

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



2023 Annual Performance Report

State: Massachusetts

Agency: Division of Marine Fisheries

Project Title: Massachusetts Fishery Resource Assessment

FA Grant Agreement: F-56-R

Segment Number: 29

ASAP ID No. F12AF00099

Period Covered: January 1, 2023 – December 31, 2023

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Date Submitted: 2/22/2024

Sport Fish Program
Massachusetts Fishery Resource Assessment:
F-56-R-29 2023 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-fifth annual spring and fall bottom trawl surveys of Massachusetts territorial waters in 2023. 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-eighth 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 2023 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 - 2023.

[Appendix C:](#) Corrections to the trawl survey database in 2023.

CRUISE RESULTS

R/V GLORIA MICHELLE

2023 Massachusetts Inshore Spring
Bottom Trawl Survey
Cruise No. 202391

CRUISE PERIOD AND AREA

From May 8 through May 23, 2023, the Massachusetts Division of Marine Fisheries conducted its 45th 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 (Figure 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.

Thirty-two MDMF employees participated in the survey as part of the scientific party along with one biologist from NOAA, one biologist from University of Massachusetts Amherst and one biologist from Responsible Offshore Science Alliance (Table 1).

CRUISE SUMMARY

There were 112 stations attempted in 16 sampling days (Figures 1 and 2, Table 2). 101 completed stations were considered acceptable for assessment of all species, SHG ≤ 136 (Table 3) and no substandard tows were processed (Table 4). Eleven attempted tows were aborted during the survey. Aborts were caused by hard bottom, excessive weed/algae, lobster gear, and mechanical issues (Table 5, Figure 3). The survey was completed two days ahead of schedule and all planned stations were attempted.

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 2023 spring survey at individual stations. The largest tow for Bay Anchovy abundance (581 individuals) and biomass (1.686 kg) as well as Kingfish abundance (4 individuals) and biomass (1.369 kg) was observed at station 94 east of Fairhaven. At station 102 south of Hyannis the largest biomass tow of Scup (2,464.274 kg) was recorded. The largest Atlantic Halibut (10.717 kg) in the survey's timeseries was observed at station 48 west of Race Point. The survey also observed the largest Atlantic Sturgeon (49.83 kg) to date at station 52 west of Truro.

There were several other notable species trends observed during this survey. Atlantic Cod set record low estimates for abundance and biomass. Little Skate set new records for lowest abundance and biomass and were observed at the lowest percent of stations in the timeseries. Winter Skate catches also remained low continuing recent trends. Winter Flounder abundance and biomass remained stable, though they were observed at the lowest percentage of stations in timeseries history. Scup set a record for highest biomass throughout the survey. Longfin Squid set a record for highest abundance almost doubling the previous mark. The increase in Longfin Squid was driven by record high abundance in six of our eleven strata south of Cape Cod. Butterfish and Black Sea Bass each followed similar past trends for abundance and biomass but were observed at record high percentage of stations this survey. Silver Hake trends remained stable but had record abundance estimates in strata 21 and 30 (both 180+ feet) near Race Point.

Overall survey trends consisted of the same species composition as other recent years. Scup dominated the catches south of Cape Cod and accounted for 47% of all catch by number and 64% of all biomass throughout the survey. In addition to scup, catches south of Cape Cod consisted of high numbers of Longfin Squid and moderate catches of

Northern Searobins and Butterfish. North of Cape Cod had moderate catches of Winter Flounder, Longhorn Sculpin, Yellowtail Flounder, Silver Hake, and Red Hake. 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, Weakfish, Tautog and American Lobster. Additional samples and catch information were collected to assist ongoing research by fisheries scientists from UMass Amherst, Gloucester Marine Genomics Institute, Center for Coastal Studies, and MDMF.

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 202391.

Scientific Party		
Name	Affiliation	Num. Days
Vincent Manfredi	MADMF	9
Mark Szymanski	MADMF	8
Steve Voss	MADMF	8
Steve Wilcox	MADMF	8
Mike Blanco	MADMF	4
Michele Heller	MADMF	4
Ross Kessler	MADMF	4
Elise Koob	MADMF	4
Brendan Reilly	MADMF	4
Chrissy Pettipas	MADMF	3
Scott Schaeffer	MADMF	3
Sandy Sutherland	NOAA/NEFSC-WH	3
Sam Truesdell	MADMF	3
Alex Boeri	MADMF	2
Forest Schenck	MADMF	2
Katrina Zarella-Smith	UMASS Boston	2
John Boardman	MADMF	1
Erin Burke	MADMF	1
Dave Chosid	MADMF	1
Tara Dolan	MADMF	1
Jacob Dorothy	MADMF	1
Scott Elzey	MADMF	1
Kim Fine	MADMF	1
Kate Frew	MADMF	1
Joe Holbeche	MADMF	1
John Logan	MADMF	1
Gabe Lundgren	MADMF	1
Dave Martins	MADMF	1
Derek Perry	MADMF	1
Caylene Pillsbury	MADMF	1
Mike Pol	ROSA	1
Mark Rousseau	MADMF	1
Iris Seto	MADMF	1
Rachel Vollemans	MADMF	1
Kelly Whitmore	MADMF	1
Total		90

R/V Gloria Michelle Crew		
Name	Affiliation	Num. Days
<i>Officers</i>		
Alex Creed	NOAA OIC	16
Trevor Grams	NOAA JOIC	16
Mike Abbott	NOAA-CORPS (ret)	7
Forrest Foxen	NOAA-CORPS	7
<i>Deck Crew</i>		
George Morton	Contract Fisherman	16
Sarah Shea	NMFS-Woods Hole	9

Table 2. Station information for the spring cruise 202391.

Station	Stratum	Date	Time (est)	Depth		Latitude	Longitude	Course	Distance (nmi)	Bottom temp °C
				(m)						
1	26	5/8/2023	6:00	16		41°49.51	-70°29.60	204	0.10	
2	26	5/8/2023	7:20	16		41°49.88	-70°29.63	196	0.85	9.0
3	28	5/8/2023	9:19	31		41°55.32	-70°28.21	3	0.82	7.5
4	28	5/8/2023	10:40	37		42°00.11	-70°31.56	160	0.80	7.4
5	28	5/8/2023	11:50	39		42°00.79	-70°30.96	227	0.83	7.4
6	25	5/8/2023	13:28	10		42°02.33	-70°37.58	340	0.55	11.4
7	29	5/8/2023	15:32	49		41°59.43	-70°23.46	2	0.86	6.2
8	27	5/8/2023	17:30	27		41°51.09	-70°24.75	23	0.86	8.8
9	26	5/9/2023	6:02	15		41°45.19	-70°22.43	297	0.82	9.4
10	25	5/9/2023	7:20	8		41°44.63	-70°21.56	288	0.84	10.3
11	27	5/9/2023	8:50	21		41°48.25	-70°17.65	140	0.84	8.8
12	25	5/9/2023	10:51	9		41°48.72	-70°04.00	296	0.82	12.1
13	26	5/9/2023	12:14	15		41°48.71	-70°13.02	37	0.85	9.6
14	27	5/9/2023	13:24	27		41°51.64	-70°13.42	56	0.85	8.8
15	25	5/9/2023	14:56	11		41°53.29	-70°07.27	50	0.84	11.0
16	28	5/9/2023	16:20	32		41°54.84	-70°13.12	33	0.87	8.6
17	26	5/10/2023	8:27	17		42°08.96	-70°40.7	158	0.83	10.0
18	32	5/10/2023	10:19	15		42°14.12	-70°44.57	153	0.57	10.5
19	35	5/10/2023	12:02	42		42°19.11	-70°43.19	100	0.83	6.4
20	34	5/10/2023	13:12	38		42°18.57	-70°44.03	53	0.20	
21	34	5/10/2023	14:04	42		42°19.23	-70°43.59	173	0.82	6.5
22	33	5/10/2023	15:41	26		42°18.90	-70°48.00	231	0.38	8.2
23	33	5/10/2023	17:04	22		42°18.50	-70°49.15	98	0.80	8.2
24	32	5/10/2023	18:12	14		42°17.76	-70°51.13	82	0.61	10.5
25	31	5/11/2023	6:14	9		42°24.76	-70°57.41	208	0.79	9.8
26	33	5/11/2023	7:18	27		42°25.07	-70°53.60	232	0.84	7.4
27	34	5/11/2023	8:41	33		42°23.39	-70°48.60	300	0.73	6.8
28	34	5/11/2023	10:17	32		42°26.36	-70°51.28	106	0.85	6.5
29	36	5/11/2023	12:35	65		42°30.45	-70°39.15	161	0.82	6.0
30	35	5/11/2023	14:00	53		42°34.04	-70°36.85	243	0.82	6.2
31	35	5/11/2023	15:25	41		42°34.36	-70°38.62	104	0.85	6.7
32	35	5/11/2023	16:29	52		42°35.54	-70°34.77	250	0.82	6.5
33	36	5/11/2023	17:59	66		42°36.14	-70°32.62	75	0.55	6.0
34	33	5/12/2023	8:18	24		42°46.83	-70°45.93	176	0.84	7.4
35	34	5/12/2023	9:36	32		42°50.68	-70°45.06	162	0.83	7.0
36	31	5/12/2023	10:58	6		42°47.07	-70°47.88	9	0.63	8.3
37	32	5/12/2023	12:12	15		42°45.20	-70°46.24	357	0.84	7.5
38	33	5/12/2023	13:16	26		42°44.86	-70°44.50	4	0.72	7.5
39	31	5/12/2023	14:28	9		42°43.74	-70°46.24	156	0.84	7.7
40	35	5/13/2023	11:10	51		42°41.08	-70°33.53	346	0.82	6.5
41	34	5/13/2023	12:29	36		42°42.16	-70°37.51	290	0.83	7.0
42	36	5/13/2023	13:54	74		42°42.78	-70°33.88	331	0.83	6.0

Table 2 continued.

Station	Stratum	Date	Time (est)	Depth		Latitude	Longitude	Course	Distance (nmi)	Bottom temp °C
				(m)						
43	29	5/14/2023	9:42	48		42°05.21	-70°28.97	289	0.81	6.7
44	29	5/14/2023	10:52	46		42°02.77	-70°29.59	342	0.84	6.5
45	30	5/14/2023	12:31	59		42°05.99	-70°24.90	20	0.82	6.0
46	29	5/14/2023	14:04	54		42°02.40	-70°19.55	359	0.82	6.6
47	29	5/14/2023	15:11	52		42°01.56	-70°18.20	356	0.81	6.4
48	30	5/14/2023	16:31	59		42°03.25	-70°15.98	21	0.83	6.5
49	27	5/15/2023	6:09	26		41°48.82	-70°23.12	226	0.26	
50	27	5/15/2023	7:07	25		41°47.82	-70°24.06	45	0.84	8.9
51	28	5/15/2023	9:26	34		41°57.06	-70°12.74	230	0.82	7.6
52	27	5/15/2023	11:00	26		41°58.87	-70°08.20	195	0.54	9.6
53	26	5/15/2023	12:11	14		42°01.35	-70°06.70	179	0.46	11.8
54	26	5/15/2023	13:26	16		41°59.27	-70°06.70	15	0.59	11.6
55	21	5/15/2023	15:28	63		42°05.70	-70°13.84	82	0.85	6.5
56	21	5/15/2023	16:57	57		42°07.22	-70°12.10	86	0.73	6.4
57	20	5/16/2023	7:09	34		42°06.11	-70°09.07	114	0.83	8.4
58	19	5/16/2023	8:03	25		42°05.81	-70°09.51	108	0.56	10.8
59	17	5/16/2023	8:54	8		42°04.75	-70°07.14	306	0.85	11.3
60	18	5/16/2023	11:01	23		41°58.51	-69°58.74	4	0.80	10.8
61	17	5/16/2023	12:58	9		41°49.60	-69°55.80	2	0.82	9.4
62	20	5/16/2023	14:04	35		41°49.33	-69°53.22	11	0.83	9.1
63	18	5/16/2023	15:34	19		41°48.20	-69°54.71	194	0.55	9.5
64	15	5/17/2023	9:48	9		41°32.15	-70°05.02	34	0.56	12.8
65	15	5/17/2023	10:45	10		41°33.39	-70°04.72	61	0.77	12.8
66	15	5/17/2023	11:58	9		41°37.82	-70°02.24	261	0.54	15.0
67	16	5/17/2023	13:22	11		41°34.56	-70°05.16	42	0.82	13.3
68	16	5/17/2023	14:41	14		41°34.40	-70°10.99	83	0.84	14.5
69	16	5/17/2023	16:06	14		41°31.30	-70°14.39	21	0.85	13.3
70	18	5/18/2023	6:25	10		41°25.51	-70°00.01	264	0.85	12.4
71	17	5/18/2023	7:40	9		41°23.48	-69°59.34	67	0.65	11.4
72	17	5/18/2023	8:30	10		41°22.37	-69°59.12	4	0.73	11.4
73	16	5/18/2023	10:51	18		41°27.55	-70°03.34	100	0.82	11.4
74	16	5/18/2023	12:37	11		41°24.04	-70°08.59	77	0.84	12.6
75	16	5/18/2023	14:01	12		41°28.55	-70°10.26	121	0.56	11.8
76	16	5/18/2023	16:42	17		41°27.47	-70°27.78	281	0.85	13.9
77	15	5/19/2023	6:45	9		41°25.25	-70°31.23	10	0.34	13.8
78	12	5/19/2023	9:13	13		41°23.30	-70°24.33	205	0.52	12.8
79	11	5/19/2023	10:44	8		41°17.86	-70°23.86	223	0.87	12.4
80	11	5/19/2023	12:10	8		41°17.61	-70°29.65	156	0.83	12.7
81	13	5/19/2023	13:30	20		41°18.90	-70°36.80	108	0.84	12.6
82	13	5/19/2023	14:38	23		41°17.98	-70°40.12	90	0.85	11.5
83	12	5/19/2023	16:07	13		41°16.59	-70°47.29	161	0.84	11.3
84	14	5/20/2023	7:33	34		41°19.51	-70°54.09	145	0.81	9.9

Table 2 continued.

Station	Stratum	Date	Time (est)	Depth		Latitude	Longitude	Course	Distance (nmi)	Bottom temp °C
				(m)						
85	14	5/20/2023	8:49	33		41°23.67	-70°53.18	250	0.82	11.9
86	13	5/20/2023	10:01	21		41°22.52	-70°49.07	267	0.81	12.0
87	13	5/20/2023	11:09	23		41°23.97	-70°45.62	229	0.83	12.0
88	12	5/20/2023	12:21	15		41°25.94	-70°44.93	238	0.85	12.8
89	13	5/20/2023	14:03	21		41°28.79	-70°41.65	95	0.73	14.2
90	12	5/21/2023	6:10	15		41°32.45	-70°42.79	249	0.02	
91	12	5/21/2023	6:44	14		41°32.36	-70°42.95	248	0.73	14.5
92	12	5/21/2023	8:05	16		41°31.33	-70°48.06	241	0.82	13.4
93	12	5/21/2023	9:50	17		41°28.82	-70°57.59	264	0.43	13.0
94	11	5/21/2023	12:51	7		41°36.36	-70°48.83	162	0.56	14.8
96	12	5/21/2023	13:47	11		41°35.84	-70°45.87	215	0.84	14.5
97	11	5/21/2023	15:32	7		41°40.63	-70°41.91	210	0.20	
98	11	5/21/2023	16:01	7		41°40.33	-70°42.04	209	0.56	15.3
99	11	5/21/2023	18:14	7		41°39.07	-70°43.47	246	0.52	15.2
100	15	5/22/2023	8:16	8		41°35.51	-70°22.57	178	0.54	16.0
101	15	5/22/2023	9:17	7		41°35.15	-70°18.21	284	0.53	15.6
102	15	5/22/2023	10:23	8		41°35.07	-70°15.23	283	0.52	15.4
103	15	5/22/2023	12:06	10		41°31.24	-70°19.86	318	0.54	15.1
104	16	5/22/2023	13:34	17		41°30.19	-70°14.49	93	0.53	14.3
105	16	5/22/2023	14:57	12		41°26.16	-70°16.51	95	0.55	14.7
107	15	5/22/2023	16:32	8		41°23.50	-70°11.33	80	0.80	14.7
108	15	5/23/2023	5:35	10		41°19.20	-70°08.83	109	0.84	14.6
109	16	5/23/2023	6:38	12		41°20.40	-70°12.03	97	0.84	14.5
110	16	5/23/2023	8:10	13		41°25.51	-70°14.33	99	0.88	14.1
111	17	5/23/2023	12:31	8		41°17.77	-70°17.80	142	0.85	13.1
112	18	5/23/2023	13:53	14		41°14.92	-70°12.67	308	0.83	12.8
113	18	5/23/2023	15:46	16		41°13.57	-70°05.34	63	0.82	13.4
114	19	5/23/2023	16:48	23		41°12.32	-70°07.55	79	0.84	12.6

Table 3. Sampling effort assigned and accomplished by stratum, cruise 202391.

Stratum	Region	Assigned Stations	Number of Stations Completed			Aborted Tows
			All Accepted	Sub-Standard	Standard	
11	1	5	5		5	1
12	1	7	6		6	2
13	1	5	5		5	
14	1	2	2		2	
15	2	10	9		9	1
16	2	11	11		11	
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	2
26	4	5	5		5	1
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	
33	5	4	4		4	1
34	5	4	4		4	2
35	5	5	5		5	
36	5	2	2		2	1
TOTALS		103	101	0	101	11

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 202391. Not advised for indices of abundance other than Spiny Dogfish.

Station	Stratum	SHG Location	Description
No sub-standard tows on cruise 202391			

Table 5. Aborted tows during the spring survey, cruise 202391.

Station	Stratum	SHG Location	Description
1	26	171 Western Cape Cod Bay	winch brakes wouldn't release
20	34	171 Southeastern Mass Bay	difficulty holding track line due to strong current
21	34	179 Southeastern Mass Bay	blown out codend and 3ft tear in wing
22	33	179 Massachusetts Bay	large hole in belly
33	36	171 Central Mass Bay	caught lobster trawl
49	27	171 Cape Cod Bay	set wrong wire out had to haul back
53	26	179 Eastern Cape Cod Bay	large rock on sounder hauled but tore net
77	15	176 Near Edgartown harbor	large catch of weed net torn at headrope
90	12	173 Buzzards Bay-Woods Hole	hangset and bent triangle on port door
93	12	175 Mishaum ledge Buzzards Bay	large catch of red algae net torn
97	11	171 Top of Buzzards Bay	slowed down and hauled early

Table 6a. Total catch by number and weight from 2023 spring survey sorted by number.

Species Code	Common Name	Count	Weight (kg)
143	SCUP	58,953	10,734.042
503	LONGFIN SQUID	25,766	238.131
181	NORTHERN SAND LANCE	6,424	46.136
106	WINTER FLOUNDER	5,534	799.988
163	LONGHORN SCULPIN	4,707	692.290
72	SILVER HAKE	4,219	467.091
171	NORTHERN SEAROBIN	3,711	800.639
105	YELLOWTAIL FLOUNDER	3,064	640.518
77	RED HAKE	2,661	205.106
131	BUTTERFISH	1,978	101.884
301	AMERICAN LOBSTER	694	217.804
102	AMERICAN PLAICE	620	99.000
43	BAY ANCHOVY	582	1.693
193	OCEAN POUT	558	131.438
177	TAUTOG	547	496.373
317	SPIDER CRAB UNCL	514	45.612
33	ALEWIFE	398	21.758
141	BLACK SEA BASS	398	147.946
73	ATLANTIC COD	371	29.055
313	ATLANTIC ROCK CRAB	346	41.467
26	LITTLE SKATE	330	190.414
108	WINDOWPANE	279	56.622
104	FOURSPOT FLOUNDER	215	39.973
78	SPOTTED HAKE	163	5.546
103	SUMMER FLOUNDER	112	52.961
322	LADY CRAB	109	7.815
32	ATLANTIC HERRING	104	0.749
35	AMERICAN SHAD	78	3.391
172	STRIPED SEAROBIN	75	23.383
401	SEA SCALLOP	74	3.847
176	CUNNER	71	7.080
23	WINTER SKATE	62	63.967
197	GOOSEFISH	48	11.993
74	HADDOCK	39	21.464
164	SEA RAVEN	39	24.228
318	HORSESHOE CRAB	34	35.635
13	SMOOTH DOGFISH	21	57.338
312	JONAH CRAB	19	5.026
117	SMALLMOUTH FLOUNDER	19	0.436
155	ACADIAN REDFISH	13	1.101
34	BLUEBACK HERRING	13	0.389
348	NORTHERN MOONSNAIL	11	1.290
116	NORTHERN PIPEFISH	9	0.104

Figure 6a continued.

Species Code	Common Name	Count	Weight (kg)
45	RAINBOW SMELT	9	0.111
36	ATLANTIC MENHADEN	9	2.565
182	SNAKEBLENNY	7	0.271
107	WITCH FLOUNDER	7	1.856
146	NORTHERN KINGFISH	7	2.860
336	CHANNELED WHELK	6	1.179
121	ATLANTIC MACKEREL	6	0.745
139	STRIPED BASS	5	14.194
337	KNOBBED WHELK	4	1.252
109	GULF STREAM FLOUNDER	3	0.084
314	BLUE CRAB	3	0.390
83	FOURBEARD ROCKLING	2	0.167
323	MANTIS SHRIMP UNCL	2	0.033
76	WHITE HAKE	2	0.178
196	NORTHERN PUFFER	2	0.413
75	POLLOCK	1	0.021
403	ATLANTIC SURFCLAM	1	0.006
37	HICKORY SHAD	1	0.278
24	CLEARNOSE SKATE	1	3.189
145	WEAKFISH	1	0.585
180	ROCK GUNNEL	1	0.010
380	ATLANTIC STURGEON	1	49.830
409	OCEAN QUAHOG	1	0.194
2	SEA LAMPREY	1	0.021
101	ATLANTIC HALIBUT	1	10.717
168	LUMPFISH	1	1.408
63	CONGER EEL	1	0.012
Totals		124,068	16,665.292

Table 6b. Total catch by number and weight from 2023 spring survey sorted by weight.

Species Code	Common Name	Count	Weight (kg)
143	SCUP	58,953	10,734.042
171	NORTHERN SEAROBIN	3,711	800.639
106	WINTER FLOUNDER	5,534	799.988
163	LONGHORN SCULPIN	4,707	692.290
105	YELLOWTAIL FLOUNDER	3,064	640.518
177	TAUTOG	547	496.373
72	SILVER HAKE	4,219	467.091
503	LONGFIN SQUID	25,766	238.131
301	AMERICAN LOBSTER	694	217.804
77	RED HAKE	2,661	205.106
26	LITTLE SKATE	330	190.414
141	BLACK SEA BASS	398	147.946
193	OCEAN POUT	558	131.438
131	BUTTERFISH	1,978	101.884
102	AMERICAN PLAICE	620	99.000
23	WINTER SKATE	62	63.967
13	SMOOTH DOGFISH	21	57.338
108	WINDOWPANE	279	56.622
103	SUMMER FLOUNDER	112	52.961
380	ATLANTIC STURGEON	1	49.830
181	NORTHERN SAND LANCE	6,424	46.136
317	SPIDER CRAB UNCL	514	45.612
313	ATLANTIC ROCK CRAB	346	41.467
104	FOURSPOT FLOUNDER	215	39.973
318	HORSESHOE CRAB	34	35.635
73	ATLANTIC COD	371	29.055
164	SEA RAVEN	39	24.228
172	STRIPED SEAROBIN	75	23.383
33	ALEWIFE	398	21.758
74	HADDOCK	39	21.464
139	STRIPED BASS	5	14.194
197	GOOSEFISH	48	11.993
101	ATLANTIC HALIBUT	1	10.717
322	LADY CRAB	109	7.815
176	CUNNER	71	7.080
78	SPOTTED HAKE	163	5.546
312	JONAH CRAB	19	5.026
401	SEA SCALLOP	74	3.847
35	AMERICAN SHAD	78	3.391
24	CLEARNOSE SKATE	1	3.189
146	NORTHERN KINGFISH	7	2.860
36	ATLANTIC MENHADEN	9	2.565
107	WITCH FLOUNDER	7	1.856

Table 6b continued.

