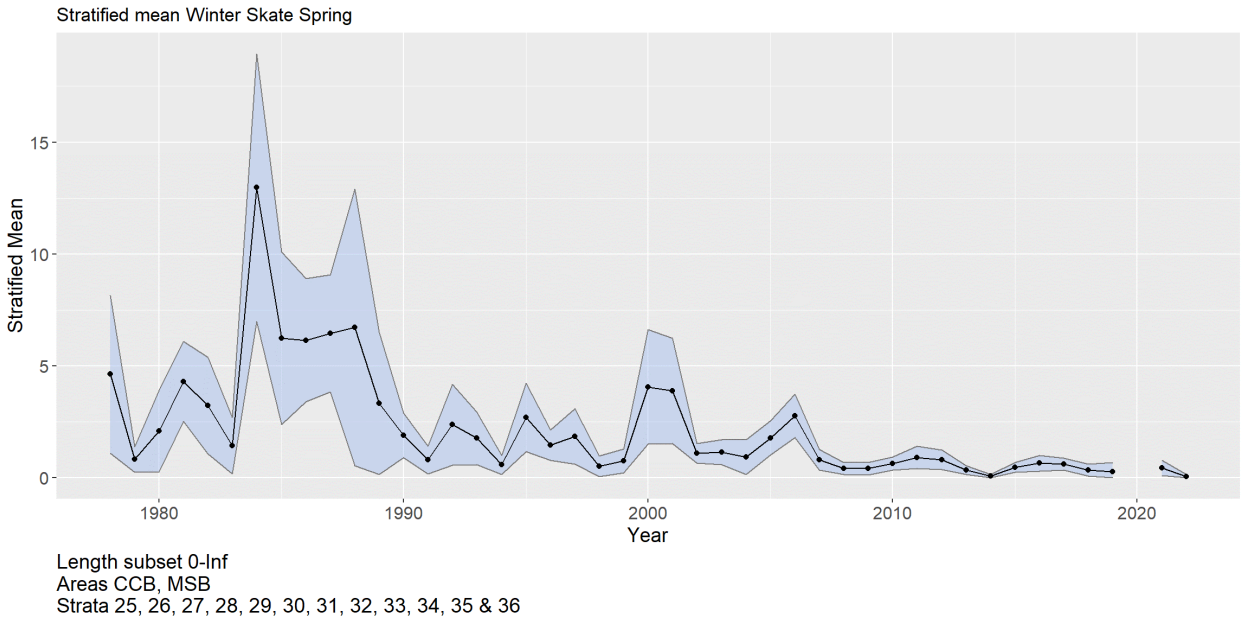

Figure 2q. Stratified mean weight per tow (kg) 1978 – 2022 spring Winter Skate GOM.

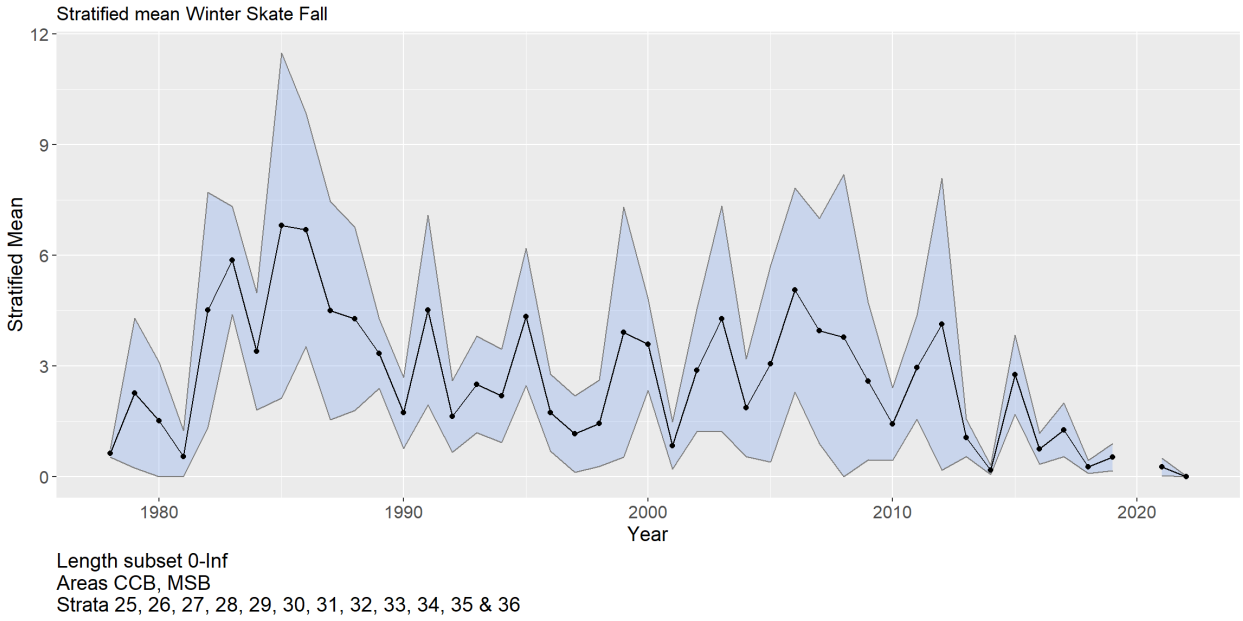

Figure 2r. Stratified mean weight per tow (kg) 1978 – 2022 fall Winter Skate GOM.

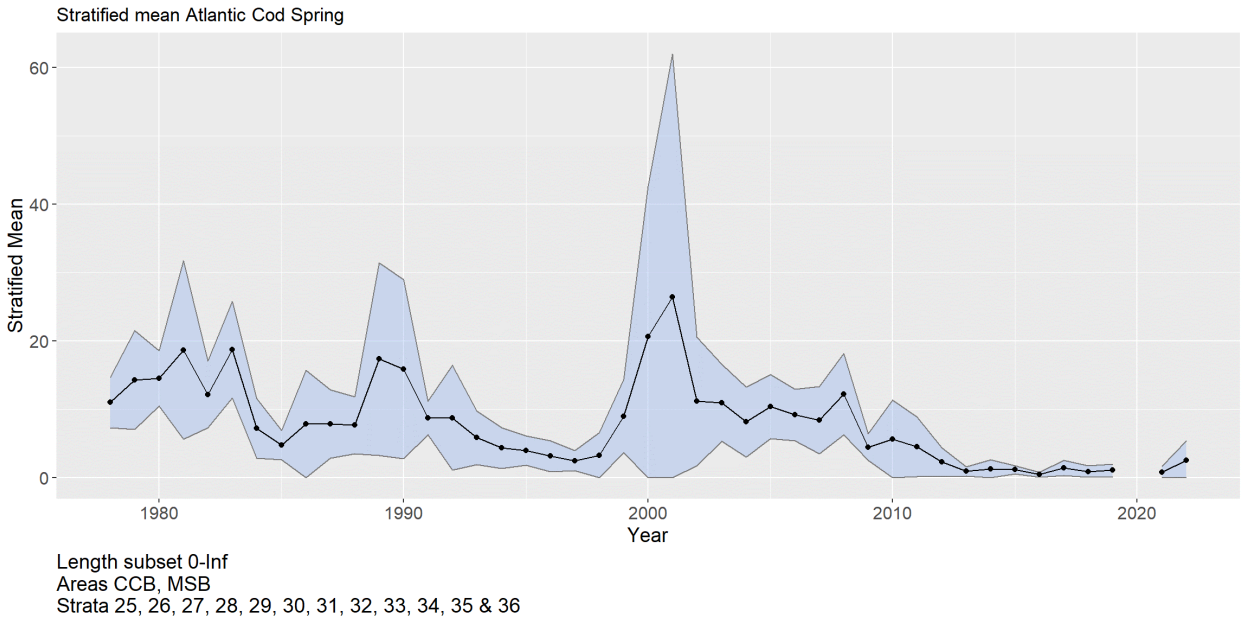

Figure 2s. Stratified mean weight per tow (kg) 1978 – 2022 spring Cod GOM

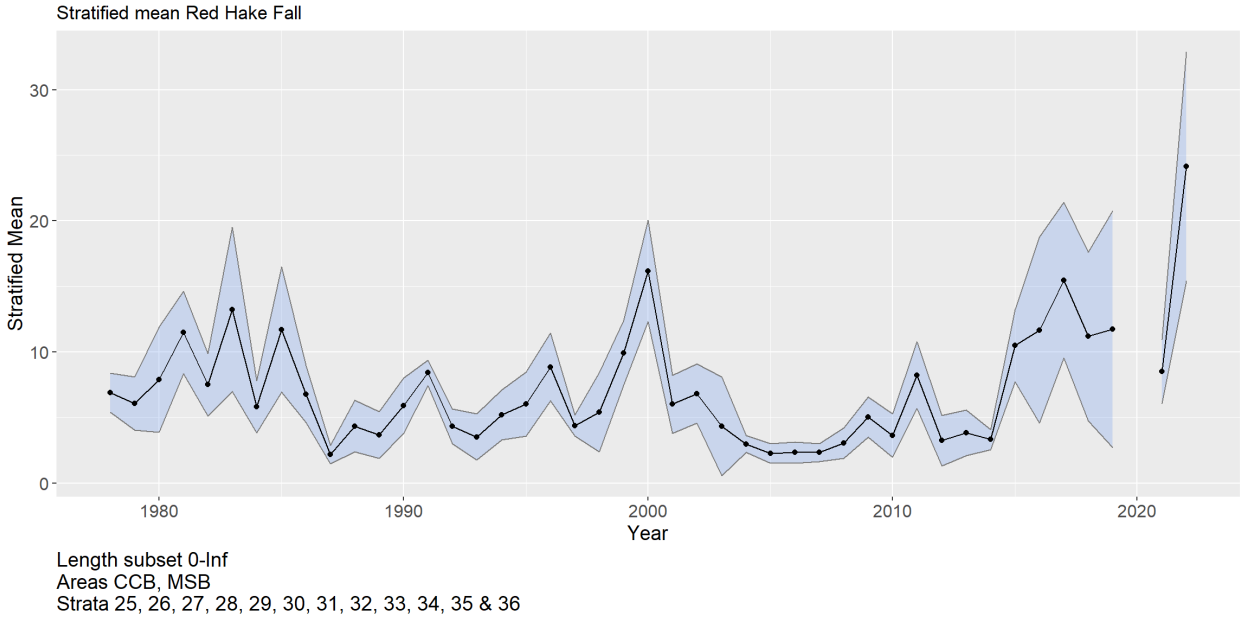

Figure 2t. Stratified mean weight per tow (kg) 1978 – 2022 fall Red Hake GOM.

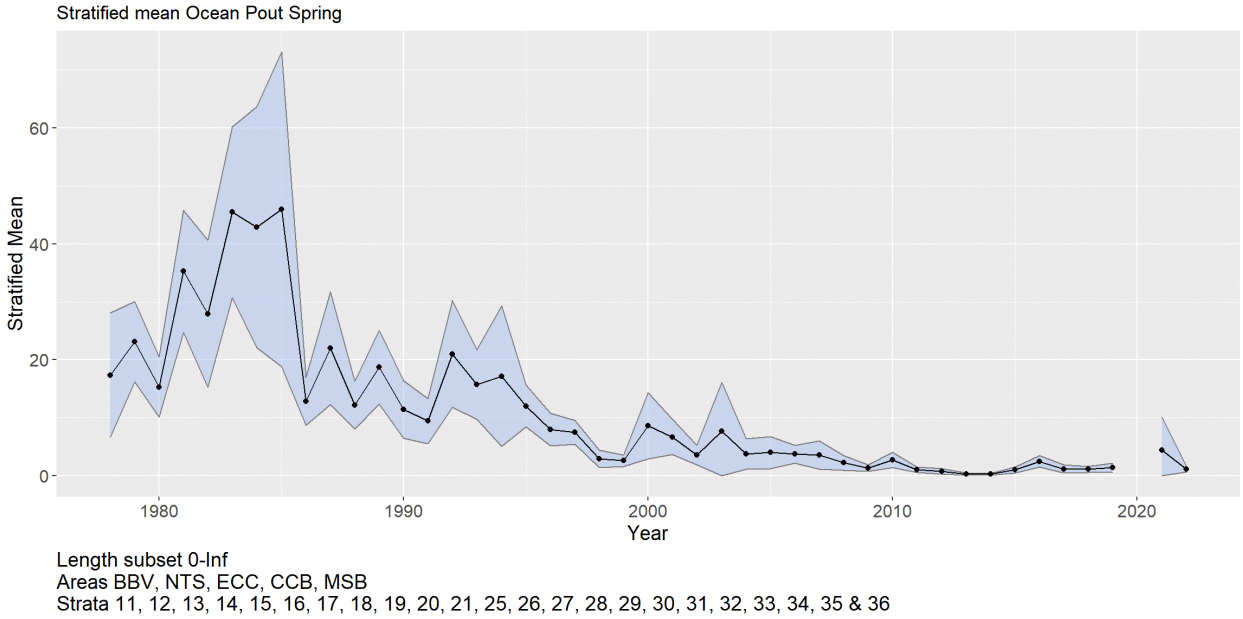

Figure 2u. Stratified mean weight per tow (kg) 1978 – 2022 spring Ocean Pout.