Species Code	Common Name	Count	Weight (kg)
43	BAY ANCHOVY	582	1.693
168	LUMPFISH	1	1.408
348	NORTHERN MOONSNAIL	11	1.290
337	KNOBBED WHELK	4	1.252
336	CHANNELED WHELK	6	1.179
155	ACADIAN REDFISH	13	1.101
32	ATLANTIC HERRING	104	0.749
121	ATLANTIC MACKEREL	6	0.745
145	WEAKFISH	1	0.585
117	SMALLMOUTH FLOUNDER	19	0.436
196	NORTHERN PUFFER	2	0.413
314	BLUE CRAB	3	0.390
34	BLUEBACK HERRING	13	0.389
37	HICKORY SHAD	1	0.278
182	SNAKEBLENNY	7	0.271
409	OCEAN QUAHOG	1	0.194
76	WHITE HAKE	2	0.178
83	FOURBEARD ROCKLING	2	0.167
45	RAINBOW SMELT	9	0.111
116	NORTHERN PIPEFISH	9	0.104
109	GULF STREAM FLOUNDER	3	0.084
323	MANTIS SHRIMP UNCL	2	0.033
75	POLLOCK	1	0.021
2	SEA LAMPREY	1	0.021
63	CONGER EEL	1	0.012
180	ROCK GUNNEL	1	0.010
403	ATLANTIC SURFCLAM	1	0.006
Totals		124,068	16,665.292

Table 7. Total samples obtained for age, growth, maturity, and special studies during MDMF spring cruise 202391.

Species	Maturity Observation	Age and Growth Collection		
		Scales	Otoliths	YOY
Atlantic Cod	26		26	
Haddock	30		30	
Summer Flounder	70		69	
Yellowtail Flounder	286		281	
Winter Flounder	536		527	
Black Sea Bass	160		159	
Scup	123		121	
Weakfish	1		1	
Tautog	44		44	
American Lobster	367		0	
TOTAL	1,643	0	1,258	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)

Atlantic Herring were saved for a UMASS Amherst Professor (A. Jordaan)

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)

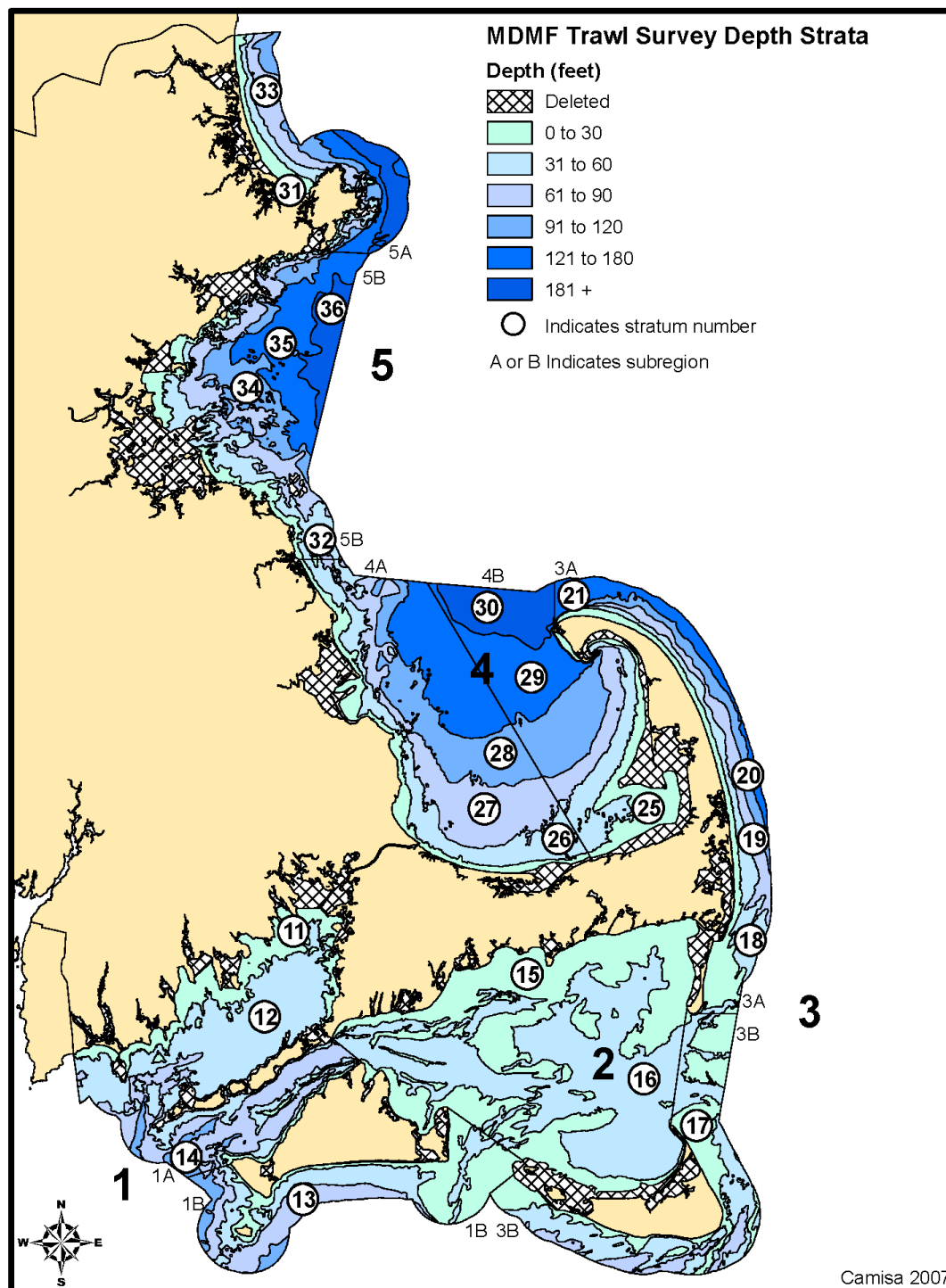


Figure 1. MDMF inshore bottom trawl survey region and strata map.

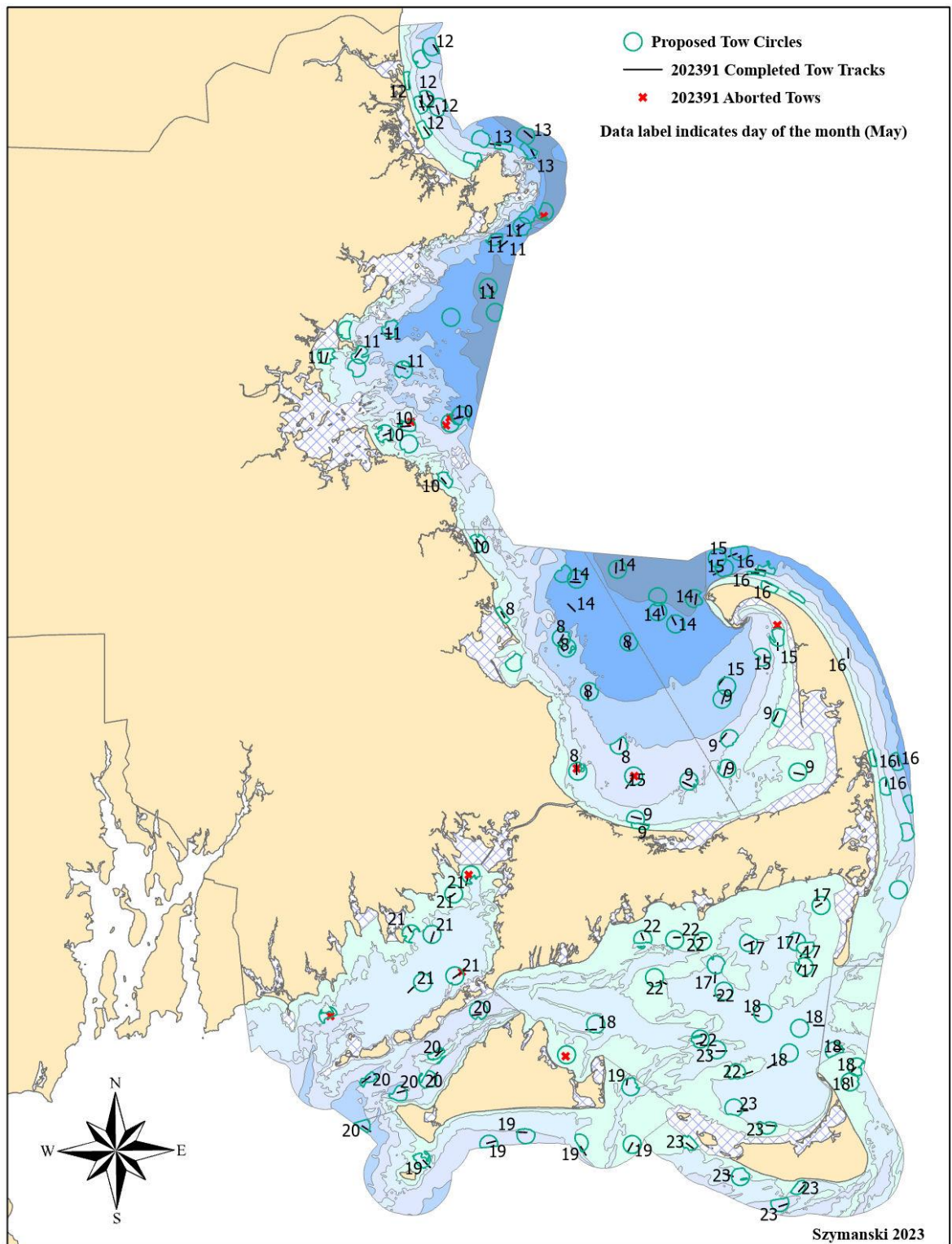


Figure 2. All proposed spring 2023 stations including completed and aborted tows by date.

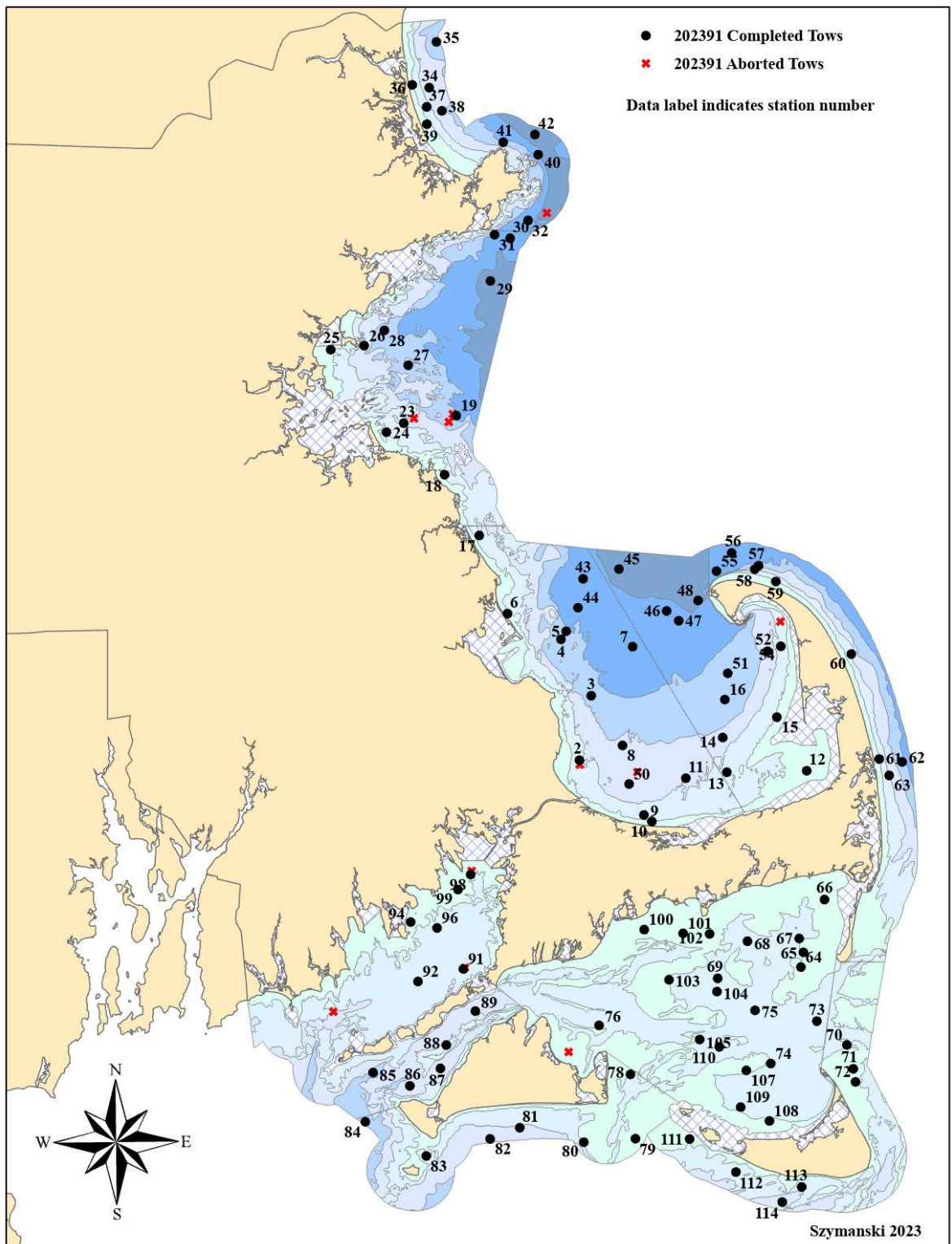


Figure 3. All attempted spring 2023 survey stations in chronological order.

Spring Cruise 202391



CRUISE RESULTS

R/V GLORIA MICHELLE

2023 Massachusetts Inshore Fall
Bottom Trawl Survey
Cruise No. 202392

CRUISE PERIOD AND AREA

From September 5 through September 24, 2023, the Massachusetts Division of Marine Fisheries conducted its 45th 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 (Figure 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.

Thirty-four MDMF employees participated in the survey as part of the scientific party along with four biologists from NOAA, one biologist from University of Massachusetts Amherst, and one biologist from Responsible Offshore Science Alliance (Table 1).

CRUISE SUMMARY

Ninety-six stations were attempted in 16 sampling days (Figures 1 and 2, Table 2). Ninety-one completed stations were considered acceptable for assessment of all species, SHG ≤ 136 (Table 3). One station in stratum 13, four stations in stratum 15, four stations in stratum 16, two stations in stratum 17, and one station in stratum 18 were dropped due to multiple weather events and vessel availability/vessel staffing issues. Five attempted tows were aborted due to fixed gear or hard bottom and one station in the Muskeget Channel was abandoned due to an avoidance area surrounding Vineyard Wind's unarmored cable (Table 5, Figure. 3).

The geographic distribution, relative abundance, relative biomass, and representative length frequencies of all fish and invertebrate species were documented (Tables 6a and 6b). Three species were recorded for the first time in survey history. The new species observed this survey were, two Weitzmans Pearlsides at station 41 in Mass Bay, a Mahogany Snapper at station 71 in Buzzards Bay, and a Fringed Filefish at station 77 in Nantucket Sound. This is the first time three or more new species were observed in a single survey since 2006.

Several records were set on the 2023 fall survey at individual stations. Station 74 in Nantucket Sound recorded the highest abundance (6) and biomass (7.817 kg) of Clearnose Skates. Station 81 south of Martha's Vineyard observed the highest count (55) and weight (1.323 kg) of Striped Cusk Eels. Other single station biomass records include Red Hake (184.532 kg) at stations 12 in Cape Cod Bay, Spotted Hake (15.246 kg) at station 62 in outer Vineyard Sound, Hickory Shad (0.566 kg) at station 80 south of Martha's Vineyard, and Pinfish (0.216 kg) at station 91 south of Cotuit.

There were several notable species trends for all stations combined in the fall of 2023. Atlantic cod recorded the lowest abundance in survey history. Winter Skate and Little Skate both continued downward trends with record low abundance and biomass numbers. Spotted Hake had the highest biomass and second highest abundance recorded to date. While not records Red Hake had the second highest biomass and abundance in the timeseries and Silver Hake recorded the third highest biomass.

General catch trends followed a similar pattern to recent surveys. Scup dominated the catches south of Cape Cod and accounted for 42% of all catch by number and 23% of all biomass this survey. Butterfish, Longfin Squid, and Bay Anchovies were the other species

that topped catches south of Cape Cod. North of Cape Cod had moderate catches of Winter Flounder, Silver Hake, Red Hake, and within the deeper strata Longhorn Sculpin.

Additional sampling goals were achieved (Table 7). To aid cooperative fisheries assessments over 800 otolith samples and over 1,500 sex and maturity observations were taken from Atlantic Cod, Haddock, Summer Flounder, Yellowtail Flounder, Winter Flounder, Black Sea Bass, Scup, Weakfish, Tautog and American Lobster. Additional samples and catch information were collected to assist ongoing research by fisheries scientists from MDMF, UMass Dartmouth SMAST, Gloucester Marine Genomics Institute, and Center for Coastal Studies.

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 202392.

Scientific Party		
Name	Affiliation	Num. Days
Vincent Manfredi	MADMF	10
Mark Szymanski	MADMF	10
Steve Wilcox	MADMF	9
Brendan Reilly	MADMF	4
Sam Truesdell	MADMF	3
Scott Schaffer	MADMF	3
Laura Tomlinson	MADMF	3
Elise Koob	MADMF	3
Sandy Sutherland	NOAA/NEFSC-WH	3
Steve Voss	MADMF	2
Tara Dolan	MADMF	2
Katrina Zarrella-Smith	UMASS AMHERST	2
Mike Blanco	MADMF	2
Amanda Meli	MADMF	2
Stephanie Berkman	MADMF	2
John Sheppard	MADMF	2
Julia Kaplan	MADMF	2
Eric Robillard	NOAA/NEFSC-WH	2
Katie Rogers	NOAA/NEFSC-WH	2
Ross Kessler	MADMF	2
Caylene Pillsbury	MADMF	1
Evan Weig	MADMF	1
Mike Pol	ROSA	1
Holly Williams	MADMF	1
Tracy Pugh	MADMF	1
John Logan	MADMF	1
Mark Wuenschel	NOAA/NEFSC-WH	1
Derek Perry	MADMF	1
Alex Boeri	MADMF	1
Jacob Dorothy	MADMF	1
Dave Martins	MADMF	1
Scott Elzey	MADMF	1
Mark Rousseau	MADMF	1
Neil McCoy	MADMF	1
Gary Nelson	MADMF	1
Kate Frew	MADMF	1
Forest Schenck	MADMF	1
Iris Seto	MADMF	1
Michele Heller	MADMF	1
Anna Webb	MADMF	1
Total		90

R/V Gloria Michelle Crew		
Name	Affiliation	Num. Days
<i>Officers</i>		
Alex Creed	NOAA OIC	11
Trevor Grams	NOAA JOIC	16
TJ Houck	NOAA-CORPS	3
Mike Abbott	NOAA-CORPS (ret)	1
Tyler Aldrich	NOAA-CORPS	1
<i>Deck Crew</i>		
Lizie Alonzo	Contract Fisherman	16
Chris Shepard	Contract Fisherman	16

Table 2. Station information for the fall cruise 202392.

Station	Stratum	Date	Time (est)	Depth (m)	Latitude	Longitude	Course	Distance (nmi)	Bottom temp °C
1	27	9/5/2023	5:51	21	41°46.71	-70°24.59	309	0.85	12.0
2	25	9/5/2023	7:15	8	41°45.43	-70°26.40	122	0.53	16.0
4	26	9/5/2023	8:30	16	41°45.56	-70°22.48	110	0.85	13.0
5	27	9/5/2023	9:58	24	41°48.33	-70°19.58	32	0.83	10.6
6	26	9/5/2023	11:25	16	41°48.01	-70°13.44	264	0.81	13.1
7	27	9/5/2023	12:44	24	41°50.81	-70°13.71	272	0.87	10.7
8	26	9/5/2023	13:59	15	41°50.75	-70°10.61	268	0.25	
9	25	9/5/2023	15:27	10	41°49.21	-70°02.73	248	0.83	19.8
10	28	9/6/2023	6:43	31	41°52.58	-70°25.21	81	0.84	9.8
11	28	9/6/2023	7:51	32	41°53.35	-70°26.08	83	0.84	9.7
12	29	9/6/2023	9:30	44	41°58.79	-70°25.24	268	0.83	9.3
13	29	9/6/2023	11:26	38	41°57.54	-70°15.95	240	0.85	9.5
14	28	9/6/2023	13:01	31	41°55.21	-70°11.68	40	0.84	10.1
15	26	9/6/2023	14:56	14	41°50.53	-70°10.30	276	0.83	13.7
16	28	9/6/2023	16:27	36	41°54.66	-70°18.50	148	0.84	9.7
17	27	9/7/2023	6:10	26	41°52.34	-70°28.91	197	0.83	11.5
18	26	9/7/2023	8:08	12	41°59.03	-70°35.54	162	0.64	13.2
19	25	9/7/2023	9:30	8	42°03.34	-70°38.25	171	0.83	16.5
20	32	9/7/2023	12:31	18	42°16.99	-70°48.52	133	0.61	12.5
21	32	9/7/2023	13:39	16	42°17.99	-70°50.43	88	0.68	12.0
22	34	9/7/2023	15:17	33	42°23.07	-70°49.17	343	0.65	10.6
23	33	9/7/2023	16:36	26	42°23.61	-70°54.32	85	0.84	11.0
24	31	9/8/2023	6:42	9	42°27.00	-70°55.20	188	0.56	16.0
25	33	9/8/2023	7:45	24	42°27.12	-70°53.04	136	0.74	10.8
26	34	9/8/2023	8:43	37	42°26.35	-70°50.30	285	0.53	10.3
27	36	9/8/2023	11:17	69	42°25.39	-70°40.12	356	0.00	
28	36	9/8/2023	11:59	69	42°25.54	-70°40.22	356	0.54	9.0
29	35	9/8/2023	15:03	50	42°30.71	-70°43.04	149	0.66	9.7
30	35	9/8/2023	16:28	55	42°31.48	-70°40.85	85	0.54	9.5
31	33	9/9/2023	8:14	27	42°47.48	-70°45.90	178	0.81	11.5
32	34	9/9/2023	9:36	31	42°51.37	-70°45.81	174	0.76	10.5
33	31	9/9/2023	11:13	8	42°46.29	-70°47.59	180	0.83	15.0
34	32	9/9/2023	12:18	15	42°44.76	-70°45.96	358	0.55	13.2
35	33	9/9/2023	13:24	25	42°45.28	-70°44.75	344	0.85	11.6
36	31	9/9/2023	14:49	8	42°41.43	-70°43.56	324	0.86	16.1
37	34	9/10/2023	8:36	31	42°44.46	-70°43.04	163	0.76	11.0
38	35	9/10/2023	10:25	50	42°42.84	-70°36.16	346	0.54	9.6
39	35	9/10/2023	11:35	41	42°40.90	-70°34.08	345	0.46	10.0
40	35	9/10/2023	12:46	49	42°41.38	-70°33.92	352	0.83	9.5
41	36	9/10/2023	14:10	76	42°42.93	-70°33.75	160	0.57	8.2
42	35	9/10/2023	15:58	49	42°34.29	-70°37.08	71	0.57	9.4
43	29	9/11/2023	9:44	49	42°05.94	-70°29.07	344	0.83	9.1

Table 2 continued.

Station	Stratum	Date	Time (est)	Depth (m)	Latitude	Longitude	Course	Distance (nmi)	Bottom temp °C
44	29	9/11/2023	11:22	51	42°04.52	-70°29.06	158	0.81	9.1
45	30	9/11/2023	12:43	61	42°07.02	-70°24.84	200	0.84	8.8
46	29	9/11/2023	13:48	55	42°03.86	-70°24.77	350	0.83	8.8
47	28	9/12/2023	7:26	32	41°55.99	-70°11.87	272	0.84	9.7
48	27	9/12/2023	8:53	28	41°59.64	-70°09.06	184	0.76	9.9
49	26	9/12/2023	10:01	17	42°01.07	-70°06.73	186	0.55	11.2
50	25	9/12/2023	11:28	11	42°02.49	-70°07.68	294	0.63	16.6
51	30	9/12/2023	13:14	62	42°05.32	-70°14.76	260	0.84	8.7
52	21	9/12/2023	14:24	63	42°06.07	-70°12.80	264	0.85	8.8
53	17	9/12/2023	15:39	6	42°05.46	-70°10.37	293	0.85	18.6
54	18	9/13/2023	5:50	16	41°52.71	-69°56.51	182	0.86	14.6
55	19	9/13/2023	6:58	22	41°50.00	-69°54.95	180	0.83	12.5
56	20	9/13/2023	8:00	36	41°50.10	-69°53.49	186	0.83	10.2
57	21	9/13/2023	9:18	43	41°49.33	-69°52.34	177	0.86	9.5
58	20	9/13/2023	10:27	37	41°47.31	-69°52.20	190	0.85	9.6
59	18	9/13/2023	12:01	16	41°44.88	-69°54.47	13	0.76	13.0
60	17	9/13/2023	13:12	9	41°44.44	-69°55.14	10	0.84	14.1
61	13	9/18/2023	7:08	24	41°23.96	-70°54.33	80	0.86	17.4
62	14	9/18/2023	8:33	31	41°21.16	-70°56.48	72	0.85	15.3
63	14	9/18/2023	10:05	28	41°20.55	-70°53.80	203	0.84	14.7
64	12	9/18/2023	12:01	15	41°25.96	-70°44.86	244	0.83	18.8
65	11	9/18/2023	13:06	9	41°25.75	-70°44.23	255	0.78	18.8
66	13	9/18/2023	14:41	22	41°28.64	-70°42.04	95	0.01	
67	12	9/19/2023	6:36	14	41°30.66	-70°47.00	259	0.54	20.4
68	12	9/19/2023	7:49	16	41°32.36	-70°47.72	277	0.83	20.1
69	11	9/19/2023	9:22	9	41°34.11	-70°54.20	20	0.84	20.9
70	12	9/19/2023	11:22	13	41°35.38	-70°43.73	232	0.86	21.2
71	12	9/19/2023	12:34	12	41°36.99	-70°42.41	213	0.55	21.2
72	11	9/19/2023	13:59	8	41°38.71	-70°42.75	41	0.57	21.3
73	16	9/20/2023	7:10	15	41°27.76	-70°29.86	110	0.85	21.1
74	16	9/20/2023	8:31	18	41°28.31	-70°23.60	297	0.53	21.2
75	16	9/20/2023	9:51	17	41°27.32	-70°18.59	288	0.82	21.3
76	16	9/20/2023	11:14	11	41°25.45	-70°15.76	260	0.72	20.6
77	15	9/20/2023	13:34	9	41°26.44	-70°29.10	275	0.74	20.7
78	13	9/20/2023	15:18	25	41°29.30	-70°40.11	81	0.56	19.5
79	15	9/20/2023	16:45	8	41°32.01	-70°35.92	106	0.66	21.1
80	13	9/21/2023	8:14	22	41°18.55	-70°40.37	250	0.80	16.9
81	12	9/21/2023	9:43	12	41°20.14	-70°39.54	107	0.55	18.0
82	13	9/21/2023	10:45	23	41°18.25	-70°38.94	98	0.57	17.0
83	12	9/21/2023	12:08	13	41°18.78	-70°30.41	293	0.85	17.6
84	11	9/21/2023	13:13	9	41°19.14	-70°28.54	256	0.84	18.0
85	11	9/21/2023	14:57	12	41°17.10	-70°24.60	225	0.86	18.2

Table 2 continued.

Station	Stratum	Date	Time (est)	Depth (m)	Latitude	Longitude	Course	Distance (nmi)	Bottom temp °C
86	19	9/22/2023	9:17	22	41°14.59	-70°17.24	115	0.84	18.5
88	18	9/22/2023	10:55	14	41°12.88	-70°10.34	102	0.83	18.6
89	18	9/22/2023	12:13	18	41°15.23	-70°13.78	123	0.85	18.7
90	17	9/22/2023	13:44	10	41°17.02	-70°20.09	96	0.85	18.7
91	16	9/23/2023	7:42	14	41°33.60	-70°21.97	107	0.53	21.0
92	15	9/23/2023	9:11	8	41°35.12	-70°16.25	108	0.85	19.9
93	15	9/23/2023	10:46	7	41°31.69	-70°20.98	126	0.57	20.5
94	15	9/23/2023	12:27	9	41°31.44	-70°11.05	272	0.82	19.1
95	15	9/23/2023	15:15	10	41°23.38	-70°11.07	82	0.85	19.8
97	16	9/24/2023	8:06	13	41°19.72	-70°04.01	264	0.77	19.3
98	16	9/24/2023	9:13	15	41°21.55	-70°04.98	255	0.58	18.3

Table 3. Sampling effort assigned and accomplished by stratum, cruise 202392.

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	4		4	
14	1	2	2		2	
15	2	10	6		6	1
16	2	11	7		7	
17	3	5	3		3	
18	3	5	4		4	
19	3	2	2		2	
20	3	2	2		2	
21	3	2	2		2	
25	4	4	4		4	1
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	1
32	5	3	3		3	
33	5	4	4		4	
34	5	4	4		4	
35	5	5	5		5	
36	5	2	2		2	
TOTALS		103	91	0	91	5

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 202392. Not advised for indices of abundance other than Spiny Dogfish.

Station	Stratum	SHG Location	Description
No sub-standard tows on cruise 202392			

Table 5. Aborted tows during the fall survey, cruise 202392.

Station	Stratum	SHG Location	Description
8	26	171 Eastern Cape Cod Bay	hailed early due to lobster gear close to boat
27	36	171 Outer Massachusetts Bay	hailed before setting winches due to bottom
39	35	171 Off Halibut Point and Rockport	caught lobster gear on "G" hook of port sweep
66	13	177 Vineyard Sound	hard hang and parted footrope
96	15	171 Nancucket Sound	caught whelk gear on set out

Table 6a. Total catch by number and weight from 2023 fall survey sorted by number.

Species Code	Common Name	Count	Weight (kg)
143	SCUP	91,653	1,581.603
43	BAY ANCHOVY	39,913	31.957
503	LONGFIN SQUID	29,234	133.265
131	BUTTERFISH	28,720	813.097
72	SILVER HAKE	6,234	654.257
77	RED HAKE	6,224	836.750
106	WINTER FLOUNDER	4,292	788.309
141	BLACK SEA BASS	2,088	47.367
301	AMERICAN LOBSTER	1,462	547.749
105	YELLOWTAIL FLOUNDER	1,123	225.639
163	LONGHORN SCULPIN	1,072	129.481
401	SEA SCALLOP	938	39.799
313	ATLANTIC ROCK CRAB	878	12.259
322	LADY CRAB	690	46.830
135	BLUEFISH	442	7.962
78	SPOTTED HAKE	389	57.727
108	WINDOWPANE	388	64.246
26	LITTLE SKATE	257	145.950
116	NORTHERN PIPEFISH	249	0.181
317	SPIDER CRAB UNCL	235	14.573
13	SMOOTH DOGFISH	235	235.600
193	OCEAN POUT	186	26.531
145	WEAKFISH	151	8.221
176	CUNNER	149	4.335
181	NORTHERN SAND LANCE	146	0.652
171	NORTHERN SEAROBIN	130	13.930
104	FOURSPOT FLOUNDER	108	18.489
103	SUMMER FLOUNDER	98	60.500
208	MACKEREL SCAD	90	1.291
32	ATLANTIC HERRING	88	11.865
132	ATLANTIC MOONFISH	81	0.395
102	AMERICAN PLAICE	73	8.241
172	STRIPED SEAROBIN	70	18.130
33	ALEWIFE	66	2.312
146	NORTHERN KINGFISH	61	5.844
188	STRIPED CUSK-EEL	55	1.323
74	HADDOCK	46	5.719
196	NORTHERN PUFFER	43	1.142
117	SMALLMOUTH FLOUNDER	40	0.502
177	TAUTOG	37	31.032
23	WINTER SKATE	34	16.277
44	STRIPED ANCHOVY	33	0.315
201	PLANEHEAD FILEFISH	27	0.798
107	WITCH FLOUNDER	22	7.697
155	ACADIAN REDFISH	20	0.563
15	SPINY DOGFISH	19	14.334

Table 6a continued.

Species Code	Common Name	Count	Weight (kg)
164	SEA RAVEN	16	6.233
36	ATLANTIC MENHADEN	16	2.713
24	CLEARNOSE SKATE	15	22.536
502	NORTHERN SHORTFIN SQUID	15	1.037
312	JONAH CRAB	11	1.373
596	VERMILION SNAPPER	10	0.068
121	ATLANTIC MACKEREL	9	1.347
212	ROUGH SCAD	9	0.299
657	DWARF GOATFISH	8	0.136
211	ROUND SCAD	8	0.065
323	MANTIS SHRIMP UNCL	7	0.363
197	GOOSEFISH	7	1.320
435	INSHORE LIZARDFISH	6	0.273
149	SPOT	5	0.711
694	NORTHERN SENNET	5	0.023
76	WHITE HAKE	4	1.631
35	AMERICAN SHAD	4	0.434
318	HORSESHOE CRAB	3	3.480
229	WEITZMANS PEARLSIDES	3	0.001
166	GRUBBY	3	0.014
109	GULF STREAM FLOUNDER	3	0.144
129	BLUE RUNNER	2	0.111
439	SNAKEFISH	2	0.021
556	GLASSEYE SNAPPER	2	0.081
343	BLUE MUSSEL	2	0.101
348	NORTHERN MOONSNAIL	2	0.091
738	NAKED GOBY	2	0.007
73	ATLANTIC COD	2	2.326
120	BLUESPOTTED CORNETFISH	1	0.016
597	SNAPPER UNCL	1	0.003
4	ROUGHTAIL STINGRAY	1	79.730
182	SNAKEBLENNY	1	0.068
640	PINFISH	1	0.216
165	ALLIGATORFISH	1	0.007
836	FRINGED FILEFISH	1	0.009
37	HICKORY SHAD	1	0.566
75	POLLOCK	1	0.049
21	ATLANTIC TORPEDO	1	8.140
336	CHANNELED WHELK	1	0.302
402	BAY SCALLOP	1	0.012
139	STRIPED BASS	1	4.291
202	GRAY TRIGGERFISH	1	1.704
492	LINED SEAHORSE	1	0.009
Totals		218,785	6,817.100

Table 6b. Total catch by number and weight from 2023 fall survey sorted by weight.

Species Code	Common Name	Count	Weight (kg)
143	SCUP	91,653	1,581.603
77	RED HAKE	6,224	836.750
131	BUTTERFISH	28,720	813.097
106	WINTER FLOUNDER	4,292	788.309
72	SILVER HAKE	6,234	654.257
301	AMERICAN LOBSTER	1,462	547.749
13	SMOOTH DOGFISH	235	235.600
105	YELLOWTAIL FLOUNDER	1,123	225.639
26	LITTLE SKATE	257	145.950
503	LONGFIN SQUID	29,234	133.265
163	LONGHORN SCULPIN	1,072	129.481
4	ROUGHTAIL STINGRAY	1	79.730
108	WINDOWPANE	388	64.246
103	SUMMER FLOUNDER	98	60.500
78	SPOTTED HAKE	389	57.727
141	BLACK SEA BASS	2,088	47.367
322	LADY CRAB	690	46.830
401	SEA SCALLOP	938	39.799
43	BAY ANCHOVY	39,913	31.957
177	TAUTOG	37	31.032
193	OCEAN POUT	186	26.531
24	CLEARNOSE SKATE	15	22.536
104	FOURSPOT FLOUNDER	108	18.489
172	STRIPED SEAROBIN	70	18.130
23	WINTER SKATE	34	16.277
317	SPIDER CRAB UNCL	235	14.573
15	SPINY DOGFISH	19	14.334
171	NORTHERN SEAROBIN	130	13.930
313	ATLANTIC ROCK CRAB	878	12.259
32	ATLANTIC HERRING	88	11.865
102	AMERICAN PLAICE	73	8.241
145	WEAKFISH	151	8.221
21	ATLANTIC TORPEDO	1	8.140
135	BLUEFISH	442	7.962
107	WITCH FLOUNDER	22	7.697
164	SEA RAVEN	16	6.233
146	NORTHERN KINGFISH	61	5.844
74	HADDOCK	46	5.719
176	CUNNER	149	4.335
139	STRIPED BASS	1	4.291
318	HORSESHOE CRAB	3	3.480
36	ATLANTIC MENHADEN	16	2.713
73	ATLANTIC COD	2	2.326
33	ALEWIFE	66	2.312
202	GRAY TRIGGERFISH	1	1.704
76	WHITE HAKE	4	1.631

Table 6b continued.

Species Code	Common Name	Count	Weight (kg)
312	JONAH CRAB	11	1.373
121	ATLANTIC MACKEREL	9	1.347
188	STRIPED CUSK-EEL	55	1.323
197	GOOSEFISH	7	1.320
208	MACKEREL SCAD	90	1.291
196	NORTHERN PUFFER	43	1.142
502	NORTHERN SHORTFIN SQUID	15	1.037
201	PLANEHEAD FILEFISH	27	0.798
149	SPOT	5	0.711
181	NORTHERN SAND LANCE	146	0.652
37	HICKORY SHAD	1	0.566
155	ACADIAN REDFISH	20	0.563
117	SMALLMOUTH FLOUNDER	40	0.502
35	AMERICAN SHAD	4	0.434
132	ATLANTIC MOONFISH	81	0.395
323	MANTIS SHRIMP UNCL	7	0.363
44	STRIPED ANCHOVY	33	0.315
336	CHANNELED WHELK	1	0.302
212	ROUGH SCAD	9	0.299
435	INSHORE LIZARDFISH	6	0.273
640	PINFISH	1	0.216
116	NORTHERN PIPEFISH	249	0.181
109	GULF STREAM FLOUNDER	3	0.144
657	DWARF GOATFISH	8	0.136
129	BLUE RUNNER	2	0.111
343	BLUE MUSSEL	2	0.101
348	NORTHERN MOONSNAIL	2	0.091
556	GLASSEYE SNAPPER	2	0.081
182	SNAKEBLenny	1	0.068
596	VERMILION SNAPPER	10	0.068
211	ROUND SCAD	8	0.065
75	POLLOCK	1	0.049
694	NORTHERN SENNET	5	0.023
439	SNAKEFISH	2	0.021
120	BLUESPOTTED CORNETFISH	1	0.016
166	GRUBBY	3	0.014
402	BAY SCALLOP	1	0.012
492	LINED SEAHORSE	1	0.009
836	FRINGED FILEFISH	1	0.009
738	NAKED GOBY	2	0.007
165	ALLIGATORFISH	1	0.007
597	SNAPPER UNCL	1	0.003
229	WEITZMANS PEARLSIDES	3	0.001
Totals		218,785	6,817.100

Table 7. Total samples obtained for age, growth, maturity, and special studies during MDMF fall cruise 202392.

Species	Maturity Observation	Age and Growth Collection		
		Scales	Otoliths	YOY
Atlantic Cod	1		1	
Haddock	15		15	
Summer Flounder	62		61	
Yellowtail Flounder	155		155	
Winter Flounder	421		419	
Black Sea Bass	60		60	
Scup	98		97	
Weakfish	20		20	
Tautog	9		9	
American Lobster	665		0	
TOTAL	1,506	0	837	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)

Various New England groundfish species for UMASS Dartmouth technician (C. Rillihan)

Water samples collected for eDNA analysis (GMGI)

Record station and position data for large catch of Loligo squid egg mops (O. Nichols)

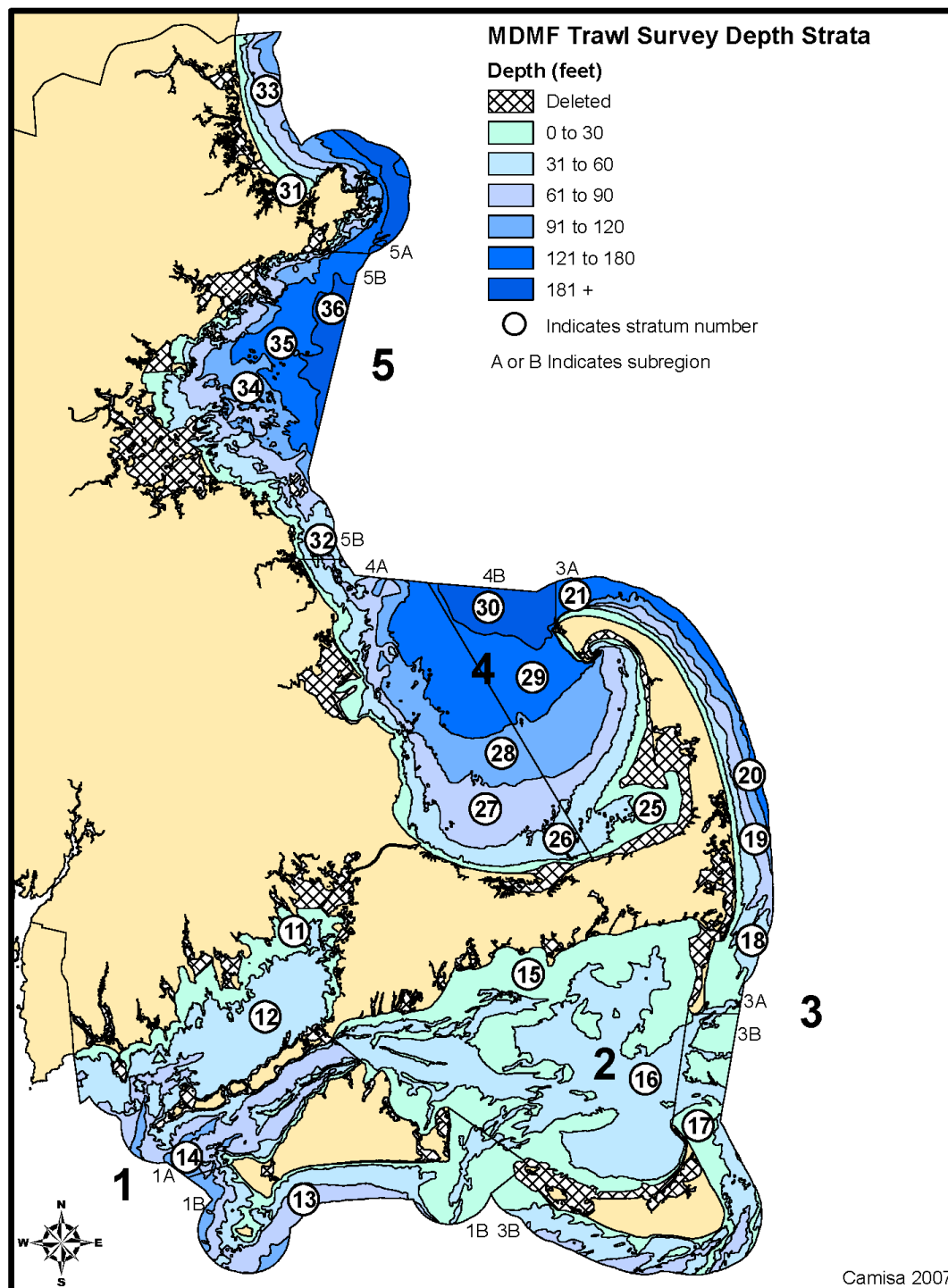


Figure 1. MDMF inshore bottom trawl survey region and strata map.

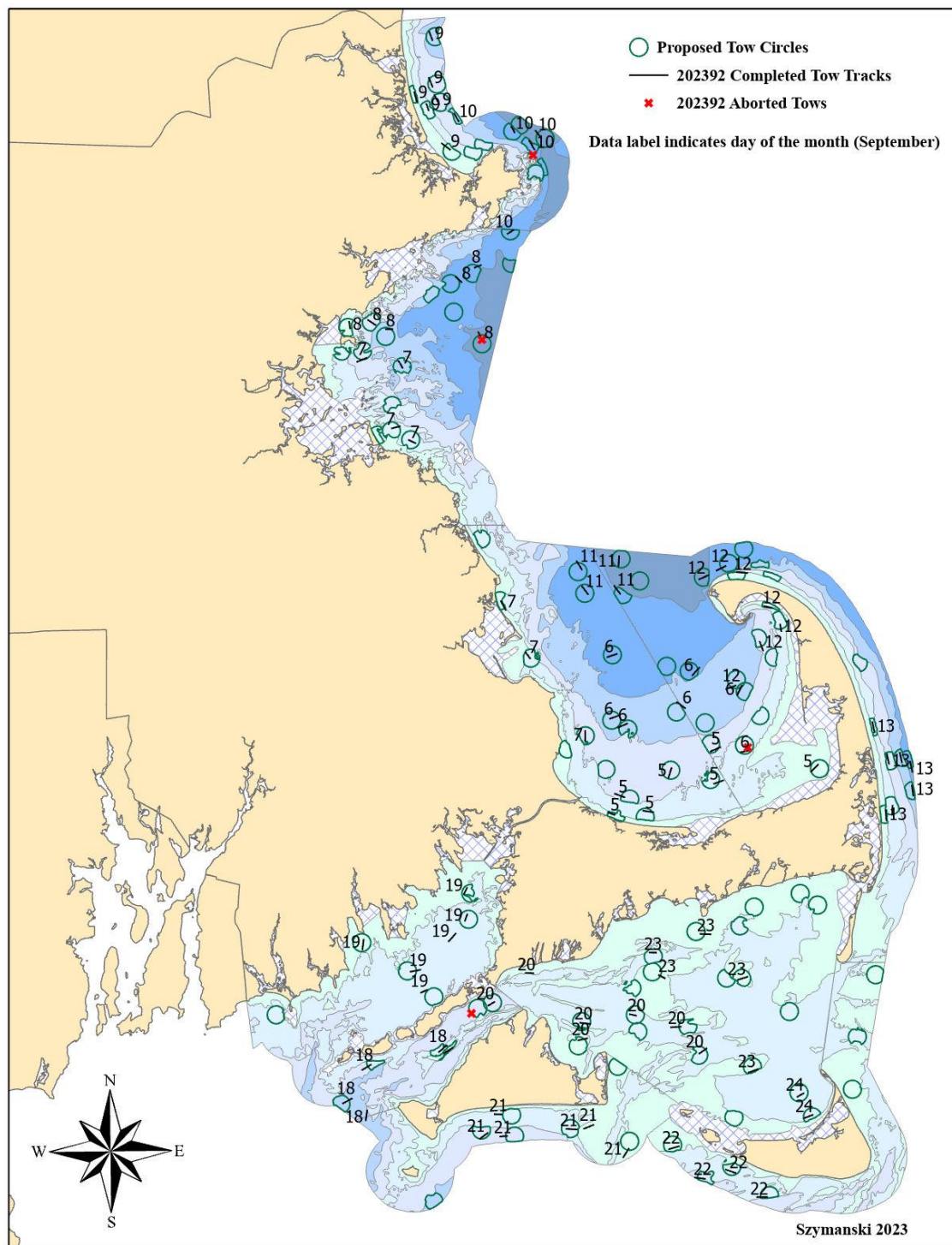


Figure 2. All proposed fall 2023 stations including completed and aborted tows by date.