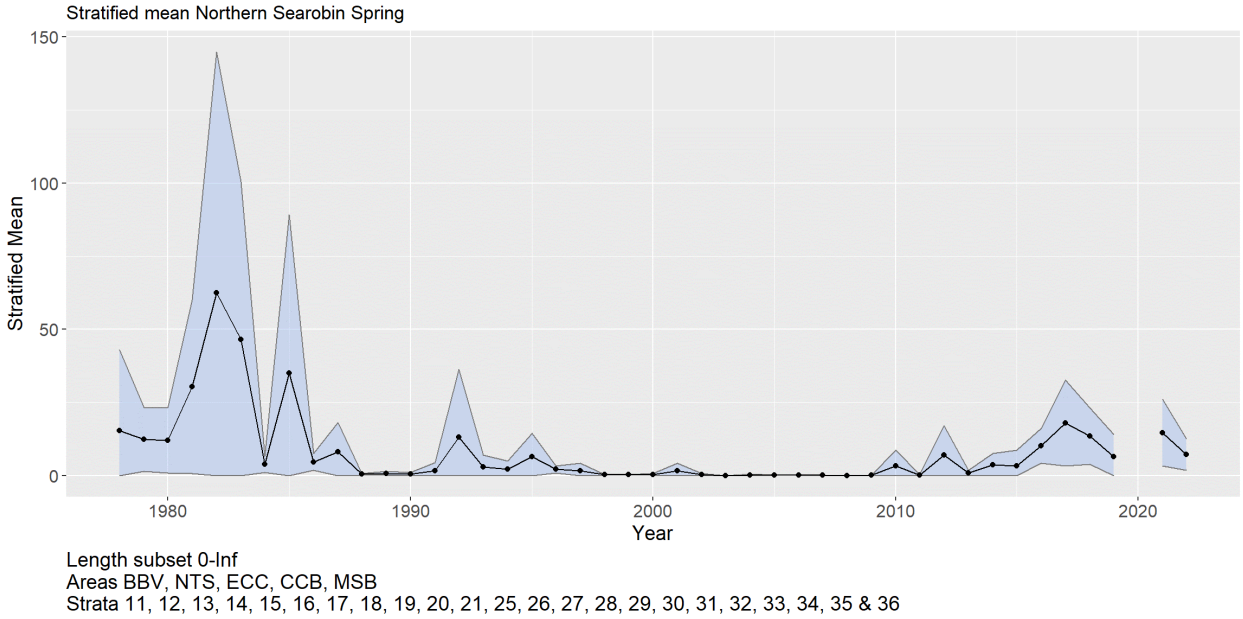

Figure 2v. Stratified mean weight per tow (kg) 1978 – 2022 spring Northern Searobin.

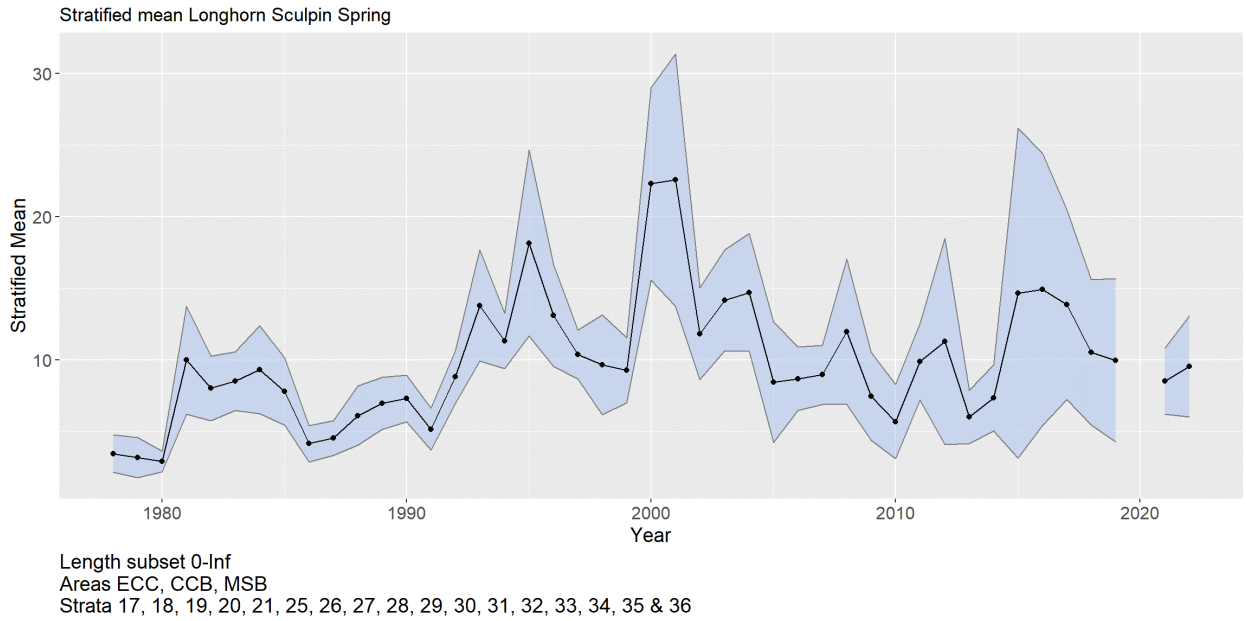

Figure 2w. Stratified mean weight per tow (kg) 1978 – 2022 spring Longhorn Sculpin regions 3, 4, & 5.

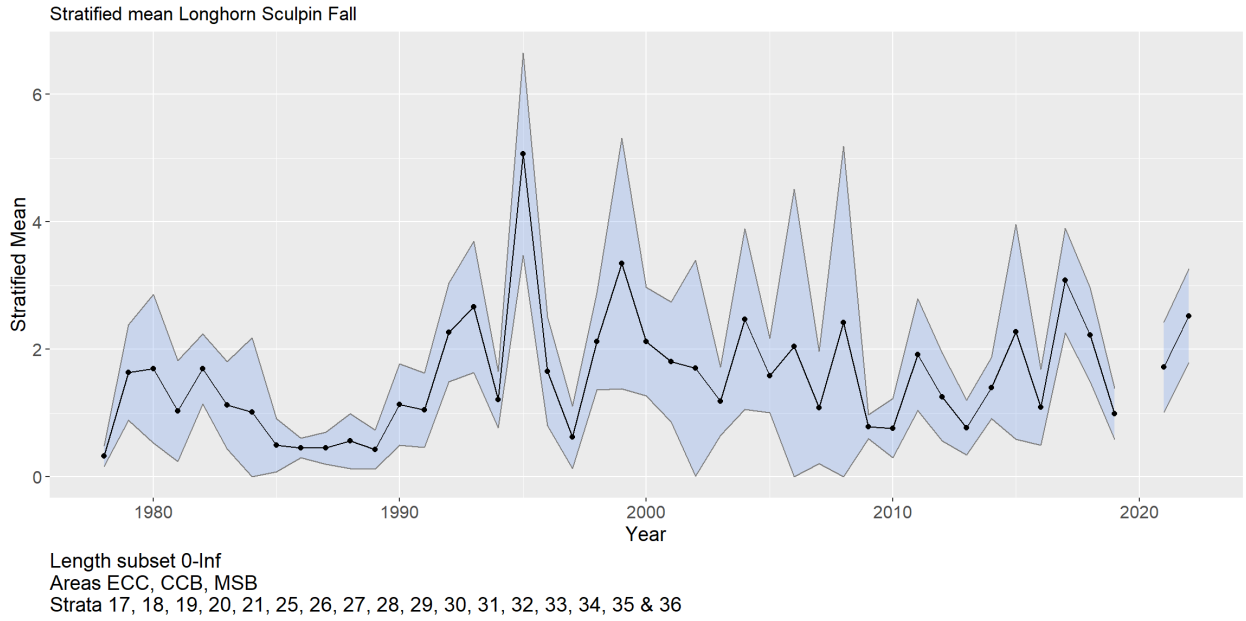

Figure 2x. Stratified mean weight per tow (kg) 1978 – 2022 MDMF fall Longhorn Sculpin regions 3,4, & 5.

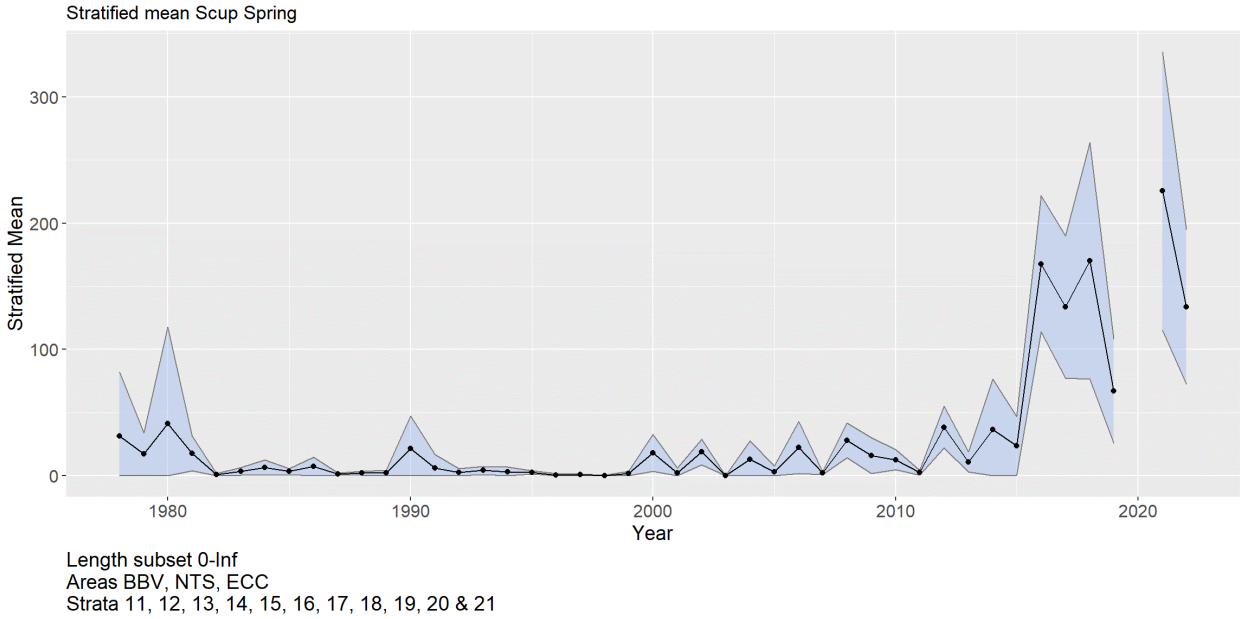

Figure 2y. Stratified mean weight per tow (kg) 1978 – 2022 spring Scup SNE.

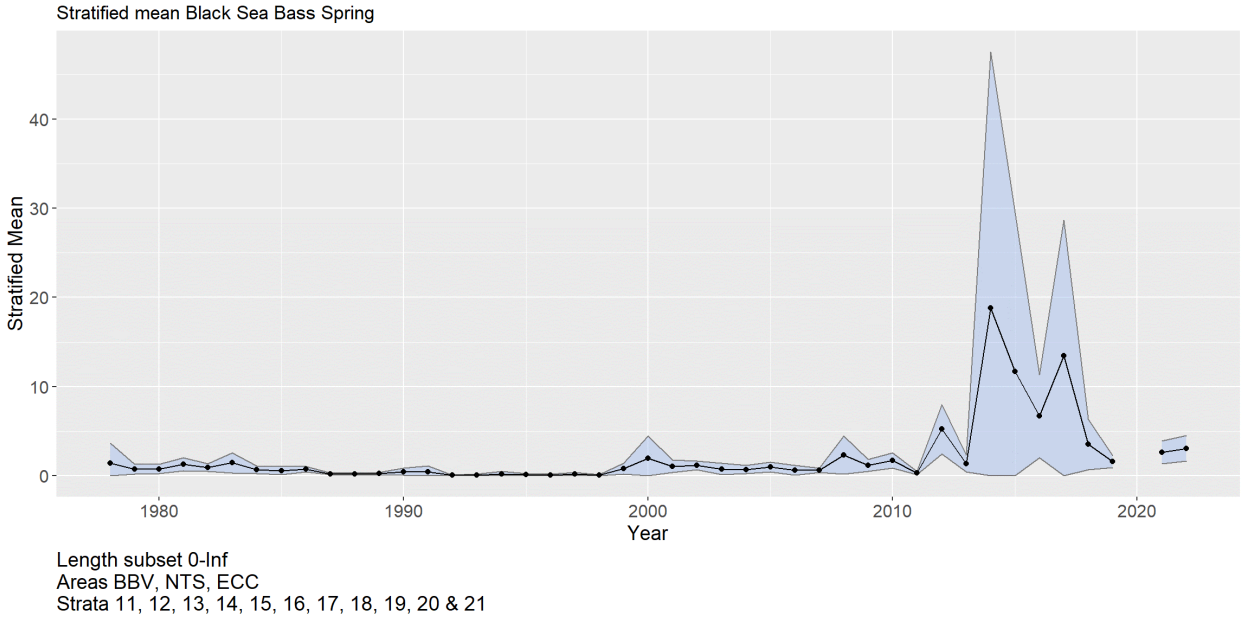

Figure 2z. Stratified mean weight per tow (kg) 1978 – 2022 spring Black Sea Bass SNE.

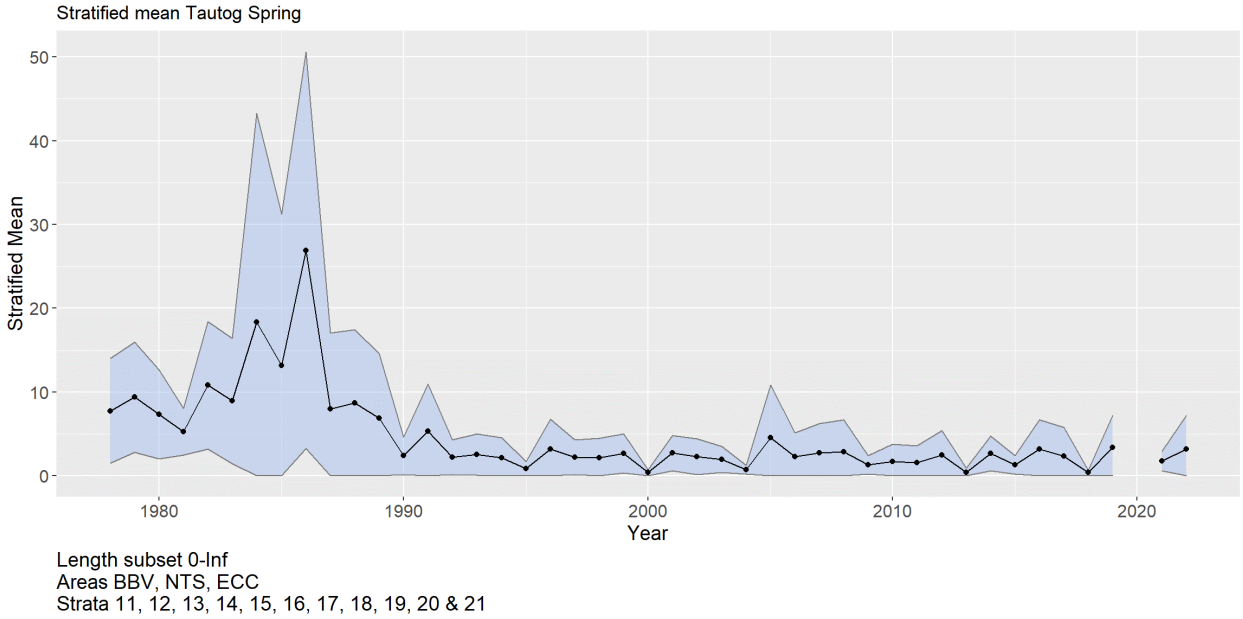

Figure 2aa. Stratified mean weight per tow (kg) 1978 – 2022 spring Tautog SNE.

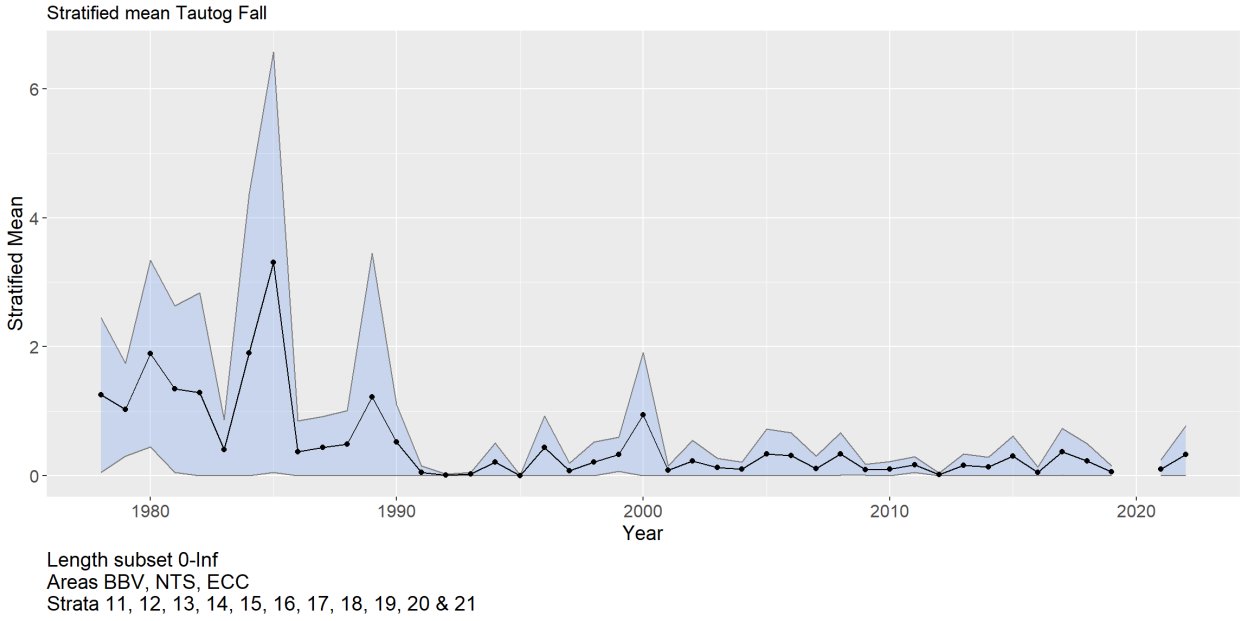

Figure 2bb. Stratified mean weight per tow (kg) 1978 – 2022 fall Tautog SNE.

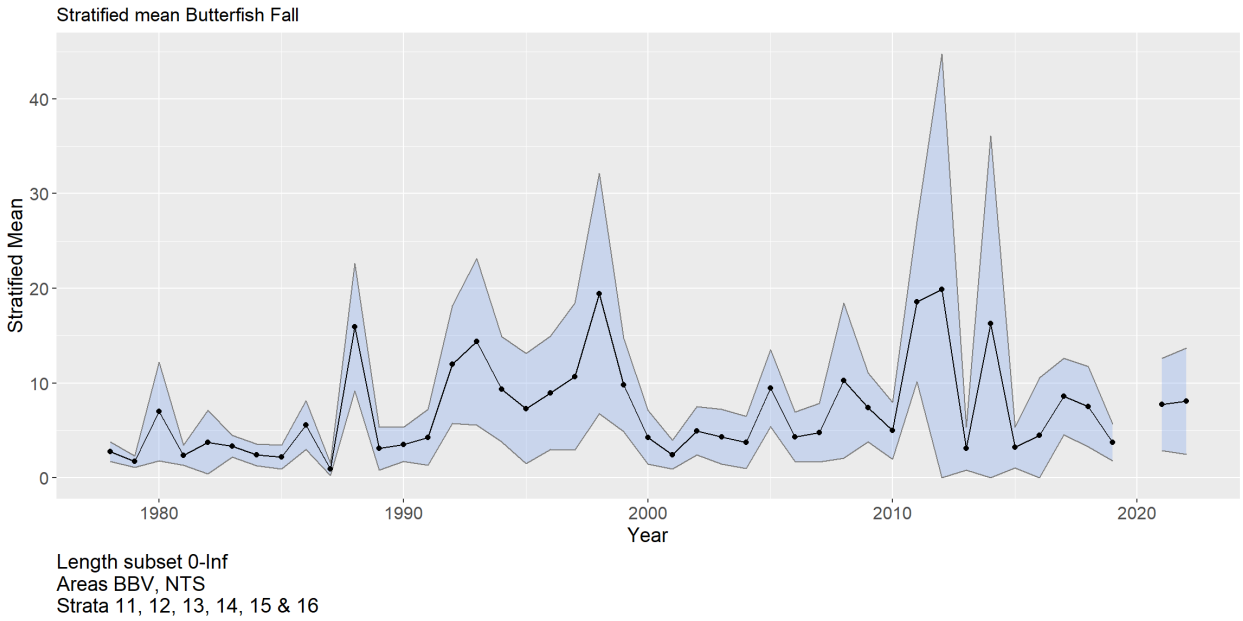

Figure 2cc. Stratified mean weight per tow (kg) 1978 – 2022 fall Butterfish regions 1&2.

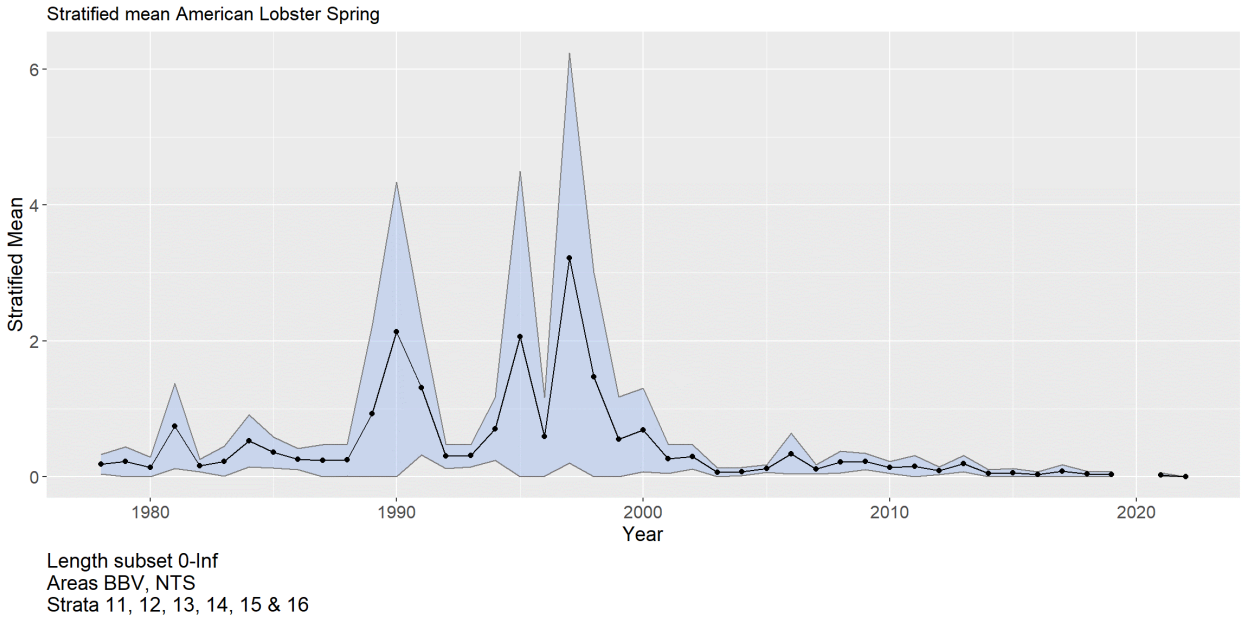

Figure 2dd. Stratified mean weight per tow (kg) 1978 – 2022 spring Lobster regions 1&2.