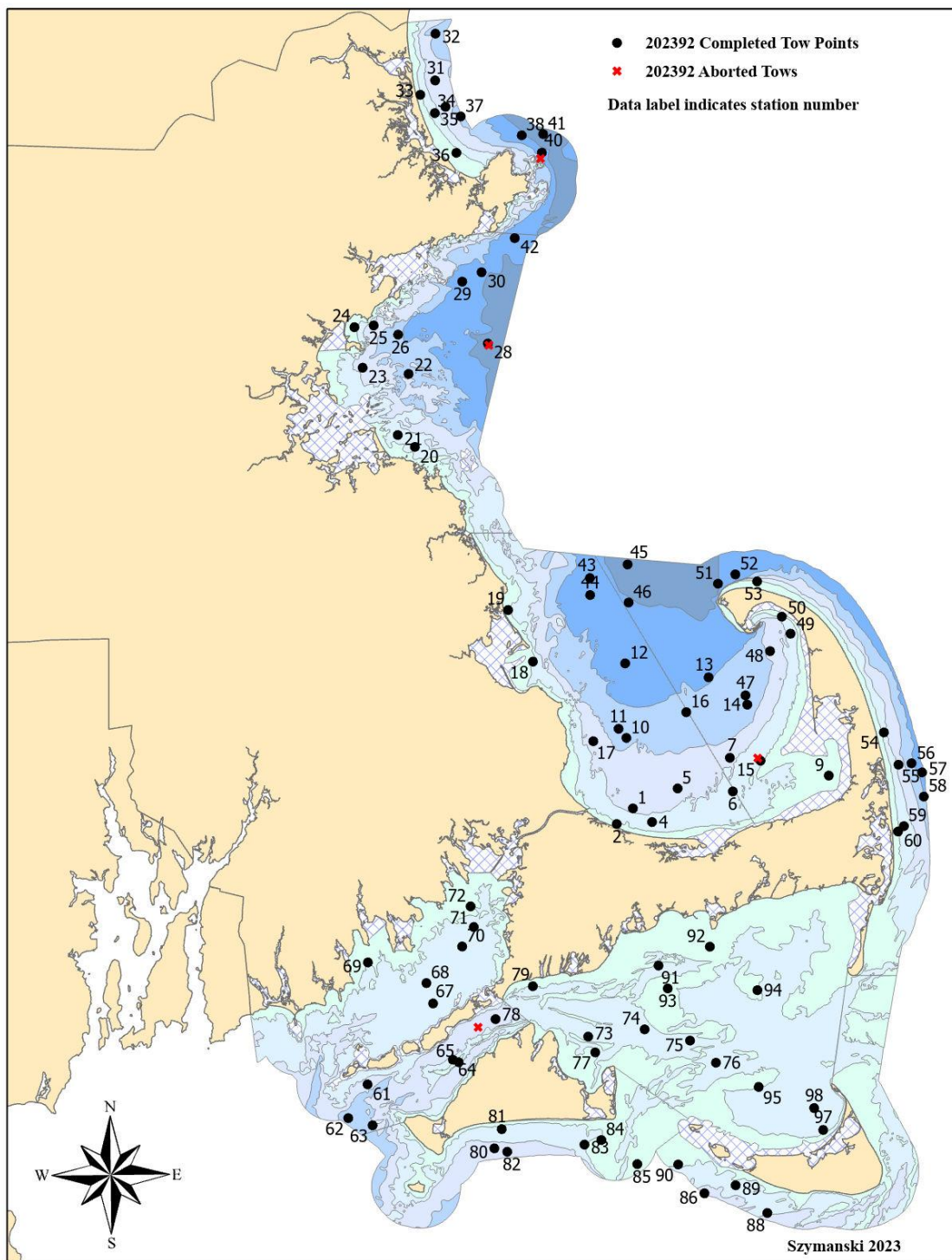
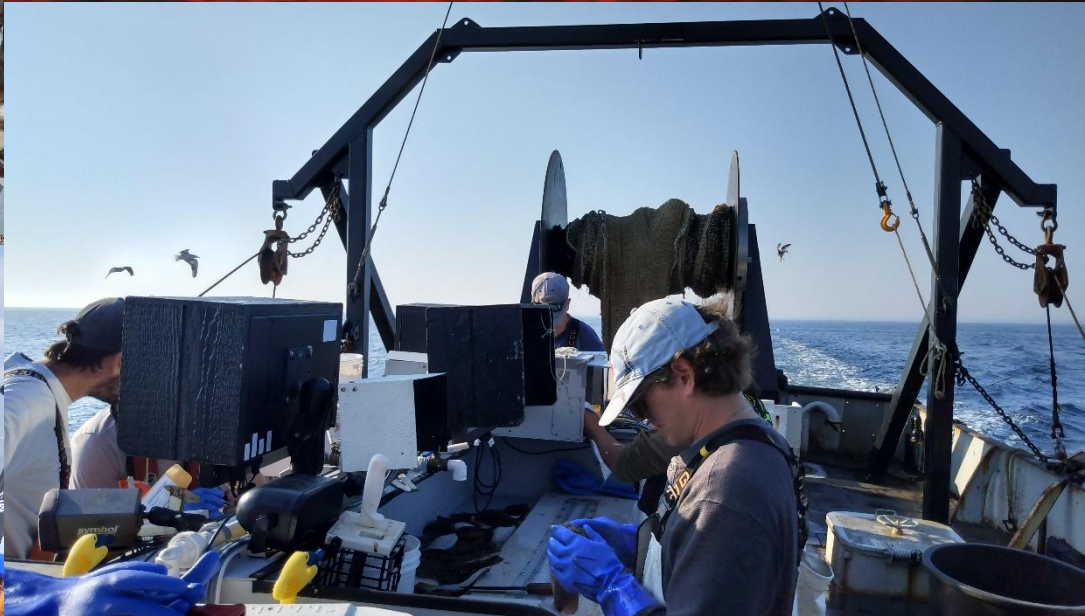


Figure 3. All attempted fall 2023 survey stations in chronological order.

Fall Cruise 202392



2023/09/09

2023/09/11

SURVEY REPORT
2023 Nantucket Sound Estuarine Winter Flounder
Young of the Year (YOY)
Seine Survey

SURVEY PERIOD AND AREA

From June 12 – 29, 2023 the Massachusetts Division of Marine Fisheries (MDMF) conducted its 48th Nantucket Sound Estuarine Winter Flounder 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

Each survey 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. The first 9 days that meet the protocol during this timeframe are used. Weekends, Holidays, and afternoons are avoided to reduce recreational use conflicts at site locations. Forty-nine fixed stations, originally chosen for efficient seining (i.e., smooth sediment bottom generally devoid of attached vegetation) and historic availability of 0-group winter flounder, were proportionately allocated by each estuary's littoral perimeter. A 6.4 meter straight seine of 4.8 mm nylon mesh equipped with a weighted lead line footrope to minimize escapement was set and hauled perpendicular to shore from depths between 0.9 to 1.2 meters.

Winter flounder density (# YOY per square meter) was determined by aggregating catch from three replicate hauls at each station. Consistent area swept was maintained using a fixed-length spreader rope. Haul distance was calculated as the hypotenuse of a right triangle, using the measurements of distance over the water's surface and depth at the beginning of the seine haul. Distance over the water's surface was measured with a sonic digital rangefinder (SONIN Multi-Measure Combo ProTM) and water depth at the beginning of the seine haul was measured with a weighted and marked line. When inclement weather prevents use of the rangefinder, distance over ground was measured by pacing. Statistical analysis of seine data employed stratification techniques; each estuary was considered a stratum and each station's three replicate hauls were treated as one individual sample. Stratified mean density and confidence limits were derived from standard and modified formulae for mean and variance. Eleven MADMF employees participated in the survey as part of the scientific party (Table 1).

RESULTS

136 seine hauls were conducted at 49 stations over 9 sampling days. Eleven replicate hauls were dropped at nine stations due to decreased beach area, shoreline vegetation, coastal armor installations, and obstructions: Fairfield, Washburn Island 4, Bluff Point #2, Seapuit #2, Follin's Pond, Heirs Landing, Harbor Haven, Mill Pond, Sear's Point and Vineyard Avenue. Thirty-seven species were encountered in 2023 (Table 2). The 2023 pooled (all estuaries combined) winter flounder YOY index is (0.451 YOY / m²), well above the timeseries median and the third highest index observed since 1976 (Figure 2, Table 3). The Age 1+ winter flounder index remained below the timeseries median for the 15th consecutive year with only one fish encountered (Figure 3). Waquoit Bay's YOY winter flounder estuary-specific index is a new timeseries record in 2023. YOY winter flounder indices for Great Pond, Cotuit Bay and Stage Harbor increased above the median while Lewis Bay and Bass River remained near the median (Figure 4). The YOY summer flounder index increased to a new record in 2023, more than doubling the previous time series high (Figure 5). The blue crab index increased to reach the third highest observation on record (Figure 6). All bottom temperature monitors were collected and successfully downloaded (Figure 7). For further information on this survey or additional data, please contact Steve Wilcox (508)-742-9731.

Table 1. 2023 Seine Survey Staff List

Name	Affiliation	Num. Days
Vincent Manfredi	MDMF	9
Mark Szymanski	MDMF	3
Steve Wilcox	MDMF	3
Amanda Davis	MDMF	1
Amanda Meli	MDMF	1
Caylene Pillsbury	MDMF	1
Brendan Reilly	MDMF	1
Caitlyn Spind	MDMF	1
Jon Truscott	MDMF	1
Steve Voss	MDMF	1
Evan Weig	MDMF	1

Table 2. Species observed in 2023 seine survey, species without total number are only noted for presence at each station.

Common Name	Taxonomic Name	Total Number	% Occurrence
YOY Winter Flounder	<i>Pseudopleuronectes americanus</i>	3469	92.6%
Atlantic Silverside	<i>Menidia menidia</i>		82.4%
Blue Crab	<i>Callinectes sapidus</i>	995	80.1%
Sand Shrimp	<i>Crangon septemspinosa</i>		70.6%
Mud Snail	<i>Nassarius obsoletus</i>		64.7%
Striped Killifish	<i>Fundulus majalis</i>		50.7%
YOY Summer Flounder	<i>Paralichthys dentatus</i>	183	38.2%
Northern Pipefish	<i>Sygnathus fuscus</i>		35.3%
Grass Shrimp	<i>Paelmonetes pugio</i>		21.3%
Green Crab	<i>Carcinus maenus</i>	72	20.6%
Mummichog	<i>Fundulus heteroclitus</i>		19.9%
Spider Crab Uncl.	<i>Majidae</i>	58	16.2%
Rainwater Killifish	<i>Lucania parva</i>	155	12.5%
Spot	<i>Leiostomus xanthurus</i>	194	9.6%
Atlantic Needlefish	<i>Strongylura marina</i>	42	9.6%
Fourspine Stickleback	<i>Apeltes quadracus</i>		8.8%
Northern Sand Lance	<i>Ammodytes dubius</i>	217	6.6%
Atlantic Herring	<i>Clupea harengus</i>	17	4.4%
Sheepshead Minnow	<i>Cyprinodon variegatus</i>		4.4%
White Mullet	<i>Mugil curema</i>	16	4.4%
Naked Goby / Seaboard Goby	<i>Gobiosoma spp.</i>	7	4.4%
Atlantic Rock Crab	<i>Cancer irroratus</i>	6	3.7%
Horseshoe Crab	<i>Limulus polyphemus</i>	7	3.7%
Lady Crab	<i>Ovalipes ocellatus</i>	12	3.7%
Ribbed Mussel	<i>Guekensia demissus</i>	5	3.7%
Oyster	<i>Crassostrea virginica</i>	5	2.9%
Blue Mussel	<i>Mytilus edulis</i>	8	2.2%
American Eel	<i>Anguilla rostrata</i>	4	2.2%
Alewife / Blueback Herring	<i>Alosa spp.</i>	7	2.2%
Threespine Stickleback	<i>Gasterosteus aculeatus</i>		1.5%
Northern Quahog	<i>Mercenaria mercenaria</i>	1	1.5%
Mottled Dog Whelk	<i>Nassa vibex</i>		1.5%
Bubble Snail	<i>F. Atyidae</i>		1.5%
Age 1+ Summer Flounder	<i>Paralichthys dentatus</i>	1	0.7%
Age 1+ Winter Flounder	<i>Pseudopleuronectes americanus</i>	1	0.7%
Smallmouth flounder	<i>Etropus microstomus</i>	2	0.7%
Northern Kingfish	<i>Menticirrihitus saxatilis</i>	1	0.7%
Asian Shore Crab	<i>Hemigrapsus sanguineus</i>	2	0.7%
Fiddler Crab	<i>Uca pugilator</i>		0.7%

Table 3. YOY Winter Flounder Abundance, All Estuaries. MDMF Seine Survey 1976-2023.

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	0.06	0.366	0.648
1980	0.432	0.057	0.306	0.559
1981	0.34	0.056	0.208	0.471
1982	0.37	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	0.34
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	0.1	0.011	0.077	0.122
2003	0.197	0.032	0.128	0.267
2004	0.095	0.012	0.07	0.12
2005	0.075	0.01	0.054	0.096
2006	0.164	0.018	0.126	0.202
2007	0.167	0.021	0.125	0.21
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	0.25	0.025	0.198	0.302
2014	0.186	0.028	0.13	0.242
2015	0.127	0.018	0.09	0.163
2016	0.187	0.02	0.146	0.228
2017	0.291	0.05	0.182	0.4
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	0.16	0.286
2022	0.231	0.028	0.175	0.287
2023	0.451	0.088	0.258	0.643

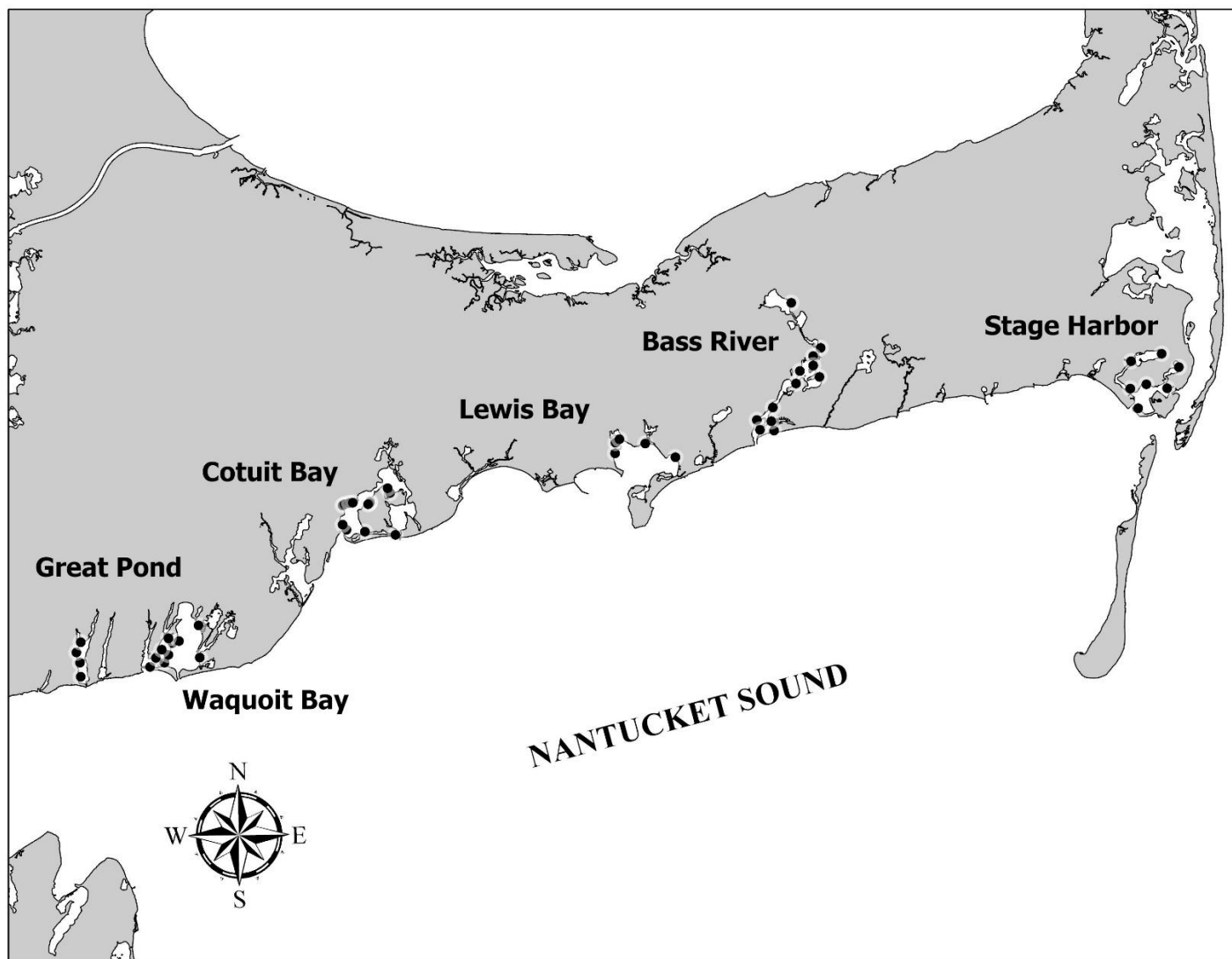


Figure 1. MDMF seine survey station locations.

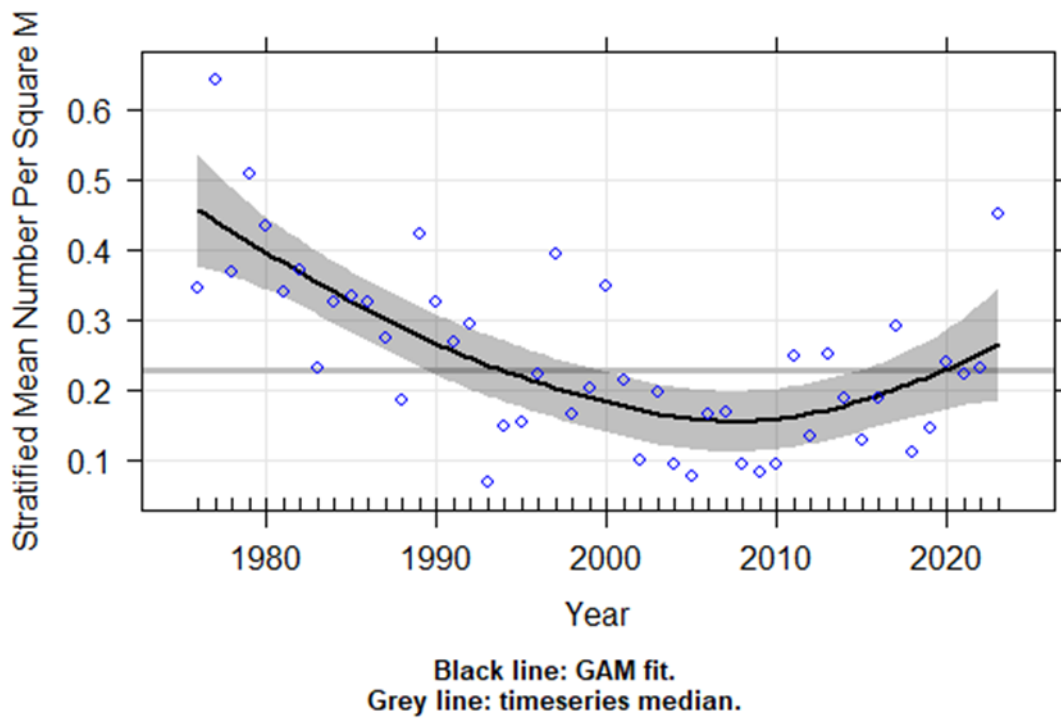


Figure 2. Seine survey cumulative YOY Winter Flounder abundance.

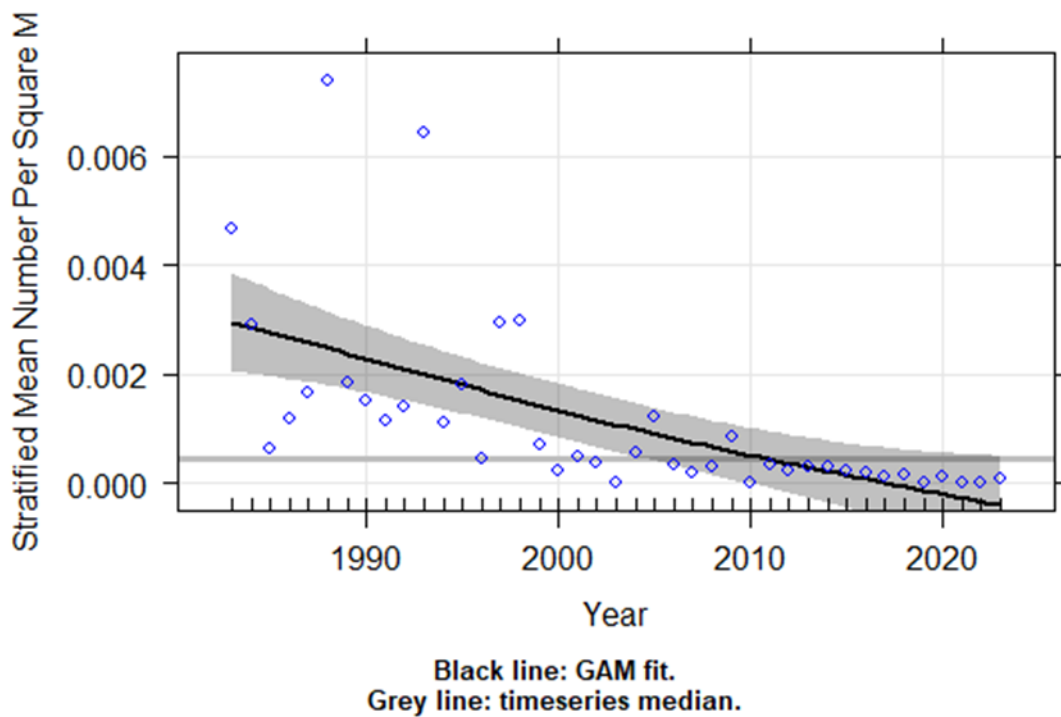
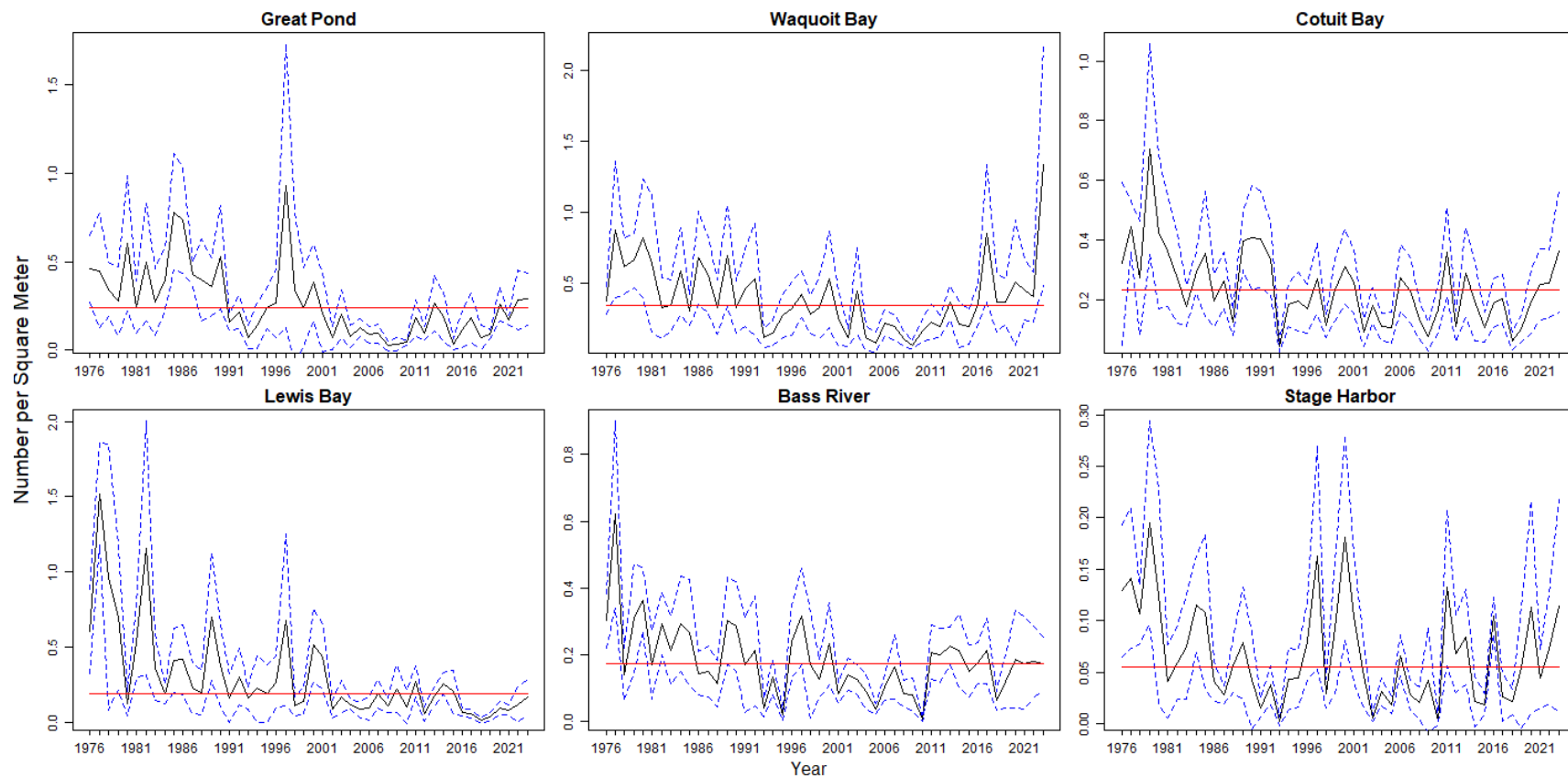


Figure 3. Seine survey cumulative age 1+ Winter Flounder abundance.