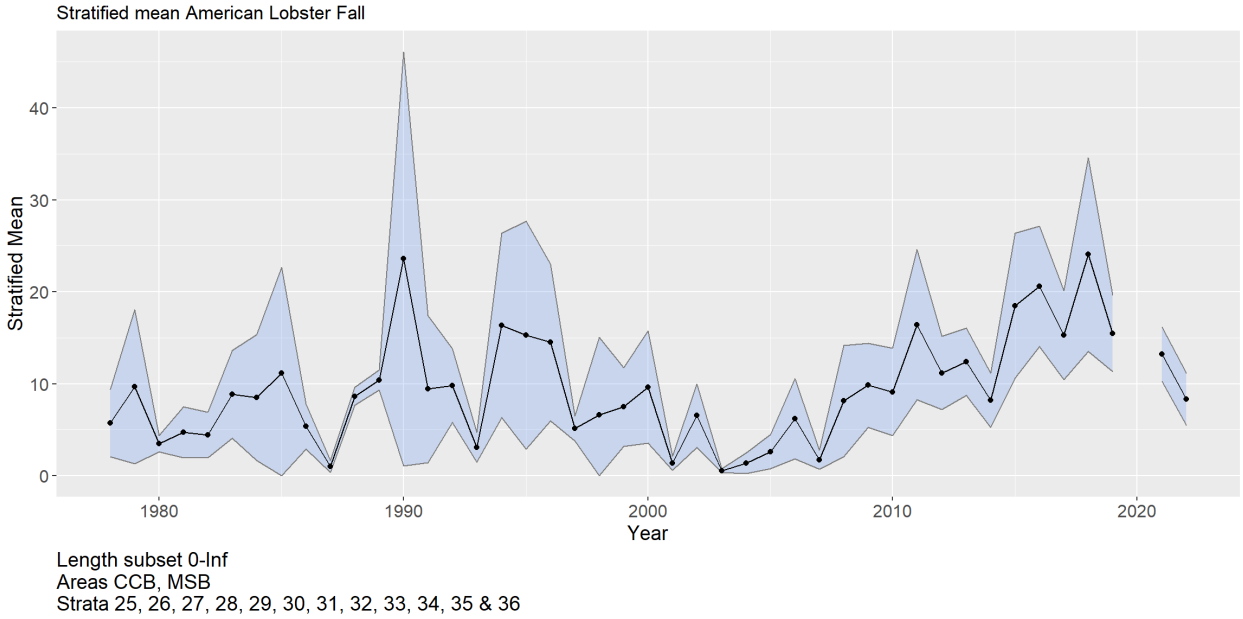

Figure 2ee. Stratified mean weight per tow (kg) 1978 – 2022 fall Lobster GOM.

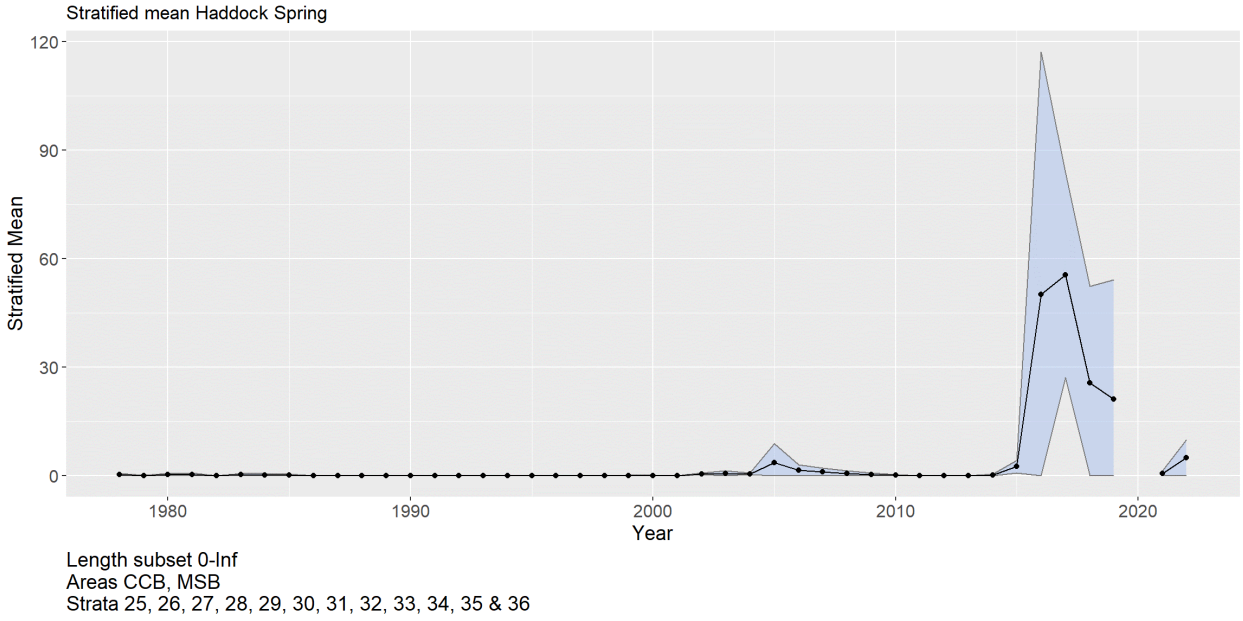

Figure 2ff. Stratified mean weight per tow (kg) 1978 – 2022 spring Haddock GOM.

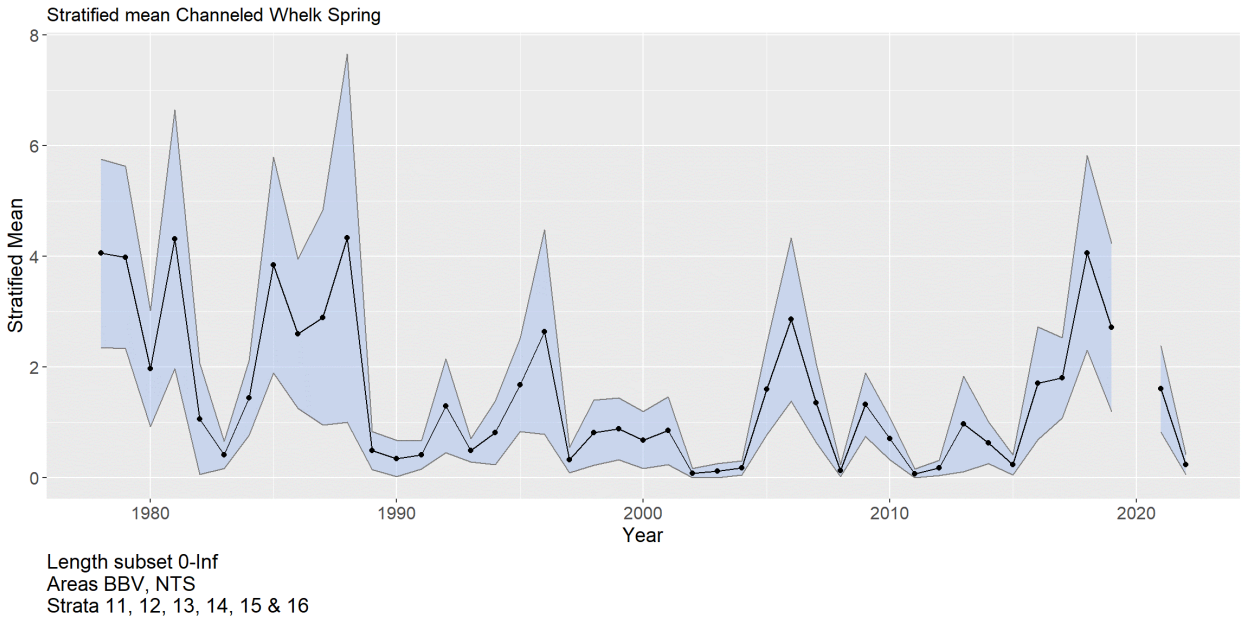

Figure 3a. Stratified mean number per tow 1978 – 2022 spring Channeled Whelk regions 1&2.

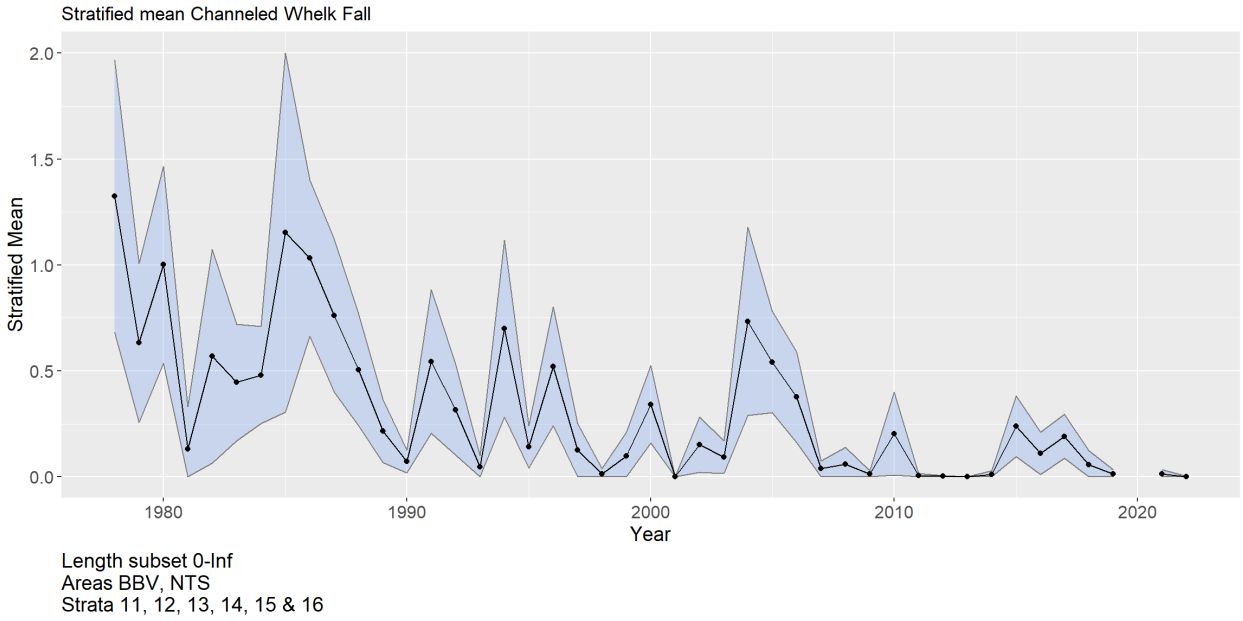

Figure 3b. Stratified mean number per tow 1978 – 2022 fall Channeled Whelk regions 1&2.

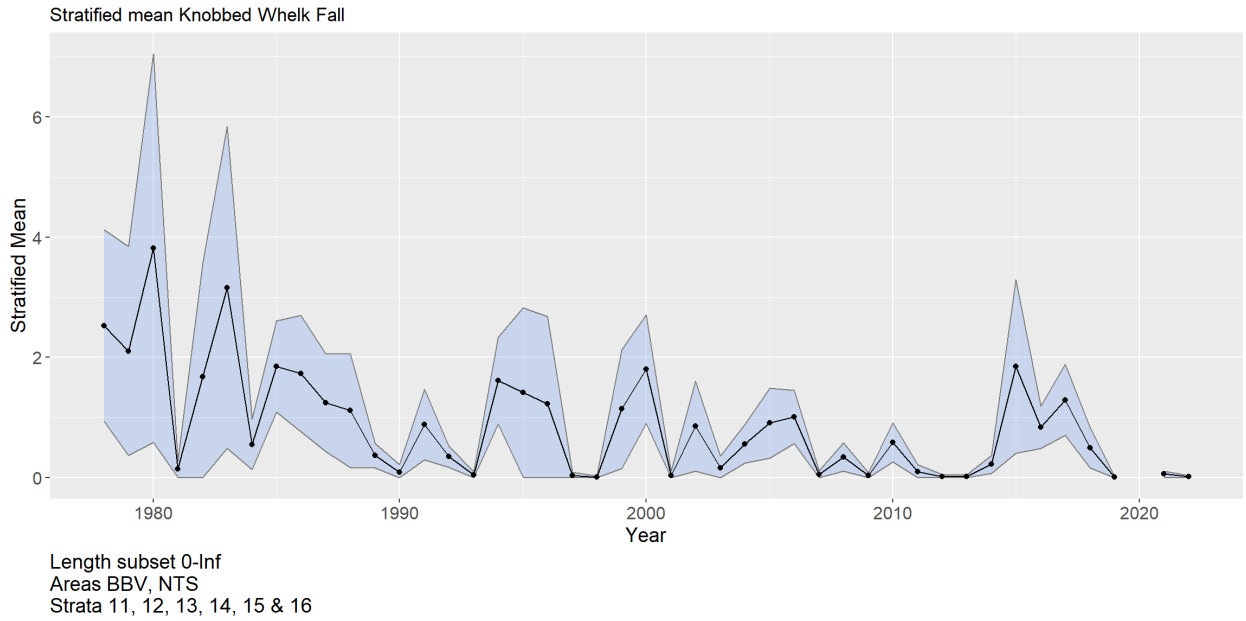

Figure 3c. Stratified mean number per tow 1978 – 2022 fall Knobbed Whelk regions 1&2.