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 – 2023.

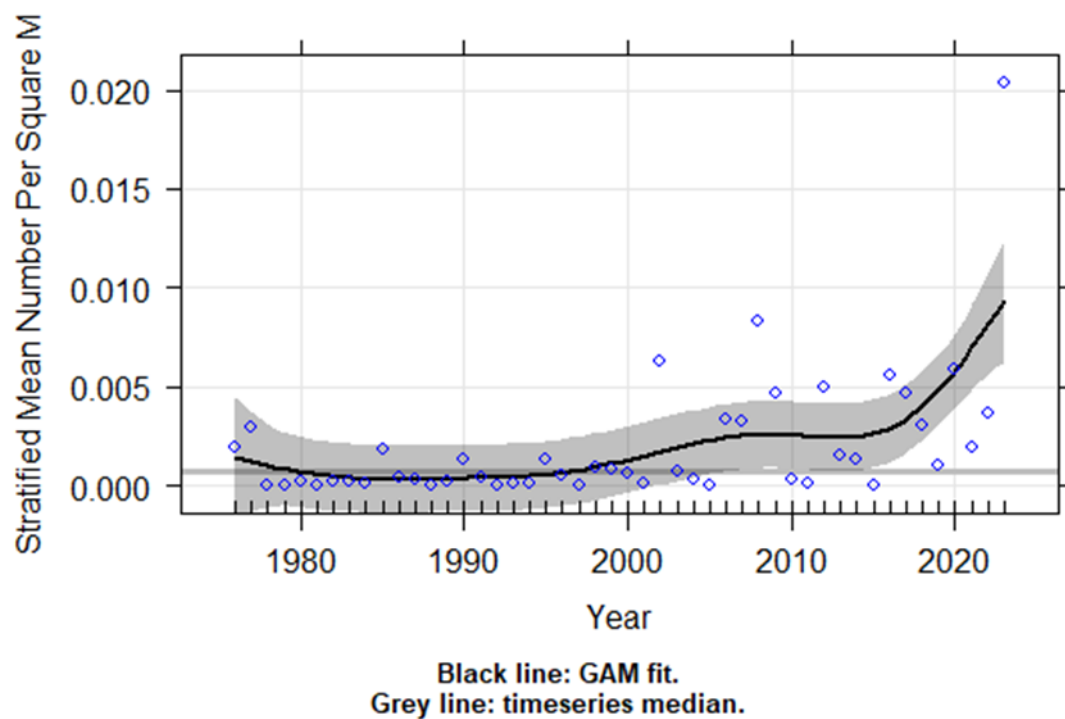


Figure 5. Seine Survey cumulative YOY Summer Flounder abundance.

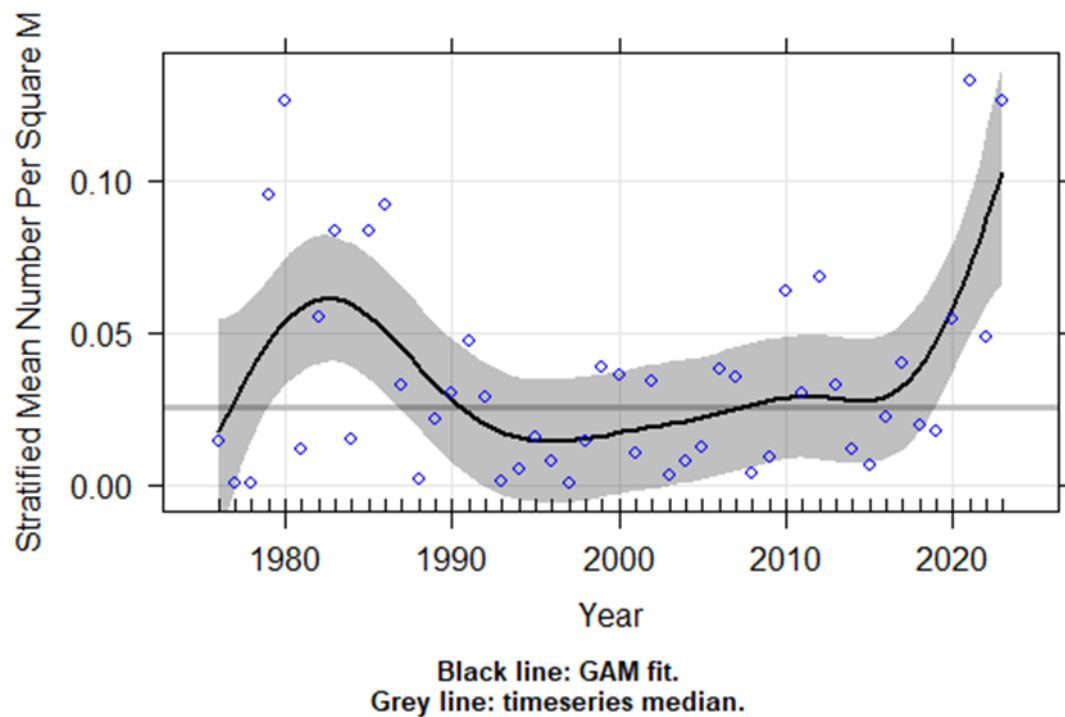


Figure 6. Seine Survey cumulative Blue Crab abundance.

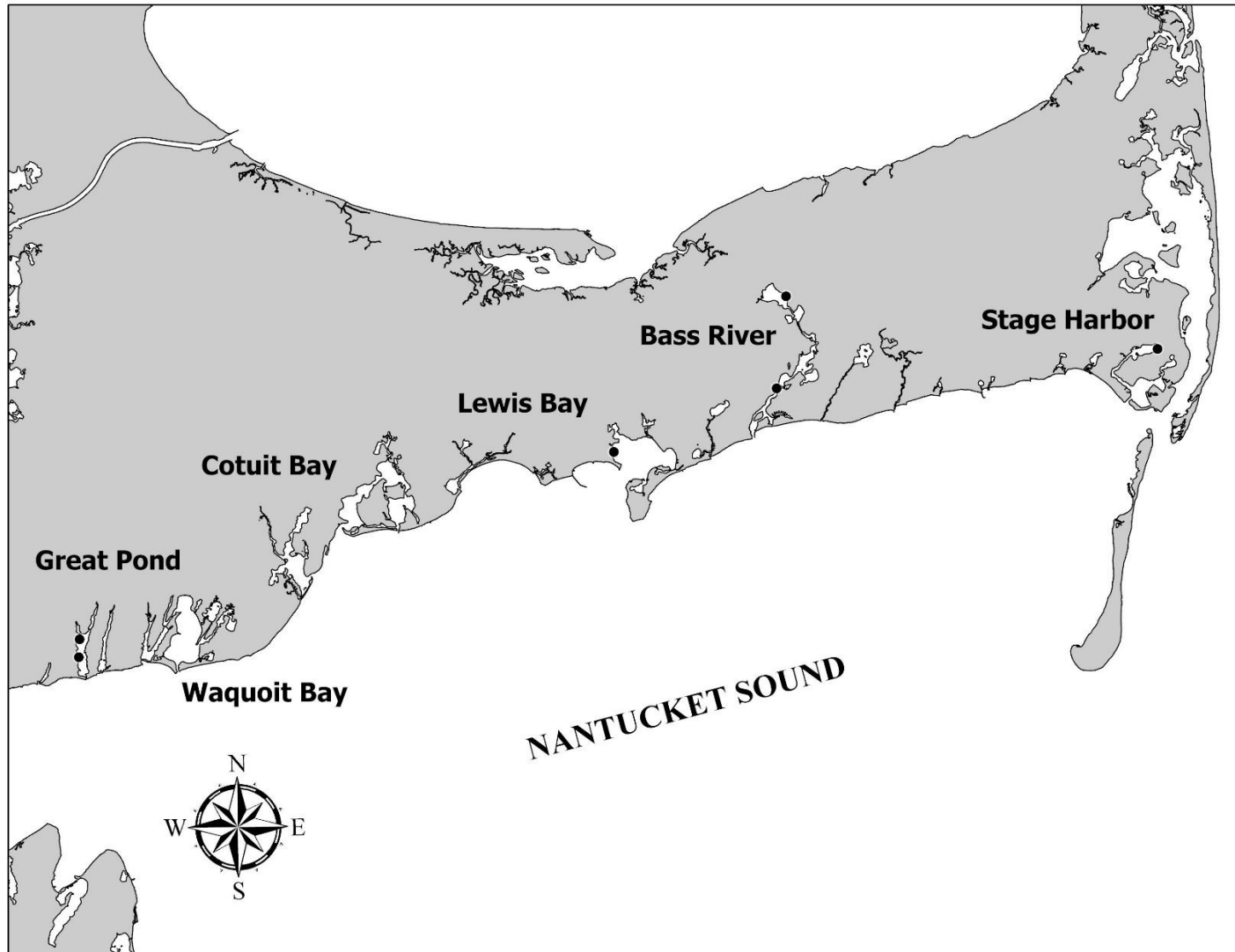


Figure 7. MDMF seine survey temperature monitor locations.

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.

Contents:

Figure 1. Massachusetts trawl survey regions.

Figure 2 (a-ff). Stratified mean weight per tow (kg) 1978–2023 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
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- (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 – 2023 MDMF trawl survey.

- (a) Spring **Channeled Whelk** Regions 1 - 2
- (b) Fall **Channeled Whelk** Regions 1 - 2
- (c) Fall **Knobbed Whelk** Regions 1 - 2
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Figure 4 (a – b). Pre-recruit stratified mean number per tow 1978 – 2023 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

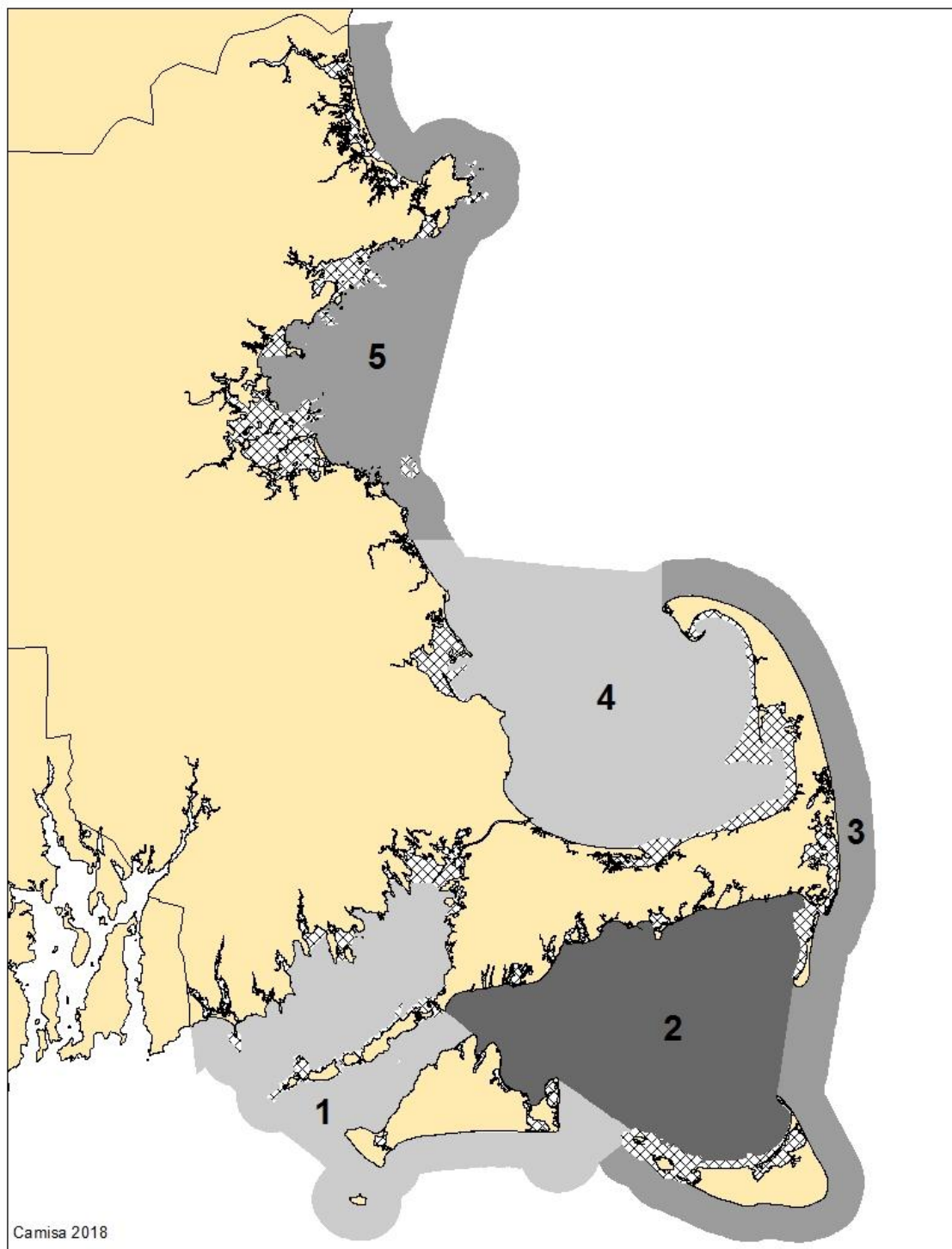


Figure 1. MDMF trawl survey regions. Gulf of Maine (GOM) = Regions 4-5. Southern New England (SNE) = Regions 1-3.

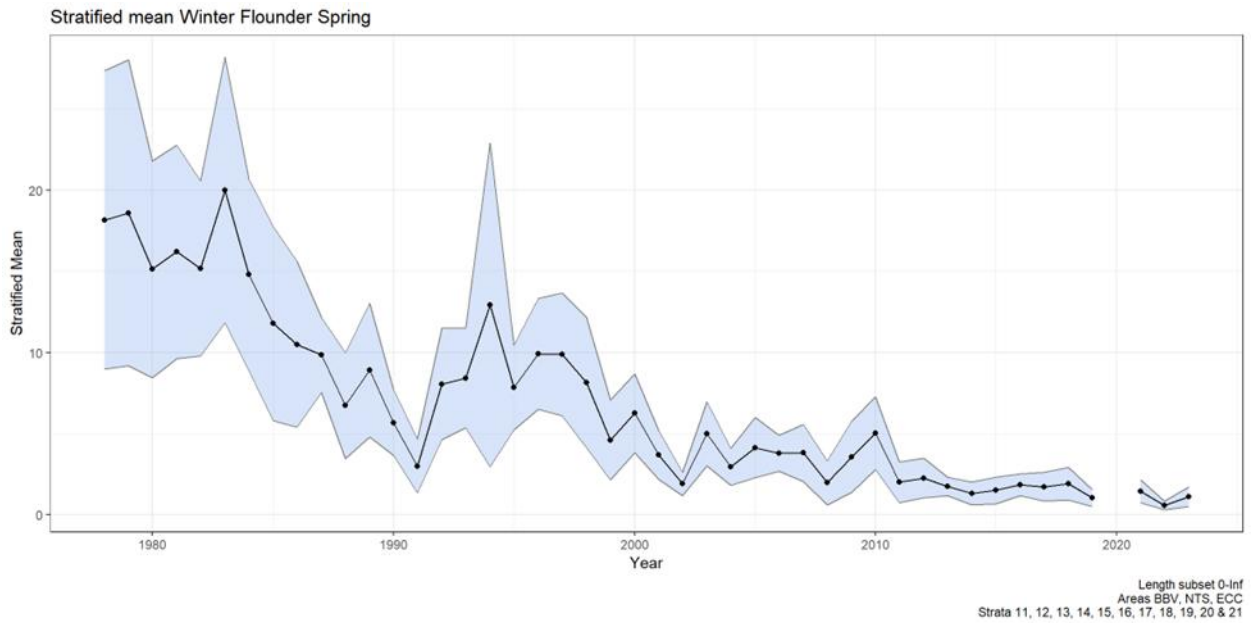


Figure 2a. Stratified mean weight per tow (kg) 1978 – 2023 spring Winter Flounder SNE.

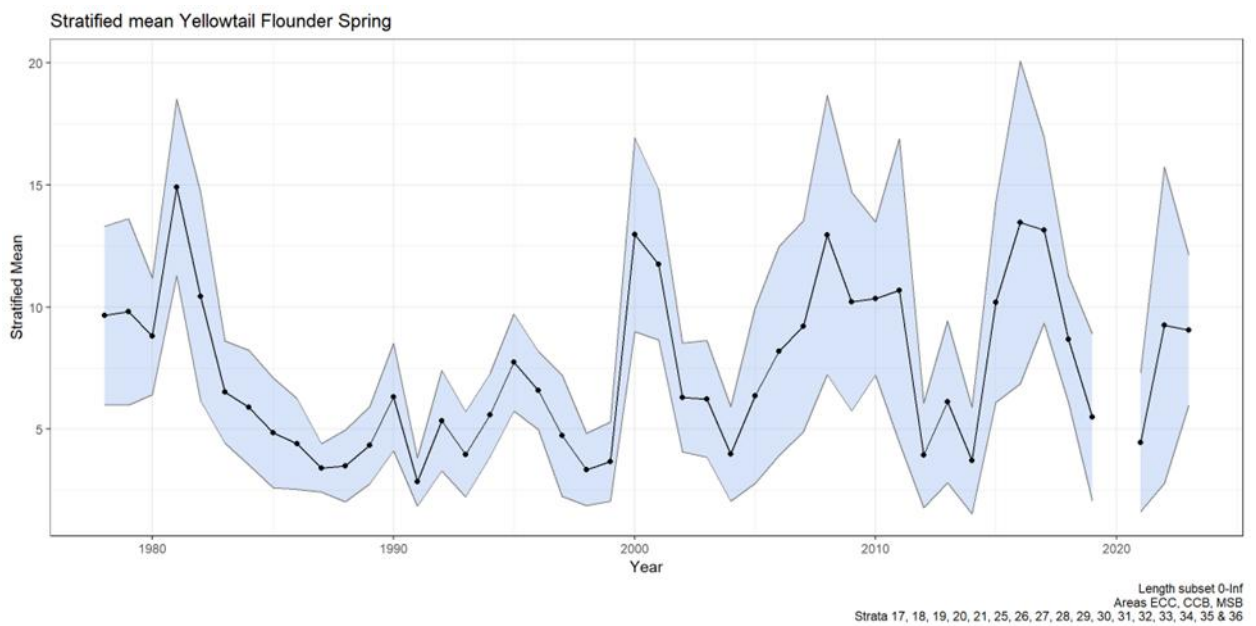


Figure 2b. Stratified mean weight per tow (kg) 1978 – 2023 spring Yellowtail Flounder in regions 3, 4, & 5.

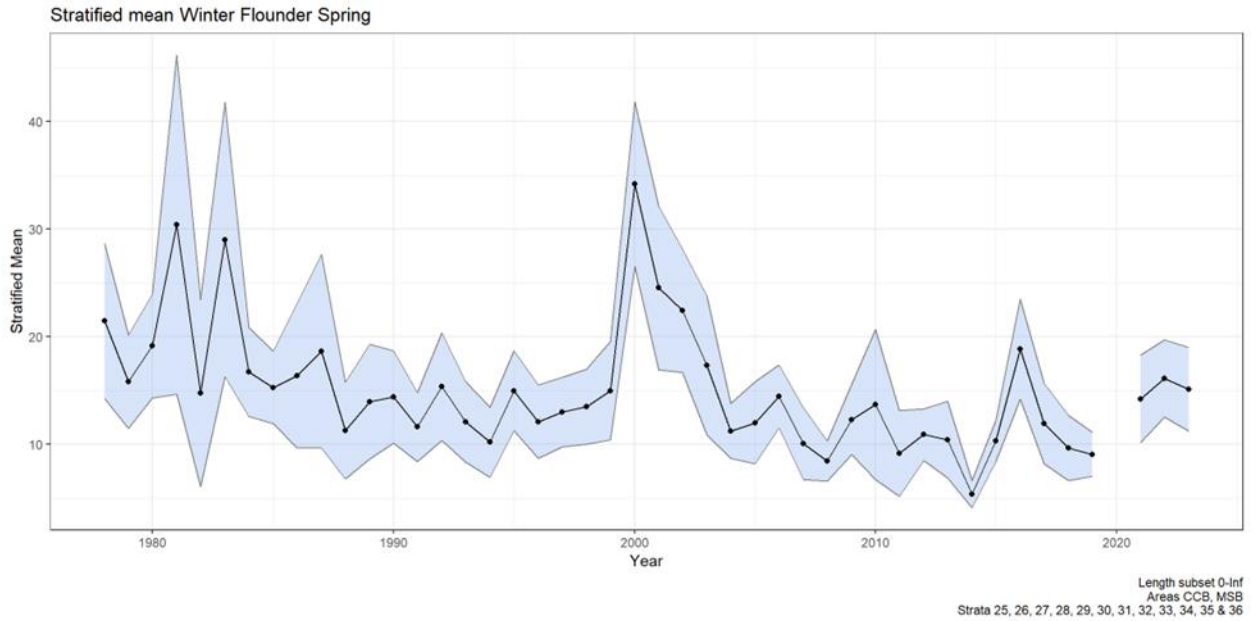


Figure 2c. Stratified mean weight per tow (kg) 1978 – 2023 spring Winter Flounder GOM.

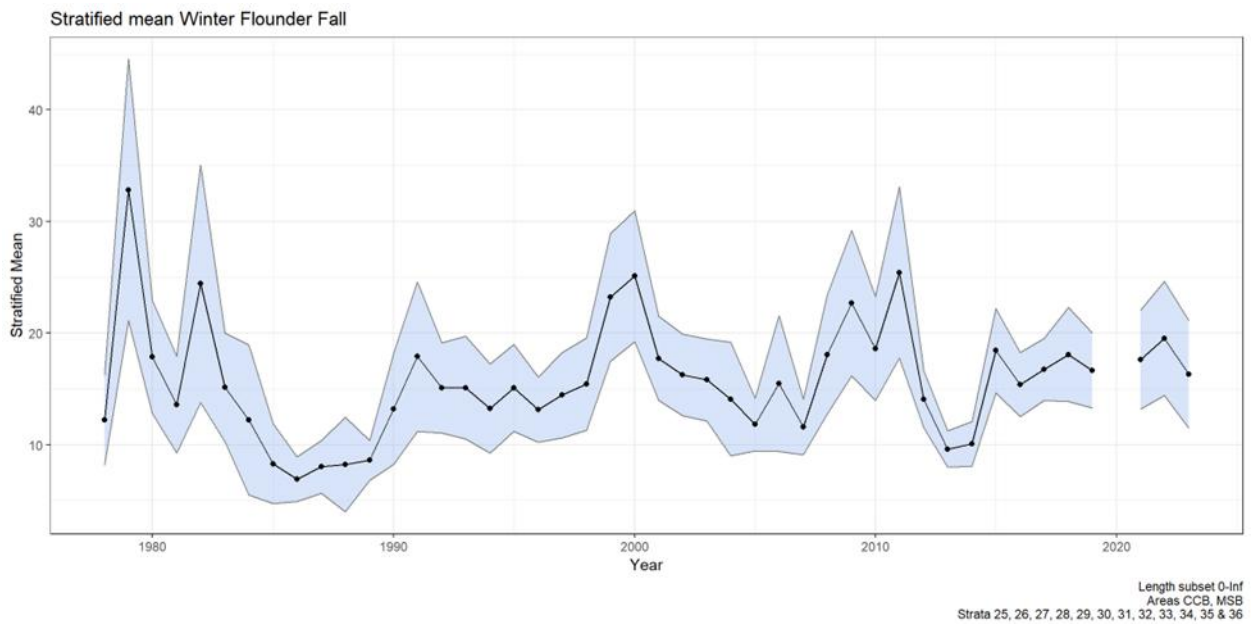


Figure 2d. Stratified mean weight per tow (kg) 1978 – 2023 fall Winter Flounder GOM.