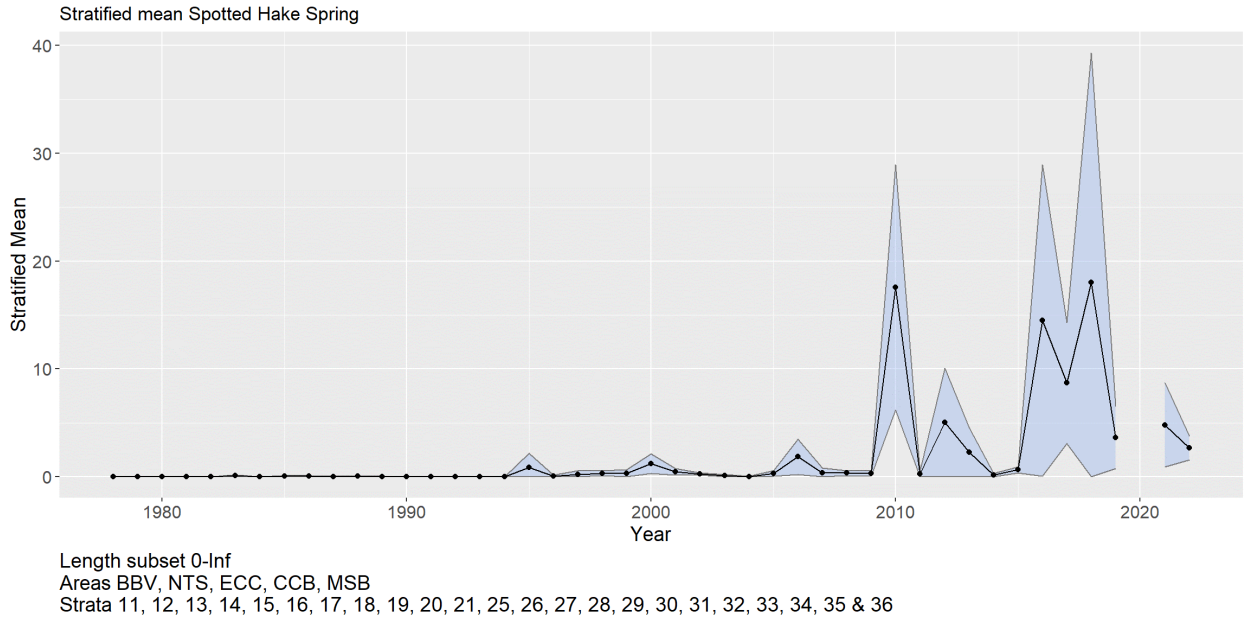

Figure 3d. Stratified mean number per tow 1978 – 2022 spring Spotted Hake.

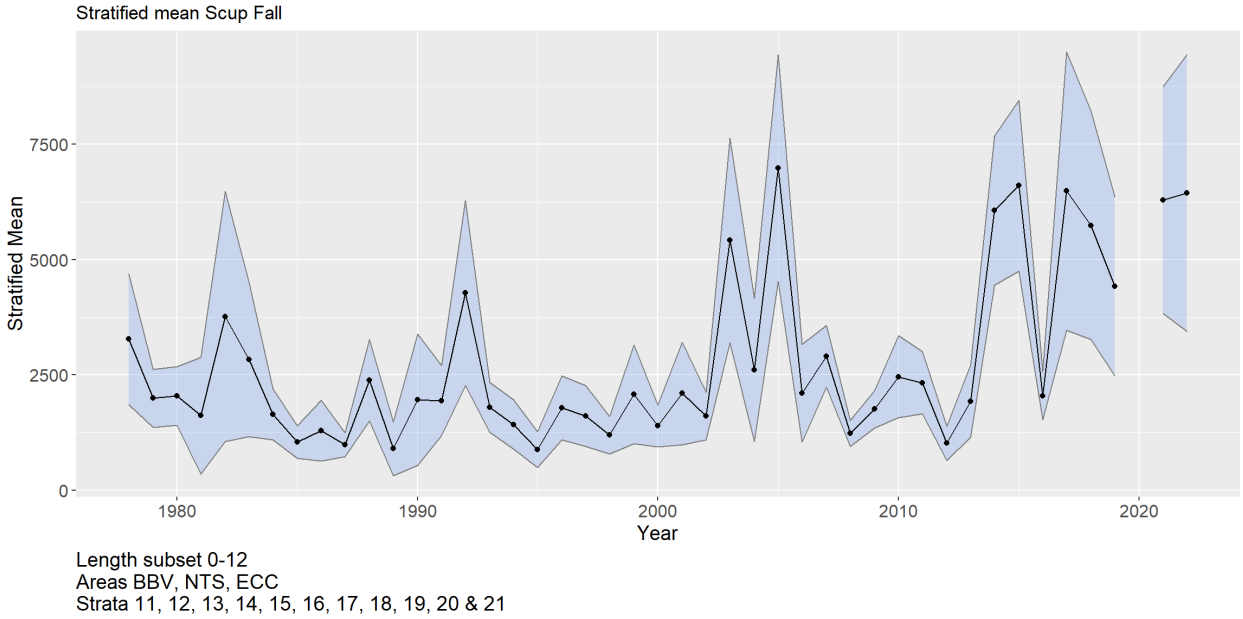

Figure 4a. Pre-recruit (<12 cm) stratified mean number per tow 1978 – 2022 fall Scup SNE.

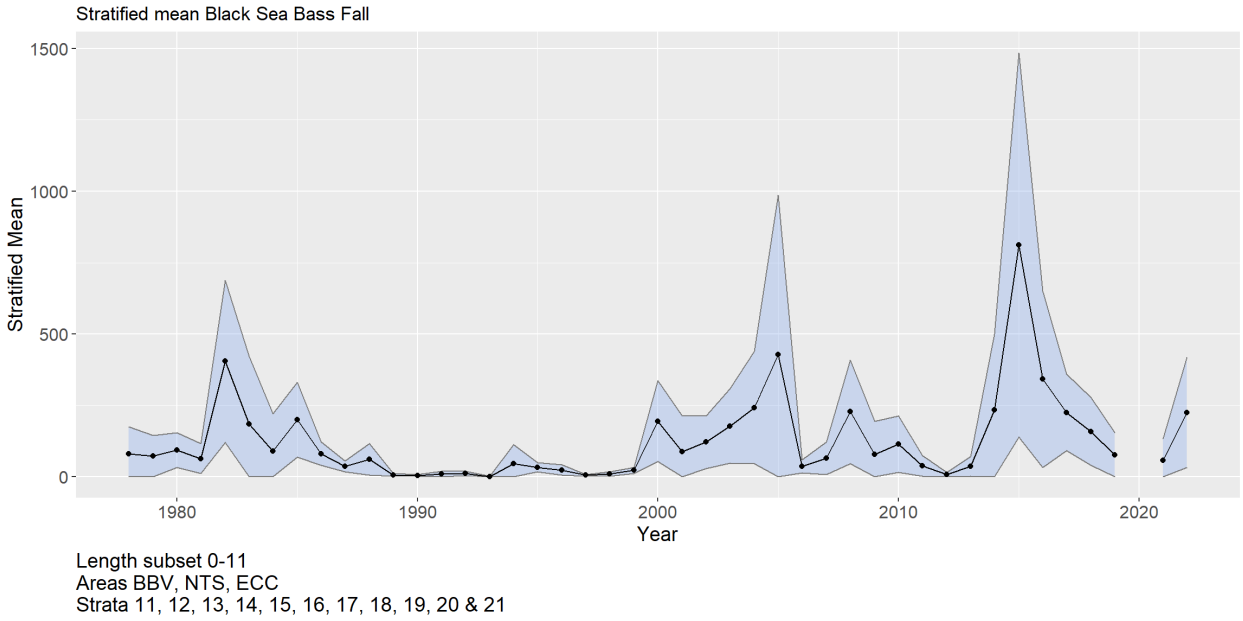

Figure 4b. Pre-recruit (<12 cm) stratified mean number per tow 1978 – 2022 fall Black Sea Bass SNE.

Appendix B.

Trends in Observed Bottom Temperatures
Massachusetts Bottom Trawl Survey.
1978 – 2022

A timeseries analysis of bottom temperatures recorded during spring and fall bottom trawl surveys is updated to include 2022 observations. No data was collected in 2020, due to cancellations of both spring and fall trawl surveys due to the COVID-19 Pandemic. For a detailed interpretation and description of methods used in data preparation and analysis, refer to the 2006 annual report, (2006 Annual Performance Report, F-56-R, Massachusetts Fishery Resource Assessment, Appendix E).

There is one difference between the methods employed in 2006 and the methods reported here. Temperature observations from non-representative stations (SHG >136) are included in the dataset beginning in Fall 2004 if the tow duration is at least 5 minutes (the minimum time necessary for the temperature logger to acclimate). Some of these observations were omitted from the 2006 analysis. Elimination of temperature observations from non-representative stations had the effect of producing fall temperature data gaps in region 3. In some years there were many tow durations of less than 13 minutes due to frequent large dogfish catches. These tows, though non-representative for generation of abundance and biomass indices for most species, are used when generating spiny dogfish indices. The temperature data collected at these 'dogfish tows' since 2004 is consistent with temperature data collected at all other stations utilizing the Onset Computer Corporation temperature loggers and is therefore included in the following temperature summaries. Please refer to Table 1 and 2 for a listing of data gaps.

Table 1. Stratum mean bottom temperatures recorded on the MDMF spring survey, 1978 – 2022.

	Region 1				Region 2		Region 3					Region 4						Region 5					
Year	11	12	13	14	15	16	17	18	19	20	21	25	26	27	28	29	30	31	32	33	34	35	36
1978	12.1	11.8	13.1	13.0	13.2	11.5	10.3	11.5	10.5	6.5	11.5	11.1	10.7	7.8	7.8	8.2	N/A	11.7	7.8	6.8	7.2	7.9	N/A
1979	13.3	13.1	11.8	11.3	13.3	11.5	12.0	11.9	9.9	7.5	5.0	7.3	7.9	6.7	4.2	4.0	3.9	10.4	8.5	6.4	5.5	4.9	3.5
1980	12.5	11.7	11.8	11.1	12.2	11.1	10.2	11.5	10.1	8.0	7.4	7.8	9.8	8.1	8.0	7.2	7.2	6.7	5.6	5.3	6.5	5.2	4.2
1981	12.4	11.0	10.4	7.5	10.5	10.4	10.5	7.6	7.9	6.5	6.5	7.9	8.2	6.5	6.3	6.6	5.8	8.8	7.6	5.4	5.3	5.4	4.8
1982	11.7	10.5	9.8	5.8	11.4	11.0	10.9	8.9	8.0	6.6	4.6	7.0	5.8	5.6	4.9	4.4	4.4	7.1	6.3	5.1	4.7	4.7	4.3
1983	11.9	11.7	11.6	10.1	12.4	11.2	9.2	9.5	9.0	5.5	6.5	7.2	8.9	7.0	6.2	6.5	5.0	6.0	6.1	6.2	5.3	6.0	5.0
1984	12.1	11.0	10.6	10.1	12.3	11.9	9.3	9.6	9.6	5.2	4.5	7.6	8.1	4.8	4.5	4.1	4.0	7.3	6.6	5.2	5.1	4.9	4.9
1985	12.1	11.1	11.4	10.5	12.1	11.6	9.4	10.6	10.1	7.8	7.0	10.3	8.9	8.0	6.8	5.8	5.0	7.6	7.3	6.2	5.9	4.7	4.5
1986	10.1	10.8	9.7	9.1	10.5	9.9	9.0	9.0	8.3	7.5	5.7	10.0	8.5	7.3	7.5	6.4	5.3	8.1	7.5	6.2	6.0	5.5	5.3
1987	10.7	10.4	10.2	9.5	12.1	11.4	9.2	8.7	8.3	6.4	5.9	9.1	8.1	7.2	6.2	5.1	5.7	7.4	7.3	6.6	6.2	6.2	5.6
1988	10.8	10.4	10.0	9.1	11.5	11.1	8.6	8.4	8.6	6.0	5.5	9.4	8.1	7.2	5.9	4.8	4.4	7.7	6.8	5.8	5.3	4.6	4.1
1989	9.5	9.0	7.1	6.7	10.9	9.5	7.5	7.5	6.6	4.7	3.6	7.4	5.4	4.4	4.3	2.4	1.5	6.1	4.5	3.8	3.0	3.3	2.6
1990	10.4	10.5	9.4	7.6	12.0	11.0	9.9	8.8	9.2	5.9	3.8	9.0	8.0	7.5	4.7	4.0	3.5	6.5	6.6	5.9	4.5	3.7	2.6
1991	14.1	13.0	11.3	9.9	13.8	13.3	11.4	10.9	10.0	7.0	5.2	11.6	11.3	10.2	8.1	6.0	5.0	7.8	5.9	6.2	7.2	6.1	4.7
1992	9.9	9.2	8.6	8.1	11.4	10.3	9.2	8.1	7.9	7.5	6.5	8.7	8.1	8.0	7.0	5.9	5.2	8.4	8.1	6.7	5.4	4.1	3.8
1993	12.6	11.5	11.1	9.9	12.4	11.5	9.7	9.4	8.6	5.0	4.5	8.9	7.9	6.0	5.4	5.0	3.7	7.6	6.1	4.7	4.6	3.7	3.7
1994	10.3	9.9	9.6	9.1	10.3	9.8	9.4	9.4	7.8	6.5	5.7	9.2	8.9	8.3	6.7	6.0	4.7	8.4	7.2	4.7	5.1	4.0	4.3
1995	11.7	11.2	9.9	9.6	10.6	10.0	9.2	8.4	8.5	6.9	6.8	9.0	8.6	8.0	7.6	6.0	4.9	7.9	8.2	6.5	6.2	4.7	4.1
1996	11.6	11.3	10.3	9.8	11.7	11.5	9.4	8.4	8.5	6.4	5.4	7.3	7.4	5.9	5.4	4.6	4.1	6.1	6.3	4.2	4.1	4.0	4.0
1997	10.9	10.1	9.0	7.3	11.4	11.2	9.9	8.9	8.4	6.2	6.1	7.2	7.9	6.6	6.4	5.5	5.3	5.5	5.4	5.2	4.7	4.7	4.7
1998	11.0	11.1	11.0	10.2	10.5	9.6	9.2	9.1	7.7	7.4	6.1	9.3	8.2	7.0	6.8	5.6	5.0	8.5	7.8	6.0	5.0	4.3	4.2
1999	15.0	13.3	12.7	11.7	14.6	13.6	11.3	10.6	10.7	6.2	5.5	11.5	9.6	8.2	6.1	4.8	4.7	9.1	7.3	6.4	5.2	4.9	4.3
2000	12.1	12.0	11.2	10.8	13.3	12.2	11.1	9.9	10.4	7.6	7.2	10.2	9.5	7.4	7.1	6.3	6.5	9.7	10.0	8.1	7.2	6.2	6.0
2001	13.3	11.5	11.2	8.8	12.9	11.6	11.5	11.1	10.2	5.7	4.9	7.9	9.7	6.1	6.0	4.9	4.6	7.6	7.7	5.2	4.7	4.5	4.5
2002	12.2	11.7	11.5	10.8	12.2	12.0	9.6	9.1	9.8	7.5	6.3	9.4	9.1	8.0	7.5	6.3	5.6	7.9	8.0	6.7	6.2	5.7	5.5
2003	11.5	11.3	11.2	9.7	11.6	10.8	8.4	8.5	9.1	4.7	4.2	7.9	7.7	5.8	5.2	4.1	3.8	7.2	6.5	5.4	4.2	4.0	3.9
2004	13.3	12.1	11.7	9.3	12.9	11.8	9.9	9.0	8.3	4.5	3.9	7.6	7.6	4.7	4.1	3.6	3.5	6.0	5.1	3.8	3.6	3.4	3.2
2005	11.6	11.2	10.4	9.8	9.3	9.2	9.1	8.2	7.4	5.3	5.0	7.9	7.6	6.6	6.0	5.1	4.6	7.2	7.3	6.1	5.3	5.0	4.4
2006	11.4	10.5	9.9	9.2	12.1	10.9	11.0	10.7	10.4	7.5	6.4	10.1	9.6	8.5	7.3	6.8	6.5	8.0	8.4	8.1	7.0	6.7	6.2
2007	12.8	11.6	10.7	9.2	12.2	11.6	10.5	10.2	8.8	5.3	4.9	9.9	10.1	6.2	4.8	4.4	4.3	6.3	6.3	4.2	4.1	4.2	4.1
2008	11.3	13.1	10.2	10.0	10.5	10.2	9.2	9.0	7.8	5.3	4.6	8.7	7.3	5.5	4.7	4.6	3.9	7.2	7.5	4.8	4.0	4.0	3.8
2009	12.6	11.8	11.1	8.8	13.1	12.4	9.5	9.5	9.2	4.4	4.2	9.2	8.1	6.3	4.7	3.8	3.6	8.2	7.7	5.5	4.3	4.1	3.6
2010	11.6	11.7	11.1	10.0	12.7	12.0	10.1	9.4	9.3	7.5	4.8	11.0	10.8	8.5	5.2	4.5	4.5	7.8	7.4	5.3	4.7	4.6	4.6
2011	11.6	11.2	10.6	9.9	11.3	10.6	9.6	9.6	9.2	7.1	7.0	9.5	8.2	6.7	8.1	6.4	4.8	7.9	7.4	5.0	4.7	4.5	4.4
2012	15.4	13.5	13.2	11.8	14.4	13.8	11.4	11.2	11.6	8.3	7.2	11.2	9.9	8.5	7.3	6.6	6.3	8.9	8.4	7.5	6.6	6.2	5.7
2013	13.5	12.7	11.2	10.3	13.5	12.8	11.3	11.8	11.0	7.4	6.6	9.8	10.1	8.0	7.3	6.1	5.5	9.4	8.6	7.6	6.5	5.9	5.2
2014	13.4	12.1	11.0	10.9	13.2	11.8	9.9	9.5	8.7	5.1	4.2	9.3	8.3	7.4	6.0	4.1	3.4	6.7	6.6	5.6	4.7	4.1	3.9
2015	13.4	12.2	10.8	10.1	13.3	12.2	9.5	9.7	8.9	5.8	4.9	10.5	9.3	6.8	6.0	3.7	3.6	6.4	6.9	5.1	4.5	4.2	4.1
2016	13.0	12.1	10.5	9.7	13.8	13.0	10.3	10.5	11.4	8.7	6.8	9.9	9.6	9.6	9.4	6.6	6.0	8.2	8.3	7.1	6.0	5.9	5.5
2017	13.5	13.2	11.9	10.9	13.7	12.8	10.9	10.6	10.1	7.0	6.2	9.9	7.6	6.3	6.3	5.0	4.8	8.1	6.4	5.4	5.0	4.9	4.6
2018	12.2	11.8	11.4	10.7	12.7	11.7	9.9	9.4	9.3	6.9	5.8	9.8	7.6	6.0	5.5	5.1	5.0	8.0	6.7	5.6	5.1	4.9	4.8
2019	11.7	11.3	10.8	9.5	11.2	11.0	10.2	10.0	10.7	6.7	5.8	8.9	7.9	6.9	6.5	5.0	4.7	7.3	7.6	6.0	4.9	4.6	4.5
2020	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2021	12.7	11.5	10.7	8.0	14.3	13.7	10.3	10.2	9.8	8.4	6.5	10.5	9.8	9.8	8.2	7.2	5.9	8.2	8.3	7.4	6.8	6.4	6.2
2022	13.4	12.5	12.1	11.6	12.8	12.4	11.1	10.4	11.1	9.7	7.8	9.2	8.7	9.2	8.7	8.2	8.0	8.5	8.8	7.6	7.3	6.8	5.7
Median	12.1	11.5	10.9	9.8	12.2	11.5	9.9	9.5	9.2	6.5	5.7	9.2	8.3	7.1	6.3	5.1	4.8	7.8	7.3	5.9	5.2	4.7	4.4
Mean	12.1	11.5	10.8	9.7	12.2	11.5	10.0	9.6	9.2	6.6	5.8	9.1	8.6	7.2	6.3	5.4	4.8	7.8	7.2	5.9	5.3	5.0	4.5
Maximum	15.4	13.5	13.2	13.0	14.6	13.8	12.0	11.9	11.6	9.7	11.5	11.6	11.3	10.2	9.4	8.2	8.0	11.7	10.0	8.1	7.3	7.9	6.2
Minimum	9.5	9.0	7.1	5.8	9.3	9.2	7.5	7.5	6.6	4.4	3.6	7.0	5.4	4.4	4.1	2.4	1.5	5.5	4.5	3.8	3.0	3.3	2.6

Table 2. Stratum mean bottom temperatures recorded on the MDMF fall survey, 1978 – 2022.