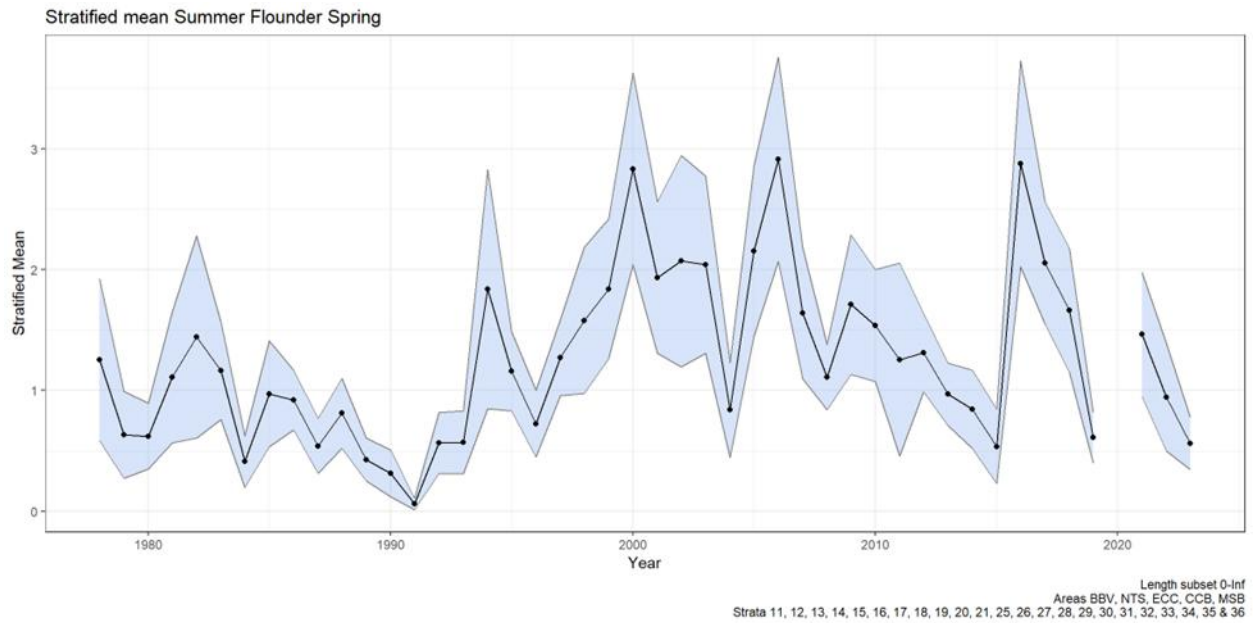


Figure 2e. Stratified mean weight per tow (kg) 1978 – 2023 spring Summer Flounder.

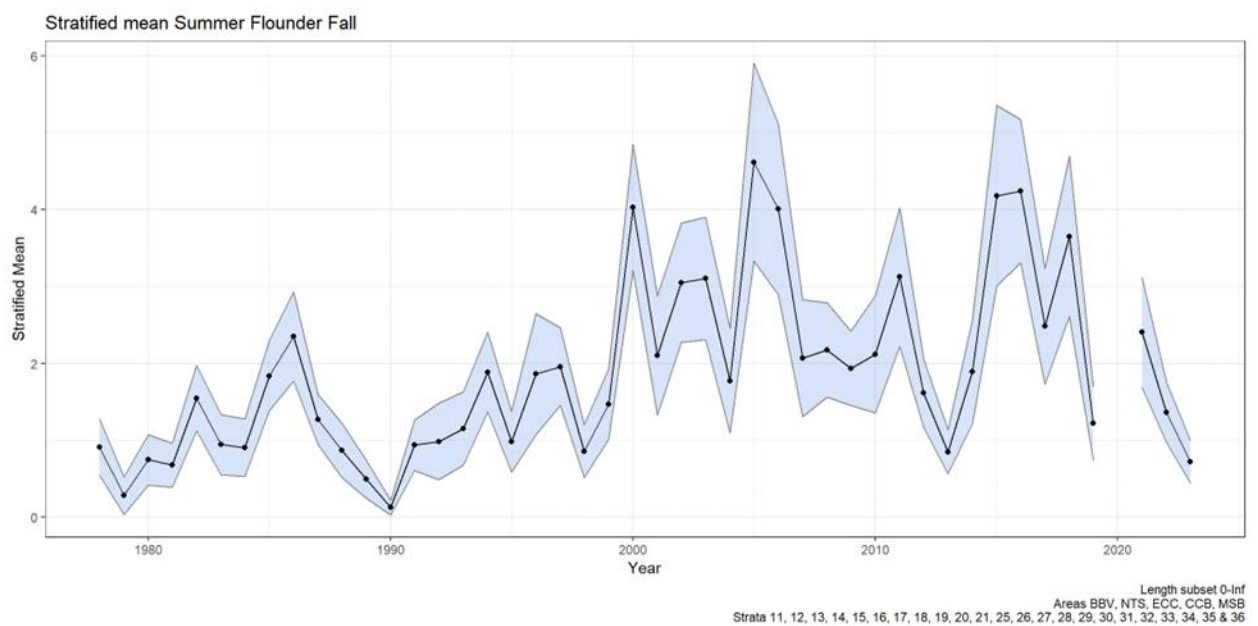


Figure 2f. Stratified mean weight per tow (kg) 1978 – 2023 fall Summer Flounder.

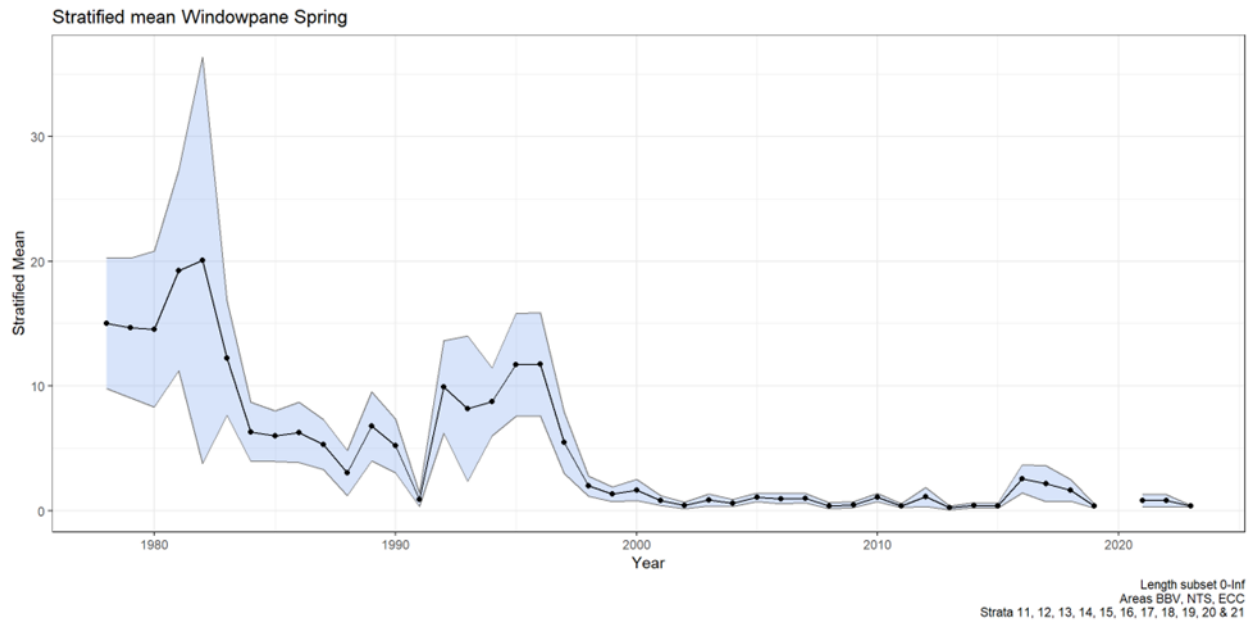


Figure 2g. Stratified mean weight per tow (kg) 1978 – 2023 spring Windowpane SNE.

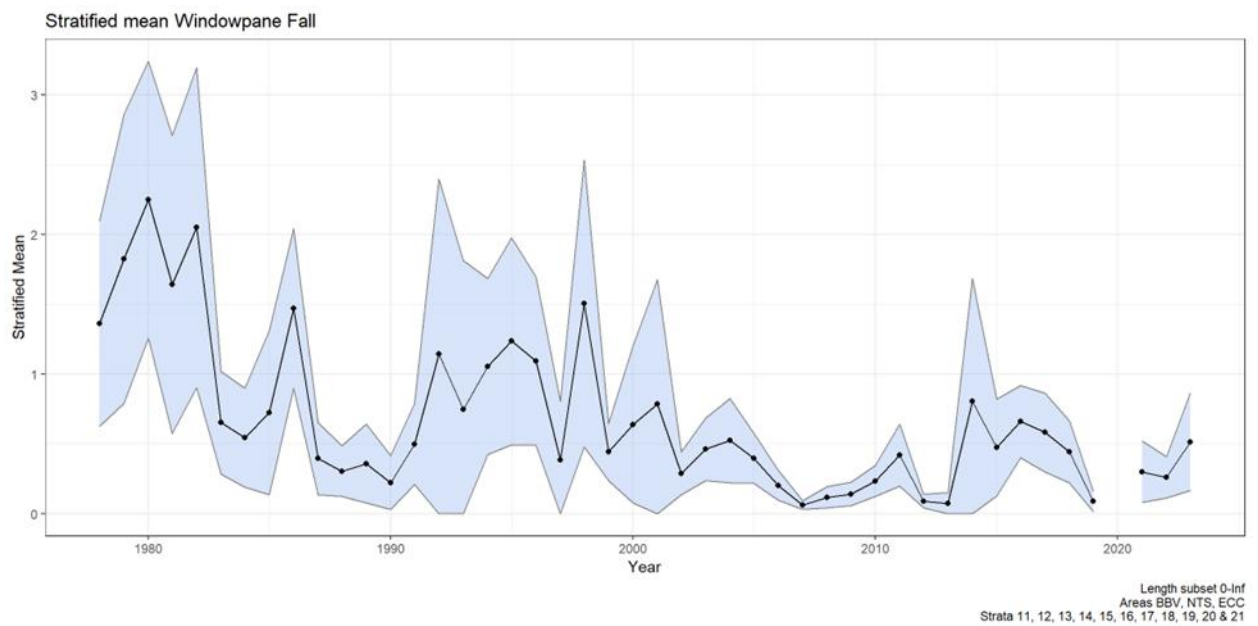


Figure 2h. Stratified mean weight per tow (kg) 1978 – 2023 fall Windowpane SNE.

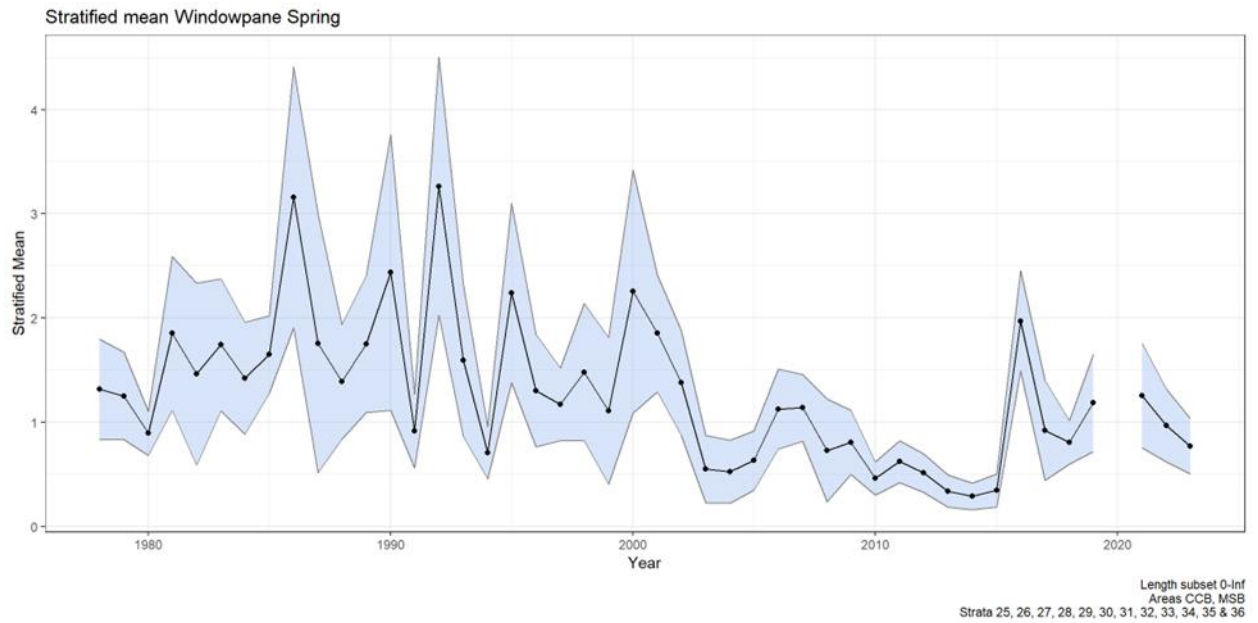


Figure 2i. Stratified mean weight per tow (kg) 1978 – 2023 spring Windowpane GOM.

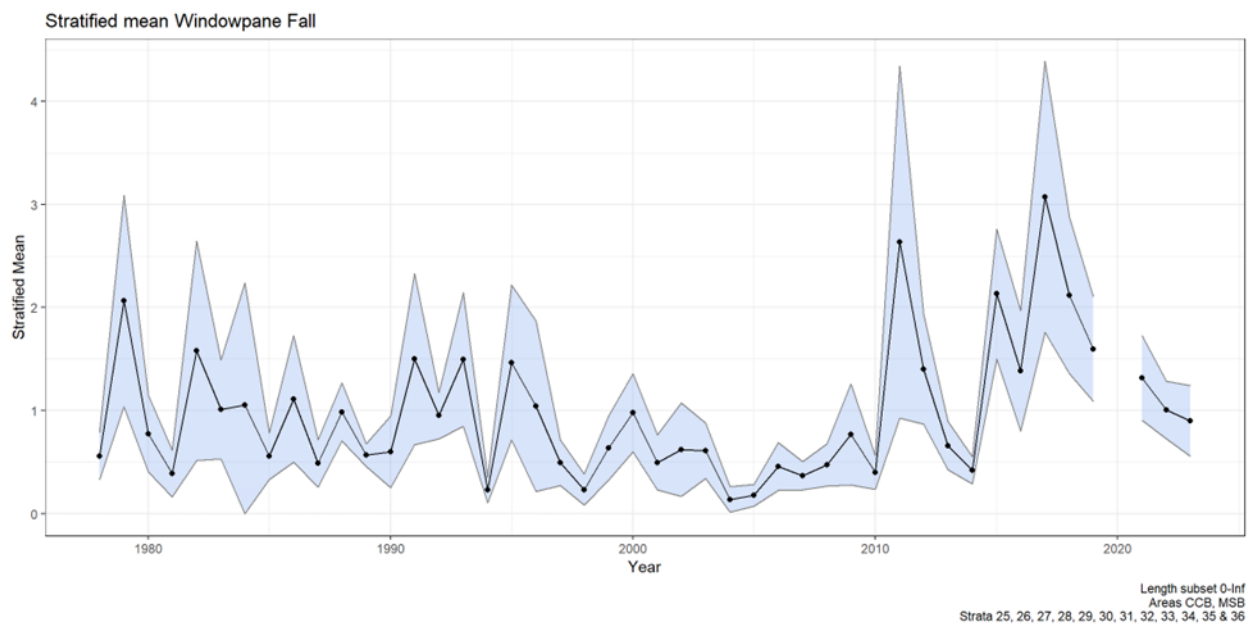


Figure 2j. Stratified mean weight per tow (kg) 1978 – 2023 fall Windowpane GOM

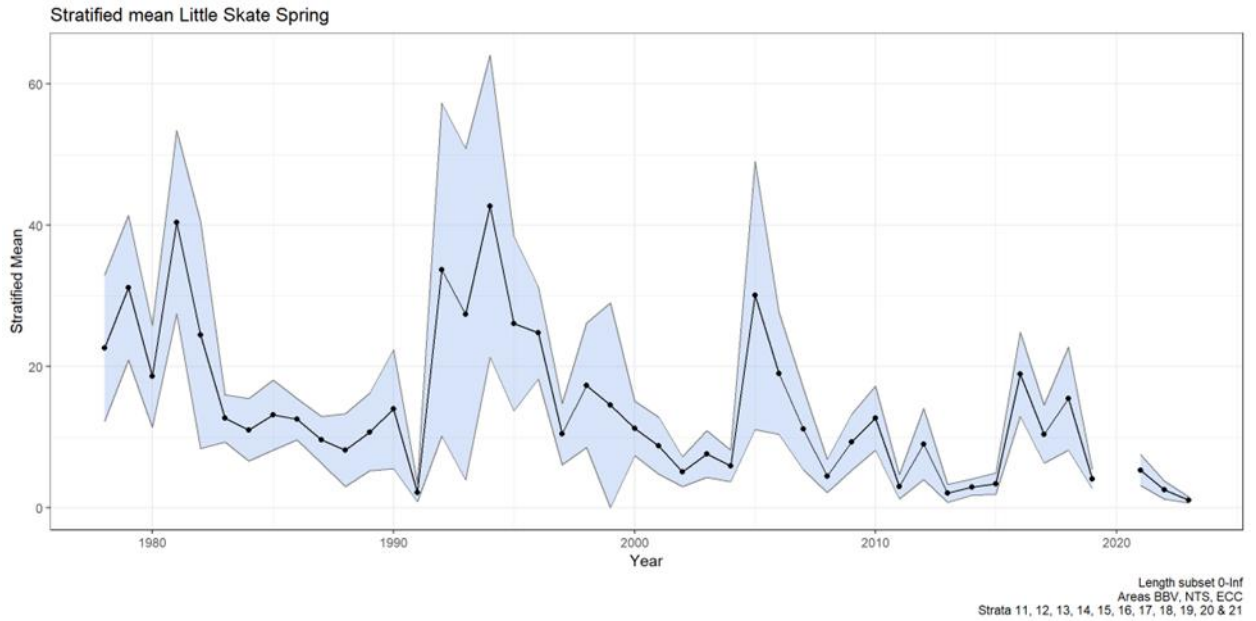


Figure 2k. Stratified mean weight per tow (kg) 1978 – 2023 spring Little Skate SNE.

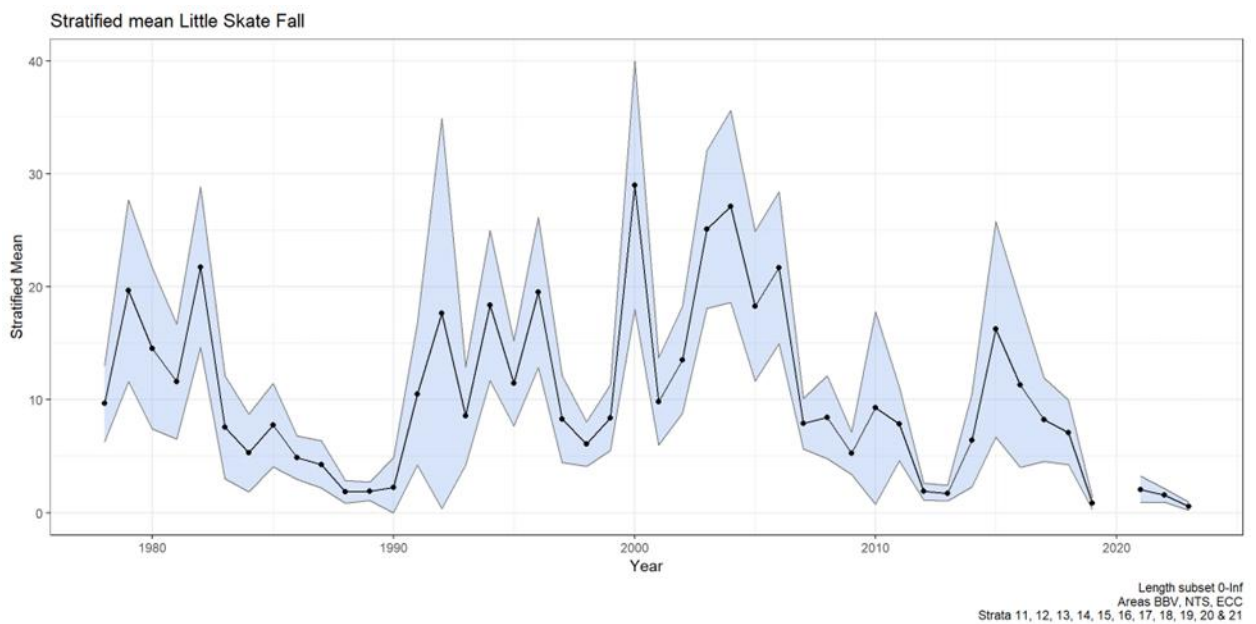


Figure 2l. Stratified mean weight per tow (kg) 1978 – 2023 fall Little Skate SNE.

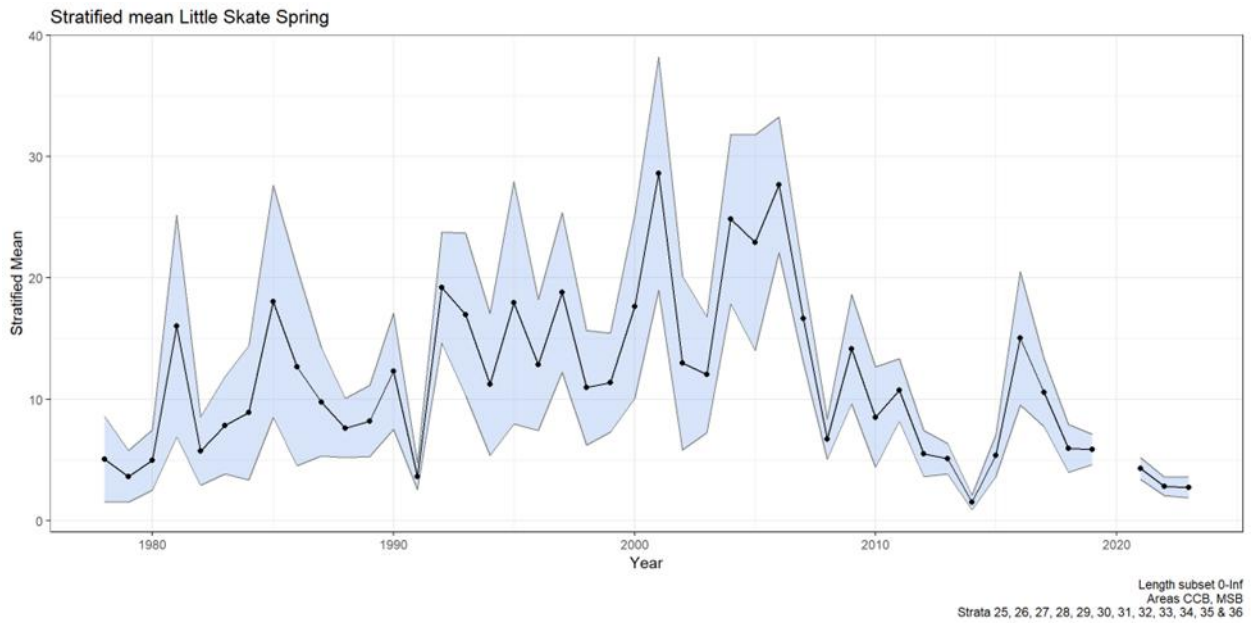


Figure 2m. Stratified mean weight per tow (kg) 1978 – 2023 spring Little Skate GOM.