	Region 1				Region 2		Region 3					Region 4						Region 5					
Year	11	12	13	14	15	16	17	18	19	20	21	25	26	27	28	29	30	31	32	33	34	35	36
1978	16.0	16.3	14.7	14.5	16.1	16.5	13.0	13.7	12.6	N/A	7.8	16.5	12.0	9.4	9.6	8.2	7.0	13.7	13.6	9.2	9.5	8.1	6.5
1979	16.7	16.5	15.8	16.0	16.9	16.1	13.6	14.7	14.2	10.2	9.7	11.3	12.3	8.1	8.9	7.9	8.8	11.7	10.0	9.1	8.8	8.8	8.2
1980	18.1	18.5	17.4	16.5	19.9	19.8	15.5	15.1	13.7	8.4	10.6	18.7	12.9	9.6	9.2	8.6	8.8	12.3	10.5	10.9	9.2	9.1	8.4
1981	19.2	18.4	16.8	16.6	19.6	19.1	16.2	16.4	15.5	11.0	10.2	15.3	13.7	13.5	12.9	11.9	9.9	13.4	13.1	12.2	12.0	11.8	9.6
1982	17.3	17.4	16.9	15.4	18.3	18.3	15.9	14.7	12.6	10.4	7.7	16.1	12.3	9.2	7.8	7.5	7.8	13.0	12.5	9.4	7.5	7.7	7.1
1983	20.3	19.5	17.8	16.7	20.9	20.5	16.0	16.6	14.1	9.5	8.5	15.0	14.9	10.8	9.2	9.0	8.3	N/A	N/A	N/A	N/A	N/A	N/A
1984	18.6	18.5	17.2	14.7	18.6	18.6	15.5	15.5	13.9	8.7	7.3	15.4	13.0	10.0	8.8	6.9	6.4	10.0	9.1	7.5	7.5	7.5	7.4
1985	19.3	18.8	18.5	16.5	19.1	19.0	16.9	15.4	15.6	13.6	9.1	16.4	14.6	13.6	11.6	9.8	8.2	16.2	14.4	13.8	10.4	9.2	8.1
1986	16.9	17.8	16.0	15.5	17.3	17.4	15.0	13.3	14.0	12.3	8.5	17.2	13.1	10.6	9.7	9.0	8.4	11.4	11.0	10.2	9.9	8.9	7.8
1987	16.4	16.7	16.7	16.3	19.2	18.7	13.5	13.1	12.9	7.0	6.1	12.7	7.8	6.4	5.4	5.0	5.1	N/A	8.6	6.4	6.2	5.6	4.9
1988	16.0	16.2	15.5	14.3	16.1	16.7	13.0	12.7	12.9	7.3	5.7	15.1	11.0	9.6	8.1	6.6	5.9	N/A	10.7	10.1	8.5	6.9	6.4
1989	19.3	18.9	17.2	14.9	19.0	18.3	15.7	16.7	11.9	5.6	4.5	12.0	8.9	8.1	7.5	6.8	5.1	13.0	11.2	9.6	8.5	7.7	6.8
1990	19.0	19.0	18.4	17.5	20.5	20.3	17.3	16.7	16.4	11.5	9.5	17.9	16.3	14.2	10.3	9.1	7.2	14.6	11.6	10.9	10.5	9.1	7.8
1991	19.6	19.2	18.6	18.1	19.5	19.7	17.2	16.8	16.1	13.7	10.7	16.4	16.2	13.8	13.3	10.5	9.0	16.6	N/A	12.1	10.2	8.9	8.5
1992	18.2	18.0	17.6	16.5	19.6	19.4	15.3	12.8	13.2	7.7	6.5	14.1	12.0	8.7	7.7	6.7	6.2	11.7	10.0	9.4	8.0	6.8	6.2
1993	17.1	17.5	16.9	16.2	18.1	19.4	13.9	16.6	14.2	8.4	7.0	13.6	12.4	8.8	8.3	7.7	6.9	12.6	11.0	9.0	8.8	8.0	6.9
1994	18.2	18.1	17.2	16.6	18.8	18.9	16.6	16.3	15.9	14.1	12.6	16.4	16.6	15.5	14.8	10.6	9.7	15.8	15.2	13.4	12.4	10.1	9.8
1995	N/A	N/A	N/A	N/A	19.2	19.4	13.7	11.7	10.7	8.7	8.3	12.8	11.7	10.4	9.8	8.8	9.2	14.9	13.0	10.3	9.3	8.6	8.5
1996	18.8	16.8	17.6	16.5	18.2	18.6	16.2	17.0	15.3	10.2	8.2	16.6	15.4	13.5	13.0	9.4	8.6	16.5	16.2	12.8	10.0	8.3	8.0
1997	18.4	18.6	17.5	17.7	20.2	19.7	16.4	17.2	14.3	9.3	8.3	17.4	16.3	11.4	9.3	8.9	8.1	16.5	15.4	13.3	9.8	8.2	8.3
1998	18.7	18.1	16.6	15.2	19.0	19.4	15.4	14.9	13.8	6.3	6.5	14.3	10.7	9.4	8.8	6.4	5.7	13.9	10.8	8.4	7.9	6.8	N/A
1999	20.3	19.8	19.3	18.2	19.9	19.9	18.1	16.0	14.9	9.2	7.7	16.2	12.2	10.2	9.5	8.4	7.8	14.6	11.8	10.4	9.7	8.6	8.7
2000	18.9	18.7	17.0	16.2	20.4	20.0	18.0	17.3	16.6	10.4	9.4	18.5	17.7	12.4	10.1	9.2	8.8	16.7	15.1	11.0	10.4	9.7	8.9
2001	19.5	19.3	17.8	16.9	20.7	20.2	15.2	16.2	12.2	7.9	6.5	16.2	10.7	8.7	7.4	6.6	6.4	10.9	8.7	8.5	7.3	6.8	6.9
2002	19.4	19.2	17.0	16.8	20.4	20.3	18.1	16.8	16.5	10.7	9.4	18.8	18.1	14.4	12.6	10.1	8.7	17.9	16.7	12.5	10.2	9.2	8.1
2003	20.2	19.0	18.6	18.0	20.0	19.4	15.8	15.6	14.7	9.7	8.7	15.0	10.9	8.3	7.7	7.5	6.8	14.4	11.6	10.5	8.6	7.3	7.2
2004	17.5	17.4	16.7	15.5	18.0	17.6	14.7	13.2	11.2	7.5	6.7	12.0	9.2	8.4	7.3	6.8	6.1	14.0	12.2	9.1	8.0	7.5	6.3
2005	20.9	20.0	18.1	17.5	20.3	21.2	16.1	15.9	16.6	7.5	6.5	16.2	10.3	7.5	6.7	6.2	5.9	11.6	10.4	8.8	6.9	6.0	5.5
2006	18.9	18.6	17.0	16.5	19.5	19.3	17.0	16.3	15.8	10.1	8.7	16.4	14.1	11.1	10.7	9.1	7.9	17.2	16.4	11.8	10.0	8.4	7.7
2007	18.4	19.0	18.1	15.3	19.9	20.3	16.8	16.3	14.5	8.2	8.7	16.8	12.8	8.8	7.6	6.8	6.1	11.1	10.3	8.7	7.4	6.7	6.6
2008	19.8	20.1	19.1	18.2	20.8	20.2	18.2	16.9	14.3	8.4	7.7	19.8	19.2	12.0	9.4	8.4	7.4	15.4	13.3	10.7	8.9	8.4	7.6
2009	19.0	18.7	17.8	17.6	19.3	19.1	17.2	16.8	17.9	14.6	10.0	17.4	15.8	13.3	12.0	9.5	8.4	16.9	17.2	16.2	11.3	8.9	7.5
2010	18.7	18.5	17.1	16.3	19.6	19.7	17.3	17.0	15.1	10.9	8.9	15.9	15.6	13.5	9.6	8.0	7.7	13.8	11.7	10.5	9.1	8.5	8.0
2011	19.7	19.8	17.7	16.6	20.7	19.9	17.1	16.2	16.4	13.9	9.0	15.0	13.1	10.3	9.9	9.3	8.5	15.6	15.0	13.5	11.8	9.0	8.0
2012	19.6	20.2	18.8	17.8	20.3	21.3	17.0	17.3	19.4	9.0	8.3	11.8	10.4	9.5	8.9	8.8	8.5	13.0	11.8	10.4	9.6	8.9	8.9
2013	18.2	18.5	17.6	15.7	20.8	20.3	16.5	16.6	15.7	9.5	9.0	15.9	11.2	9.7	9.0	8.6	8.4	14.2	12.5	11.2	9.9	8.8	7.9
2014	20.3	20.4	19.0	17.2	21.2	20.5	17.9	15.6	16.3	8.9	7.8	16.8	12.7	9.0	8.1	7.3	6.9	11.3	11.1	9.1	8.4	7.9	7.3
2015	21.5	20.7	18.9	16.2	20.9	20.1	18.7	16.2	15.9	10.0	9.2	15.7	14.5	10.3	9.7	8.7	7.8	16.9	12.5	11.7	9.7	8.4	7.7
2016	21.1	20.4	18.3	16.8	21.2	21.2	18.2	18.2	18.8	12.5	10.4	19.3	17.7	16.0	13.0	9.9	9.4	18.3	17.7	14.3	10.9	10.1	13.4
2017	19.9	19.2	18.4	16.6	19.4	19.3	16.1	15.2	14.3	9.1	8.2	15.5	16.2	10.0	8.8	7.6	7.2	12.8	10.3	8.7	8.0	7.7	6.9
2018	21.3	20.3	19.9	19.0	21.7	21.2	17.9	16.5	16.6	11.0	10.4	18.7	14.8	11.3	11.0	10.3	10.0	16.0	14.7	12.1	11.2	10.8	9.2
2019	20.5	19.9	18.0	17.0	18.7	19.5	18.1	18.4	16.8	11.3	10.0	17.3	14.0	9.6	8.8	8.1	8.1	15.7	15.6	12.9	10.2	8.3	N/A
2020	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2021	21.6	21.4	20.5	19.3	22.6	22.1	18.8	18.6	16.3	10.7	10.3	18.7	18.9	13.0	11.8	10.5	9.6	14.7	12.3	11.6	11.0	10.0	9.8
2022	21.0	20.9	19.7	18.4	21.3	21.6	18.9	19.1	17.5	12.2	11.0	14.6	12.3	11.7	10.3	9.4	9.4	17.9	17.1	14.3	11.8	10.5	9.1
Median	19.0	18.8	17.6	16.6	19.6	19.6	16.4	16.3	15.0	9.7	8.6	16.2	13.0	10.3	9.3	8.6	8.0	14.4	12.2	10.5	9.6	8.4	7.8
Mean	19.0	18.8	17.7	16.6	19.6	19.5	16.3	15.9	14.9	9.9	8.5	15.9	13.6	10.8	9.6	8.4	7.8	14.3	12.7	10.8	9.4	8.4	7.8
Maximum	21.6	21.4	20.5	19.3	22.6	22.1	18.9	19.1	19.4	14.6	12.6	19.8	19.2	16.0	14.8	11.9	10.0	18.3	17.7	16.2	12.4	11.8	13.4
Minimum	16.0	16.2	14.7	14.3	16.1	16.1	13.0	11.7	10.7	5.6	4.5	11.3	7.8	6.4	5.4	5.0	5.1	10.0	8.6	6.4	6.2	5.6	4.9

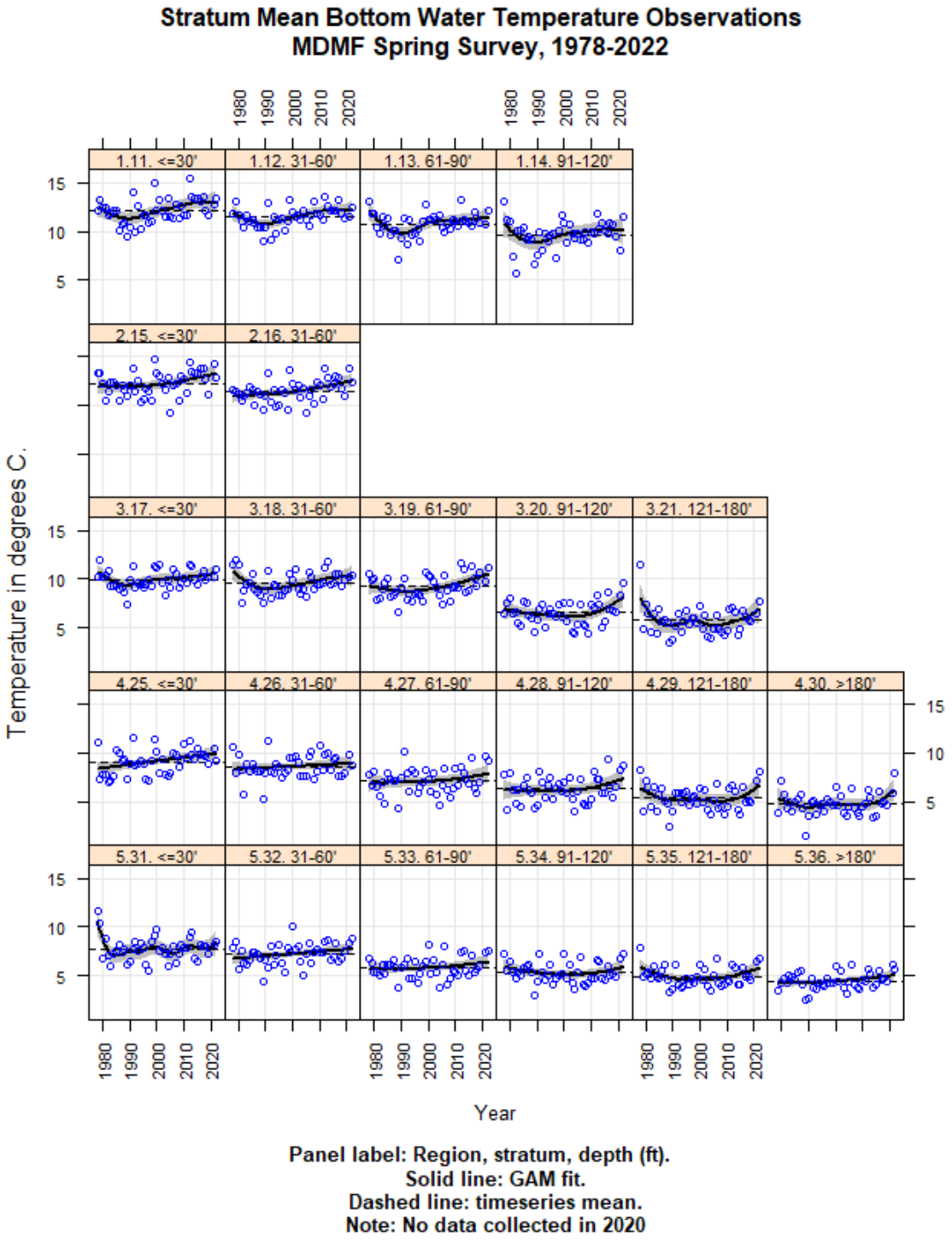

Figure 1. Stratum mean bottom water temperatures recorded on the MDMF spring survey by strata, 1978 – 2022.