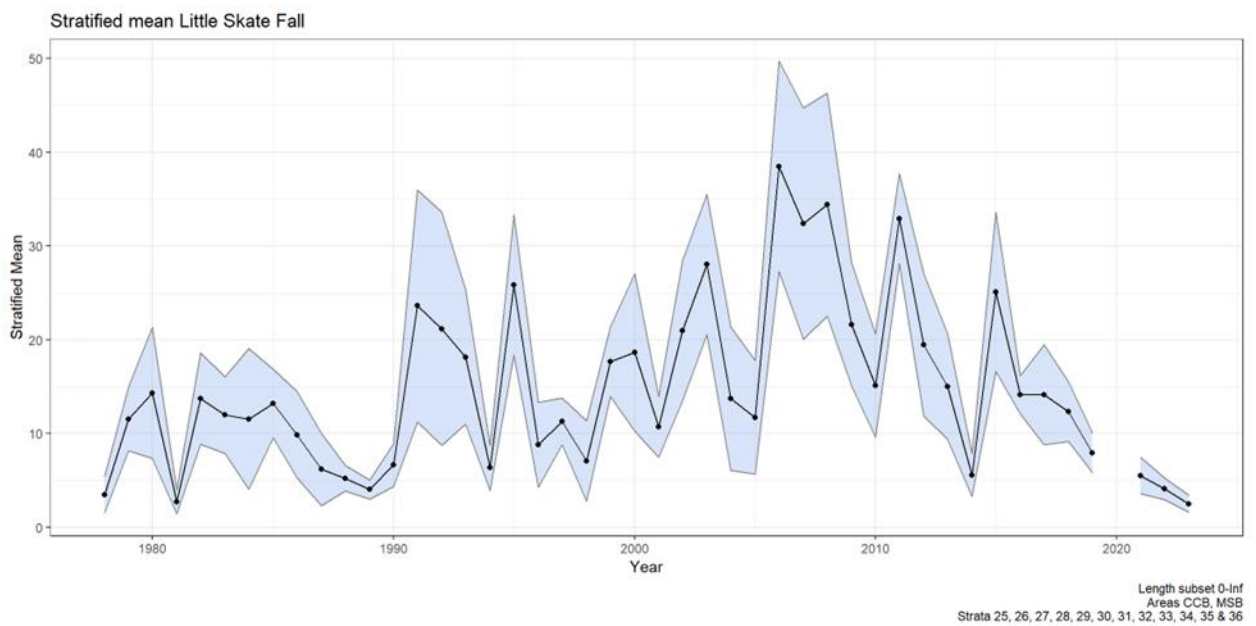


Figure 2n. Stratified mean weight per tow (kg) 1978 – 2023 fall Little Skate GOM

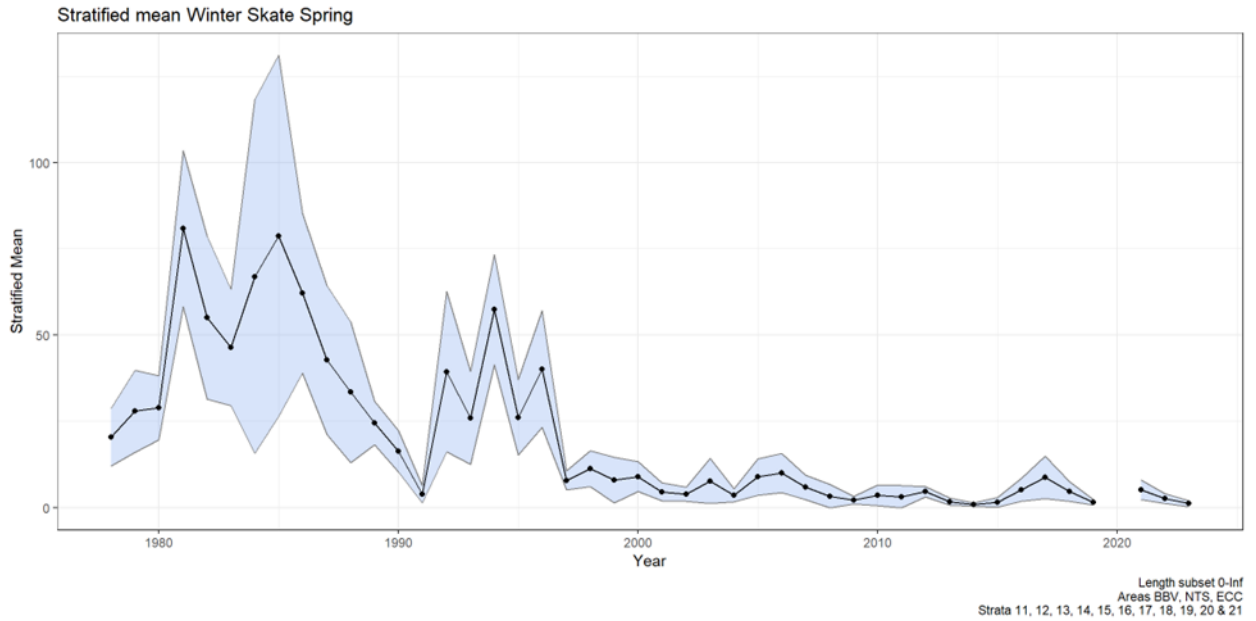


Figure 2o. Stratified mean weight per tow (kg) 1978 – 2023 spring Winter Skate SNE.

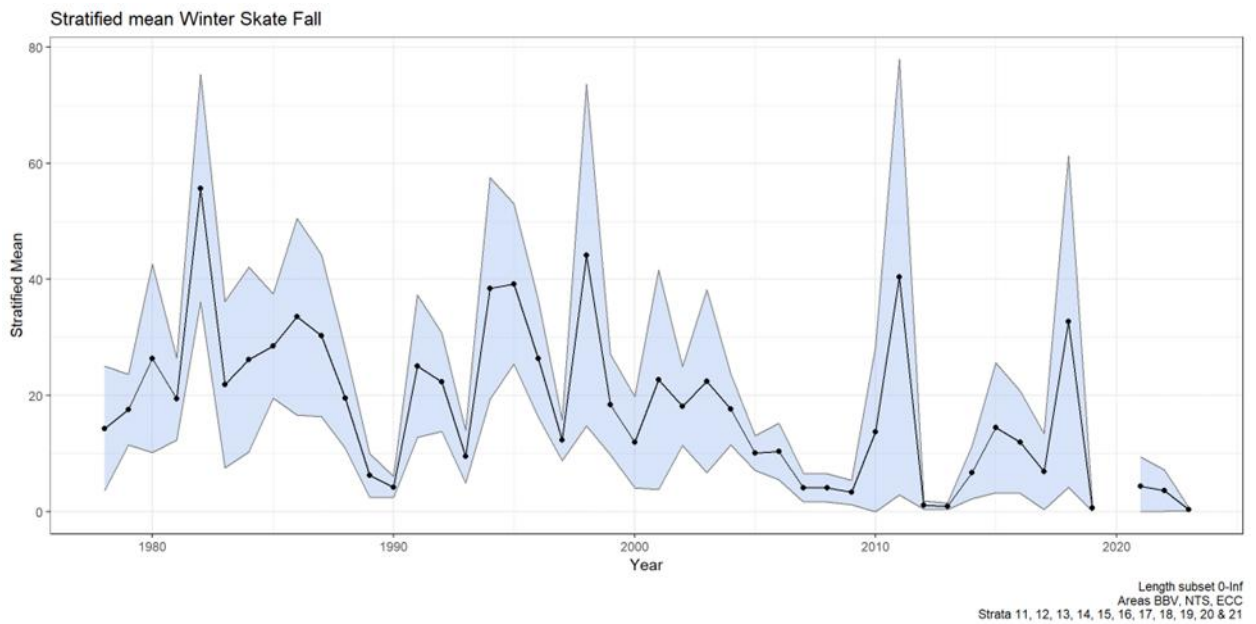


Figure 2p. Stratified mean weight per tow (kg) 1978 – 2023 fall Winter Skate SNE.

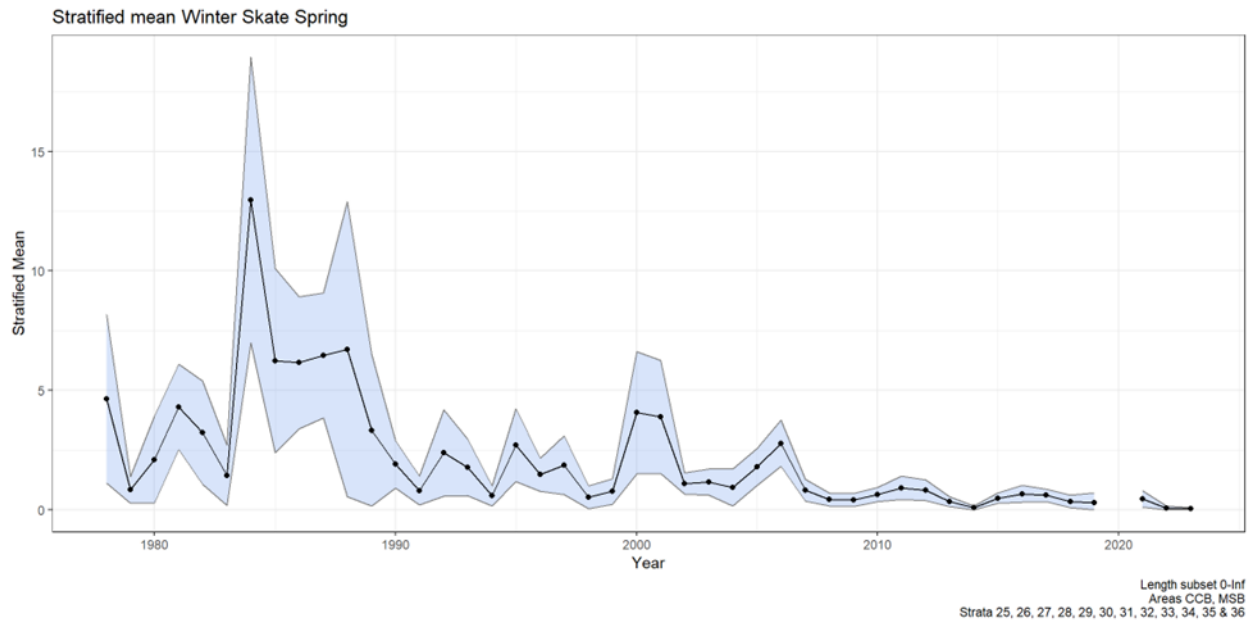


Figure 2q. Stratified mean weight per tow (kg) 1978 – 2023 spring Winter Skate GOM.

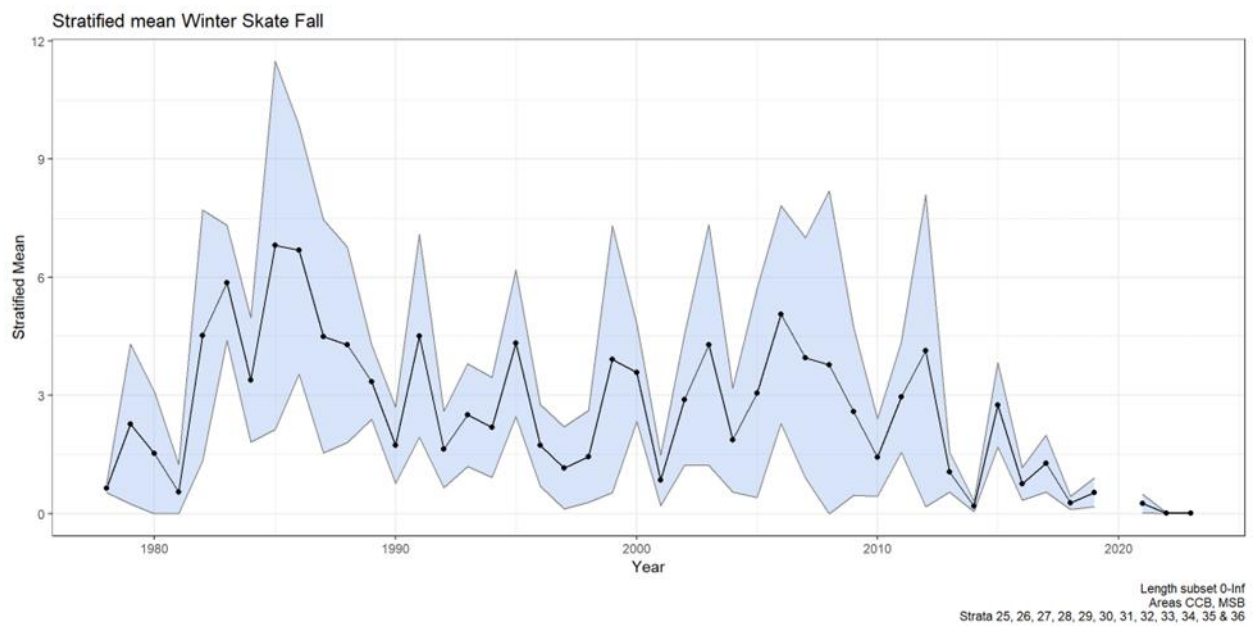


Figure 2r. Stratified mean weight per tow (kg) 1978 – 2023 fall Winter Skate GOM.

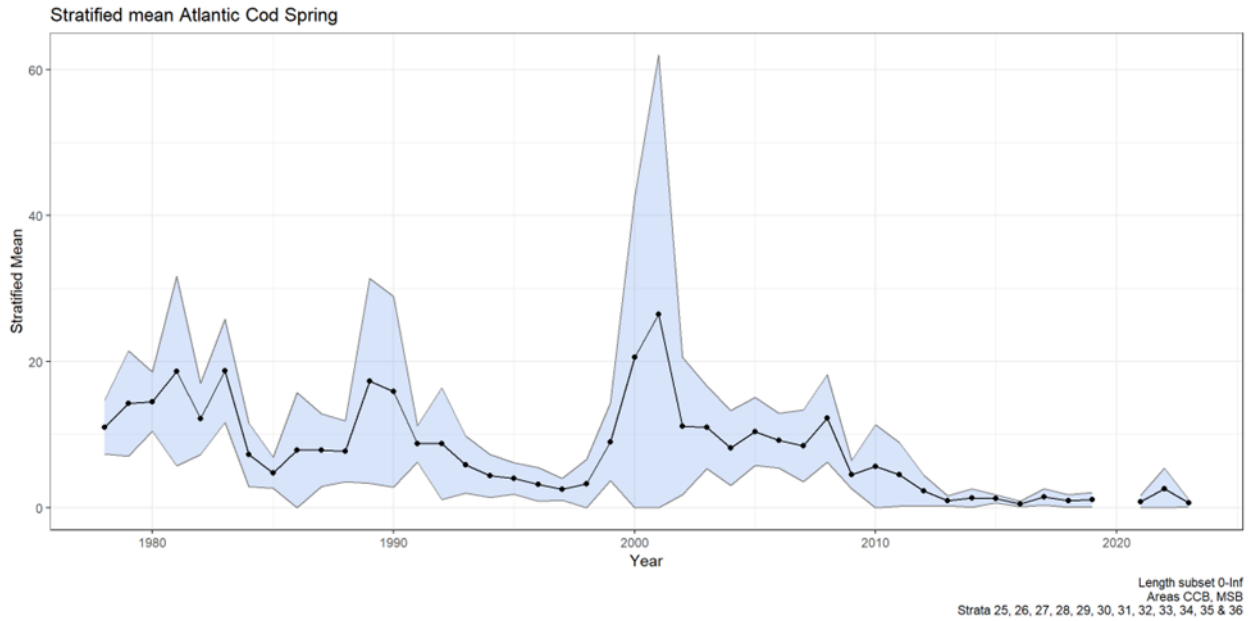


Figure 2s. Stratified mean weight per tow (kg) 1978 – 2023 spring Cod GOM

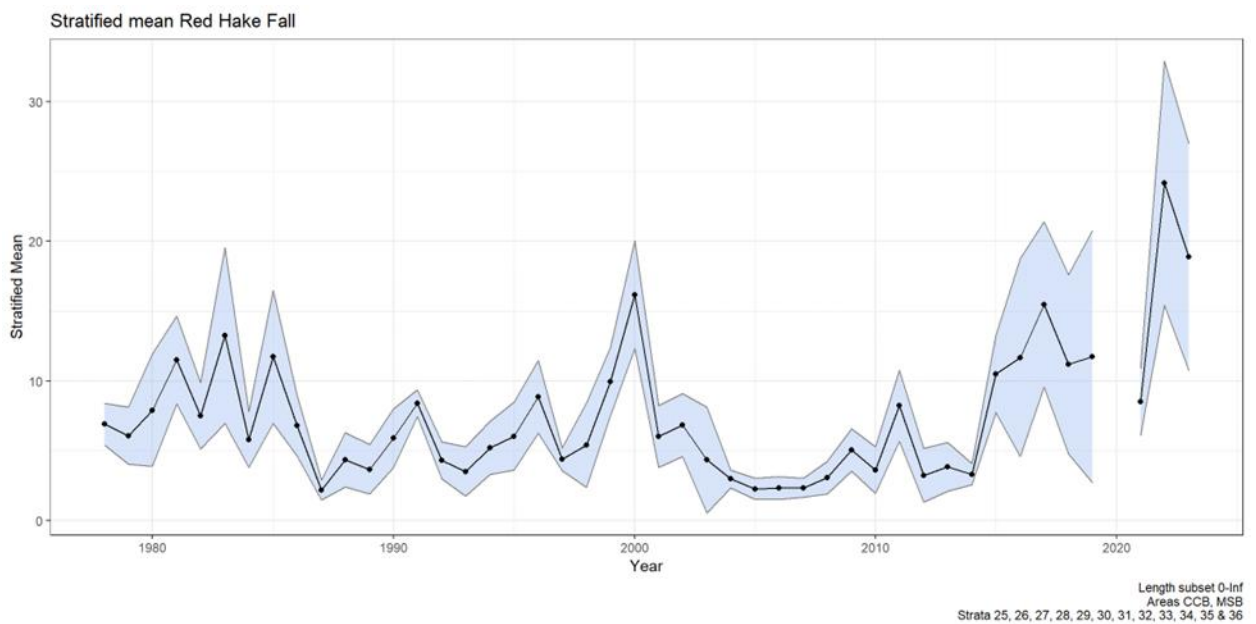


Figure 2t. Stratified mean weight per tow (kg) 1978 – 2023 fall Red Hake GOM.

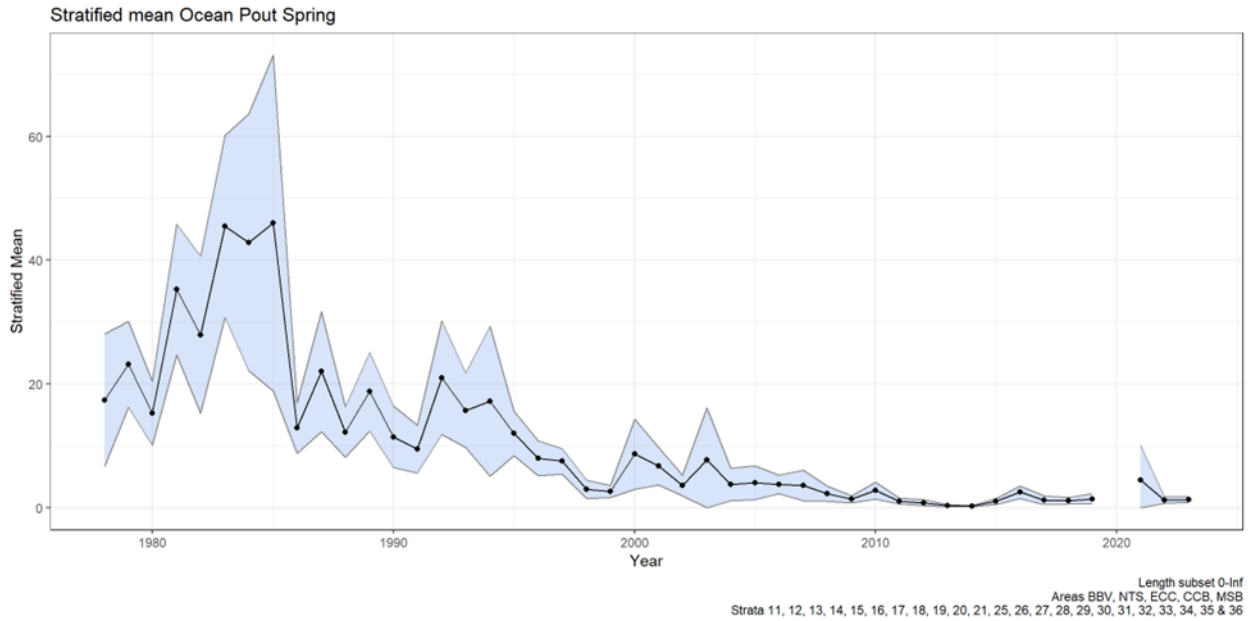


Figure 2u. Stratified mean weight per tow (kg) 1978 – 2023 spring Ocean Pout.

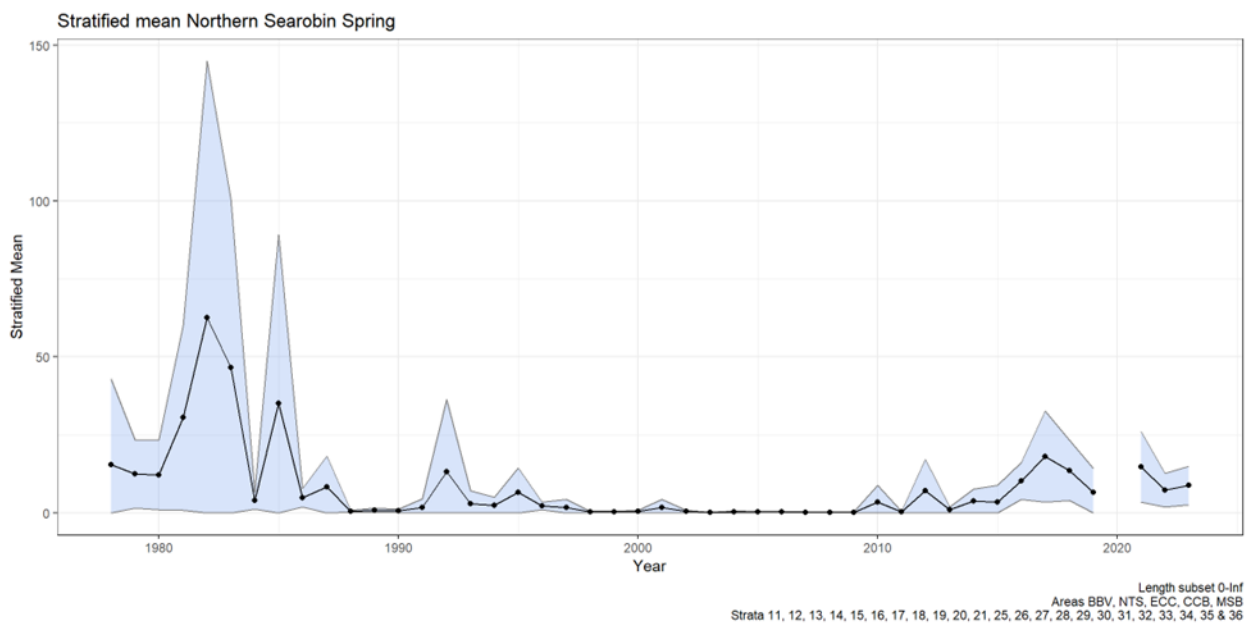


Figure 2v. Stratified mean weight per tow (kg) 1978 – 2023 spring Northern Searobin.