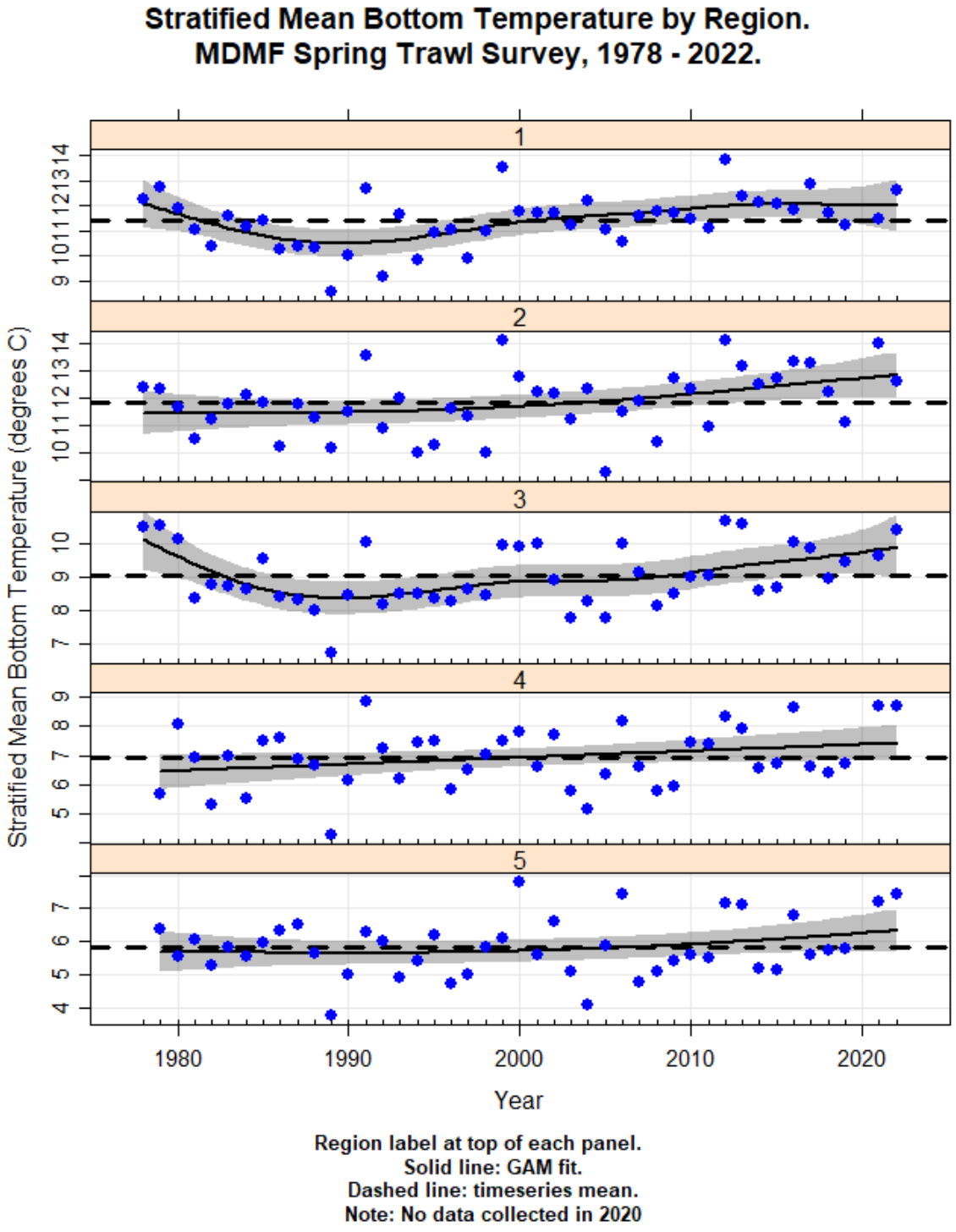

Figure 2. Stratum mean bottom water temperatures recorded on the MDMF spring survey by region, 1978 – 2022.

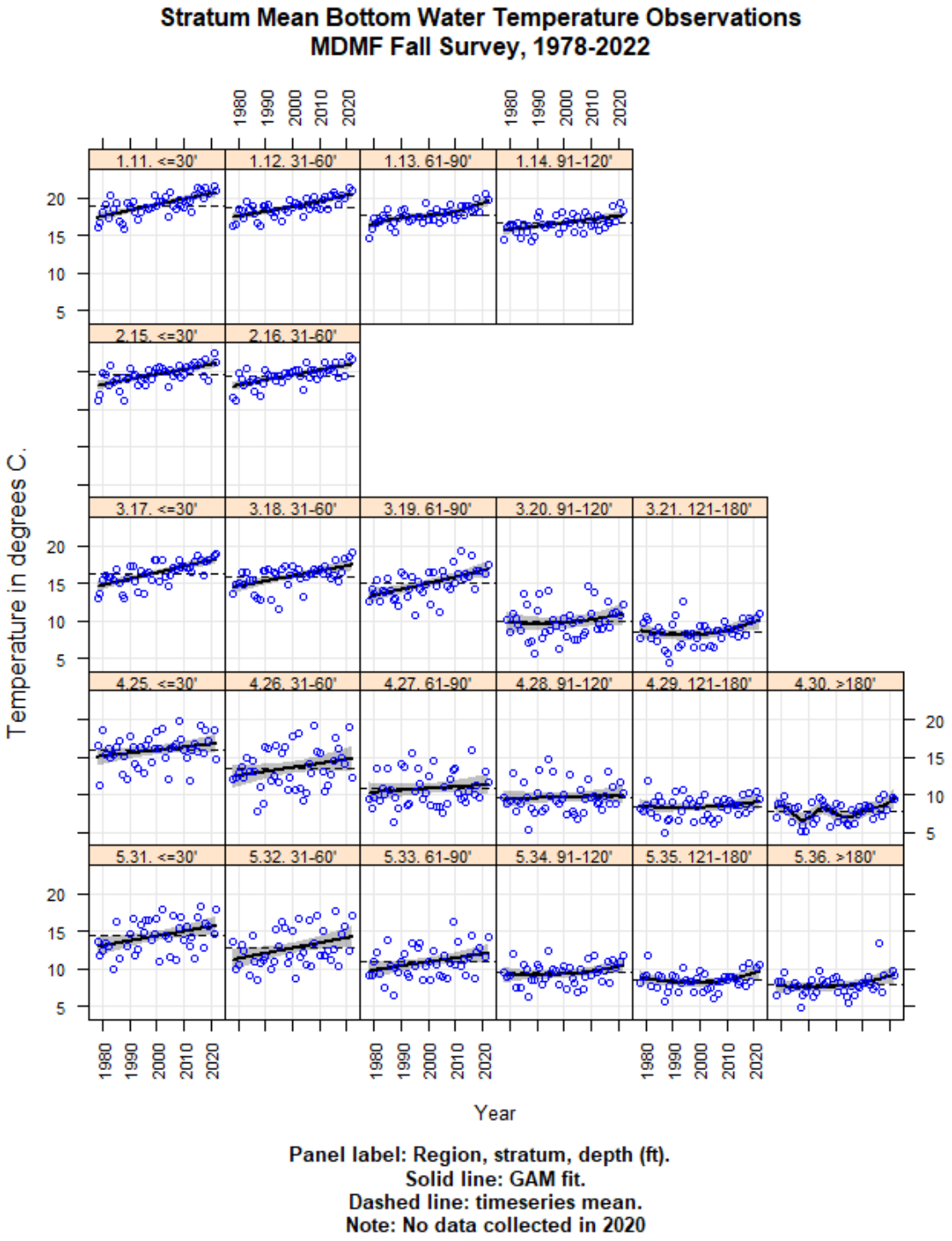

Figure 3. Stratum mean bottom water temperatures recorded on the MDMF fall survey by strata, 1978 – 2022.

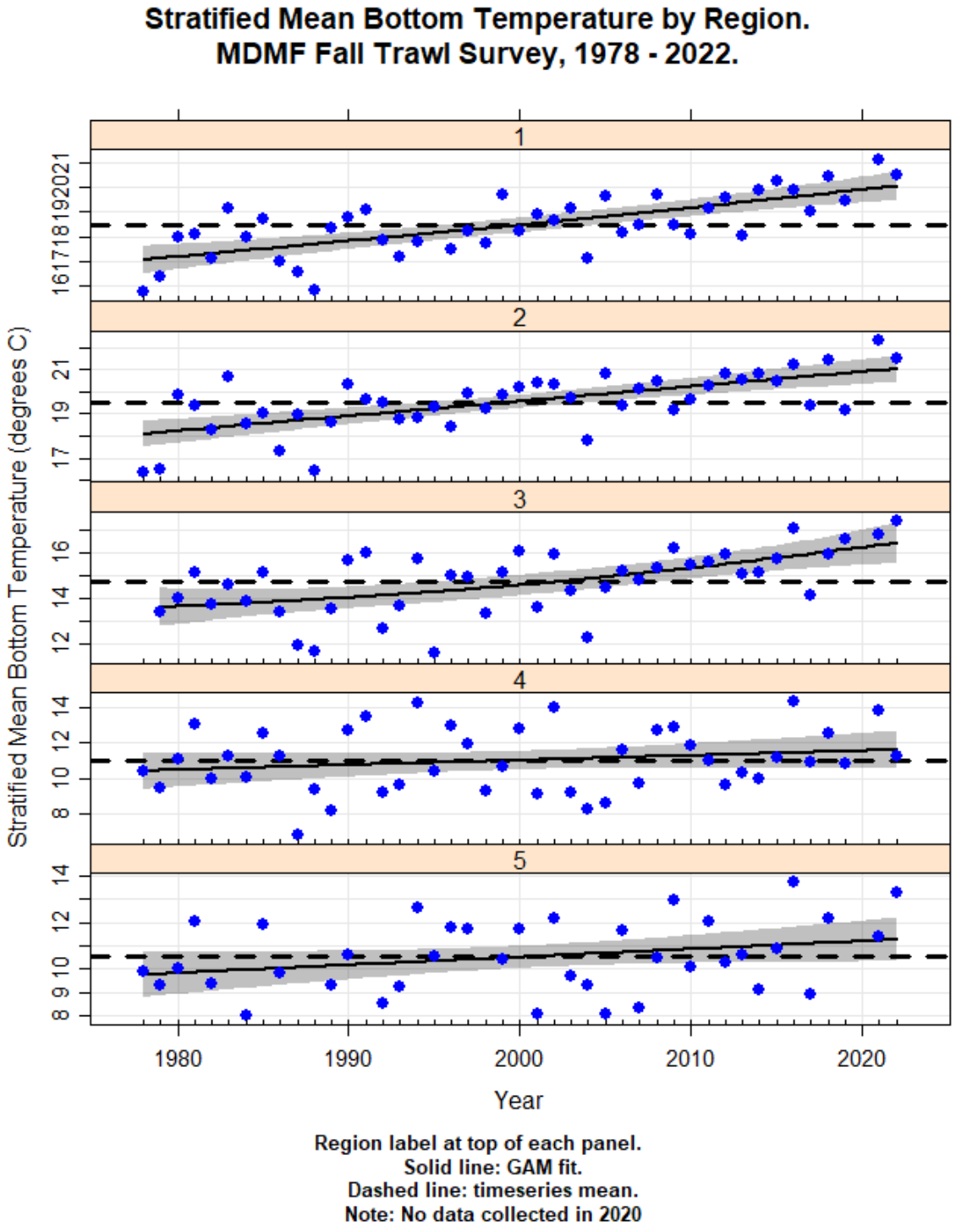

Figure 4. Stratum mean bottom water temperatures recorded on the MDMF fall survey by region, 1978 – 2022.

Appendix C. Corrections to the trawl survey database in 2022

No database corrections were made in 2022.