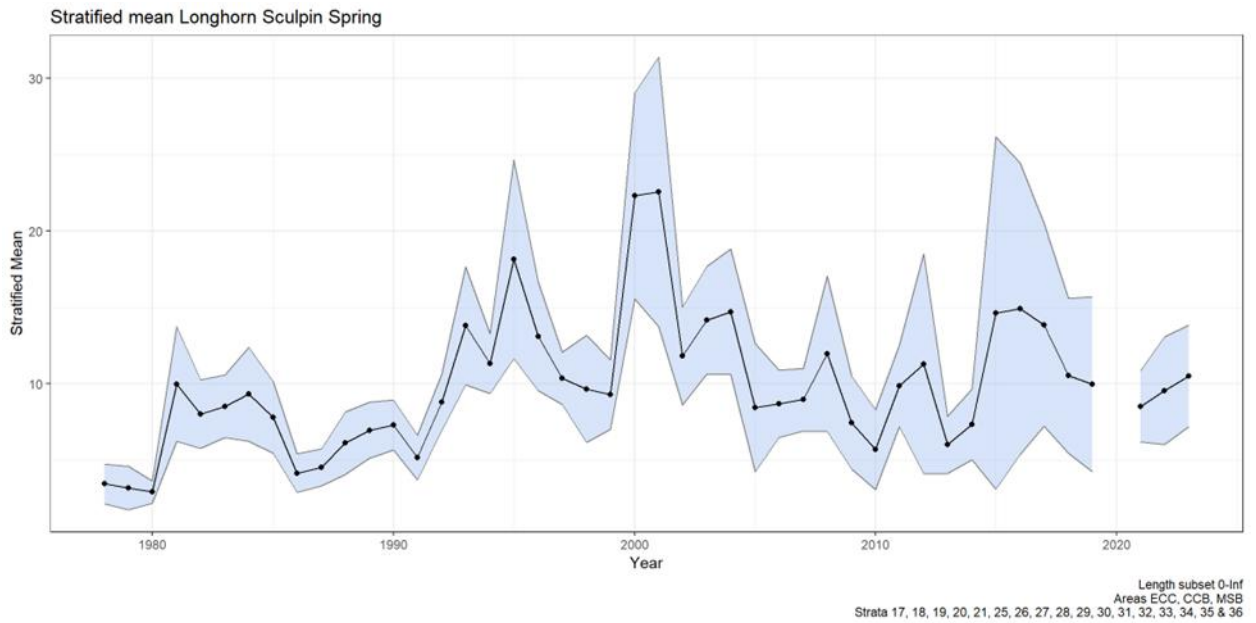


Figure 2w. Stratified mean weight per tow (kg) 1978 – 2023 spring Longhorn Sculpin regions 3, 4, & 5.

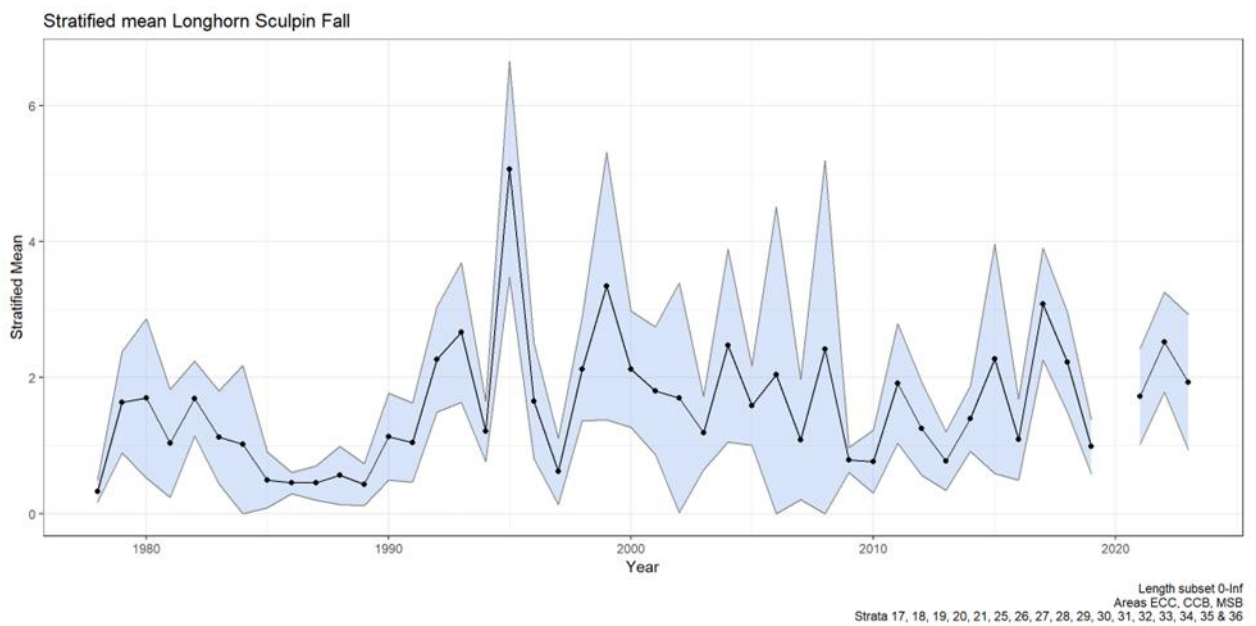


Figure 2x. Stratified mean weight per tow (kg) 1978 – 2023 MDMF fall Longhorn Sculpin regions 3,4, & 5.

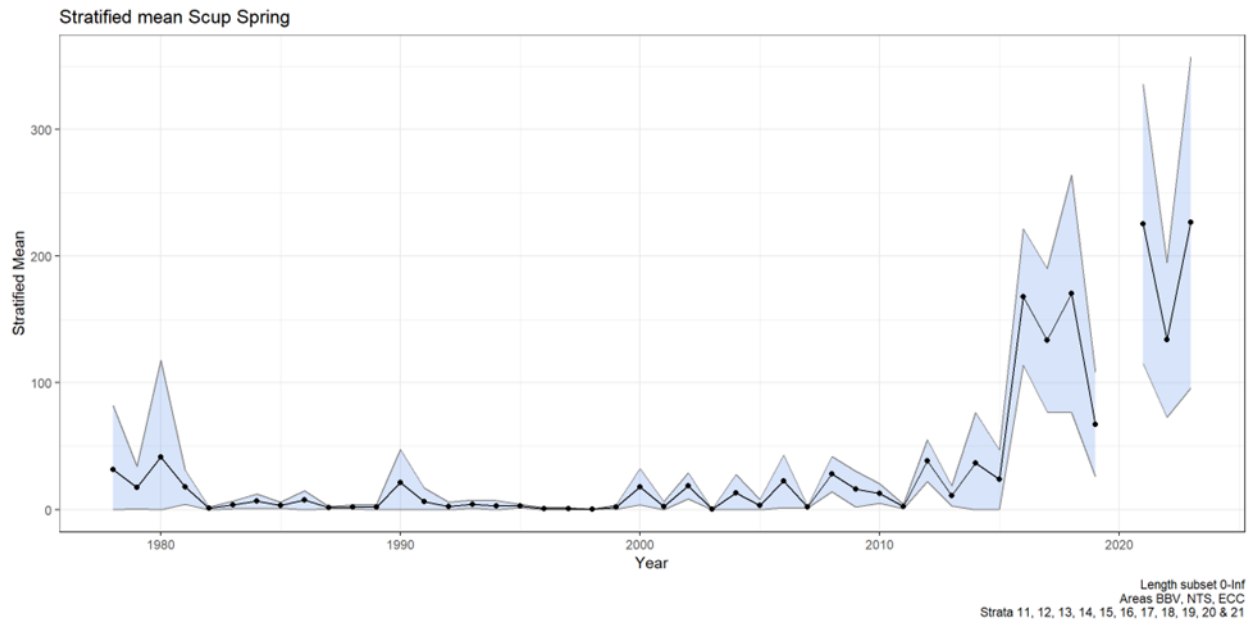


Figure 2y. Stratified mean weight per tow (kg) 1978 – 2023 spring Scup SNE.

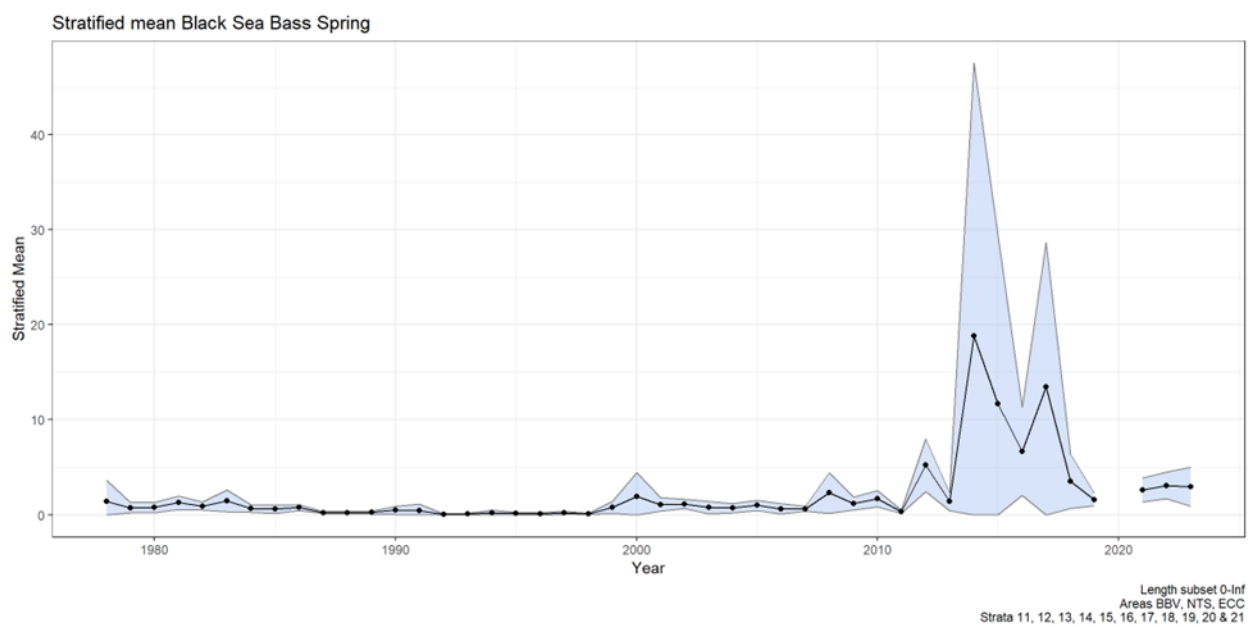


Figure 2z. Stratified mean weight per tow (kg) 1978 – 2023 spring Black Sea Bass SNE.

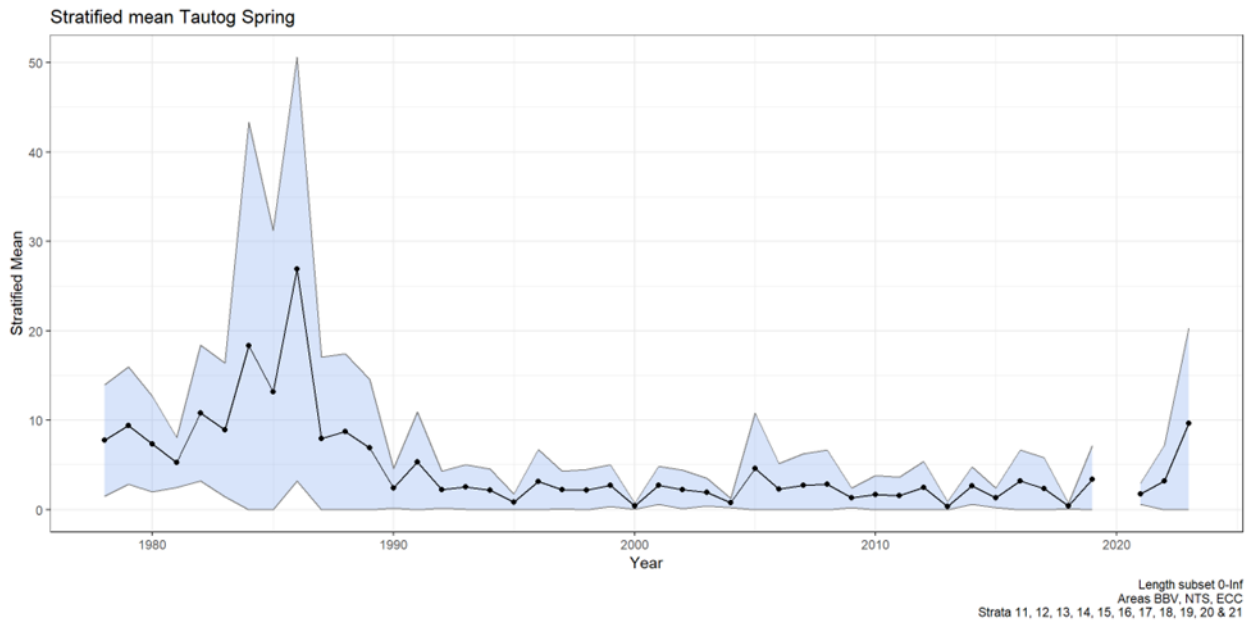


Figure 2aa. Stratified mean weight per tow (kg) 1978 – 2023 spring Tautog SNE.

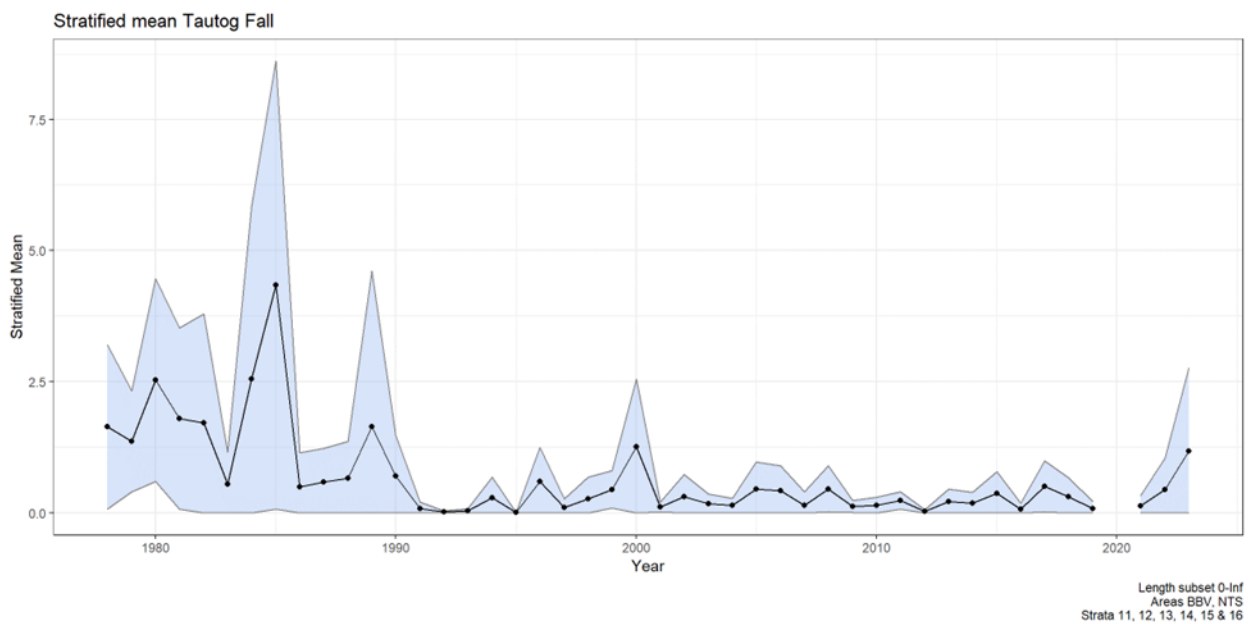


Figure 2bb. Stratified mean weight per tow (kg) 1978 – 2023 fall Tautog SNE.

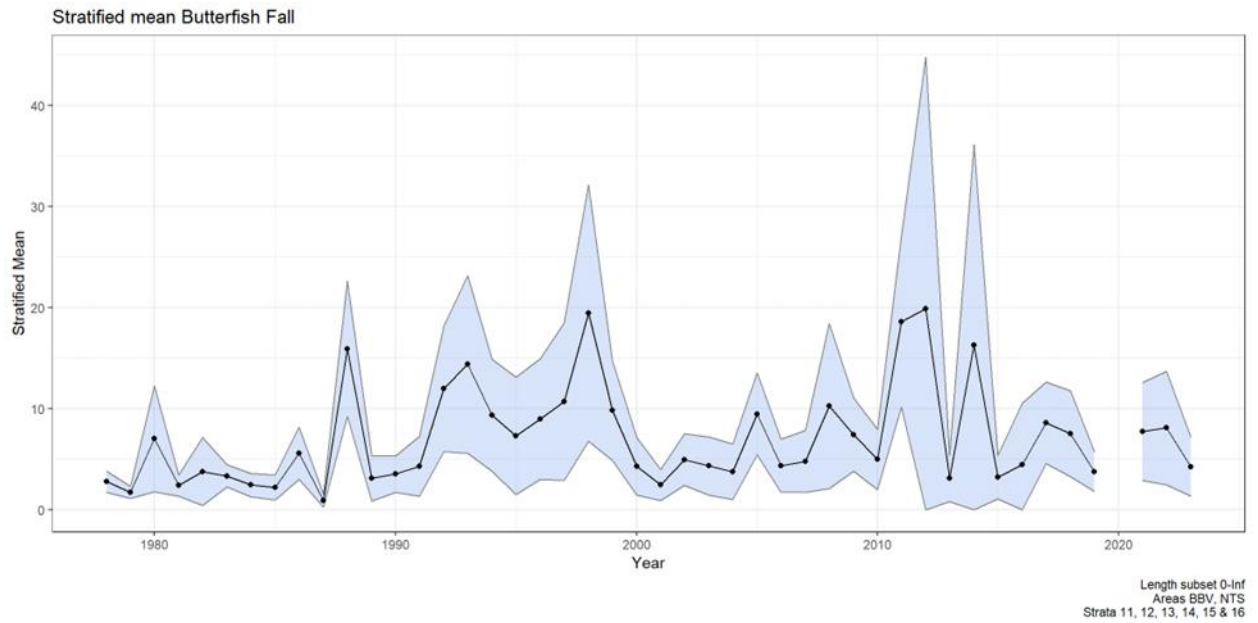


Figure 2cc. Stratified mean weight per tow (kg) 1978 – 2023 fall Butterfish regions 1&2.

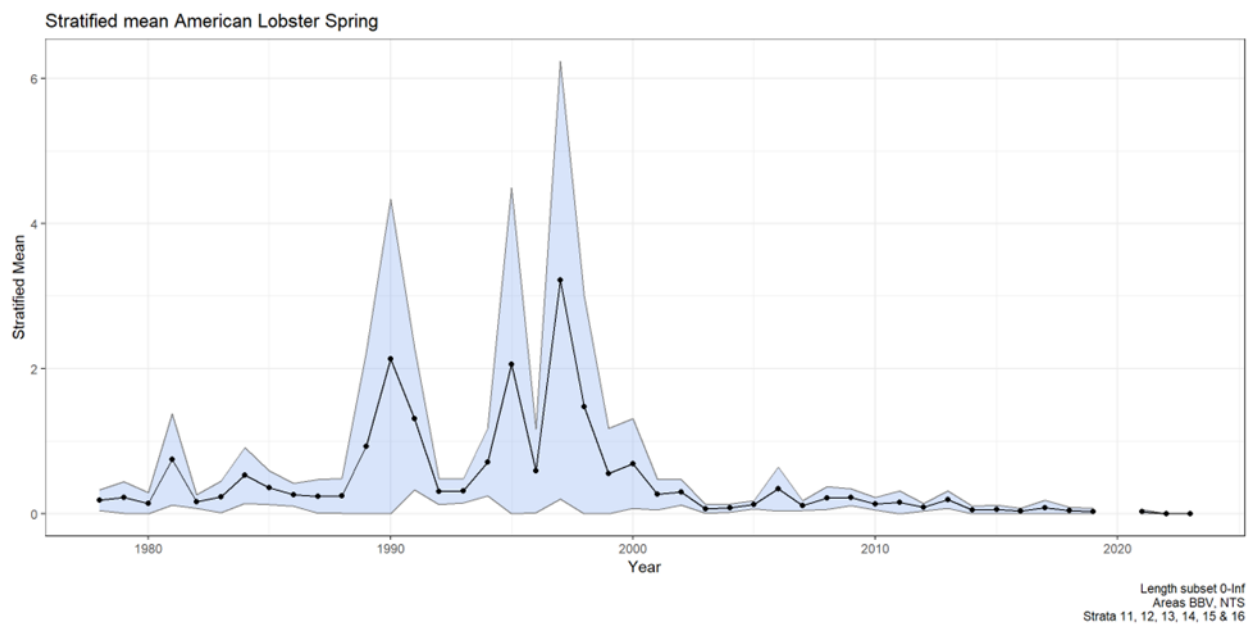


Figure 2dd. Stratified mean weight per tow (kg) 1978 – 2023 spring Lobster regions 1&2.

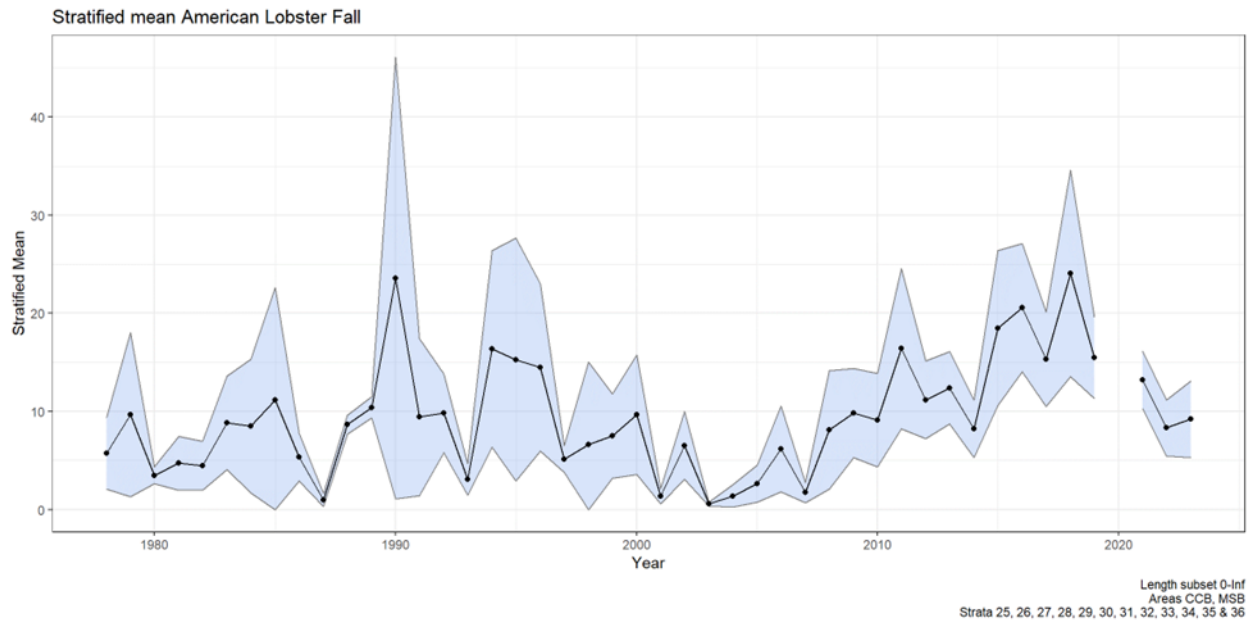


Figure 2ee. Stratified mean weight per tow (kg) 1978 – 2023 fall Lobster GOM.

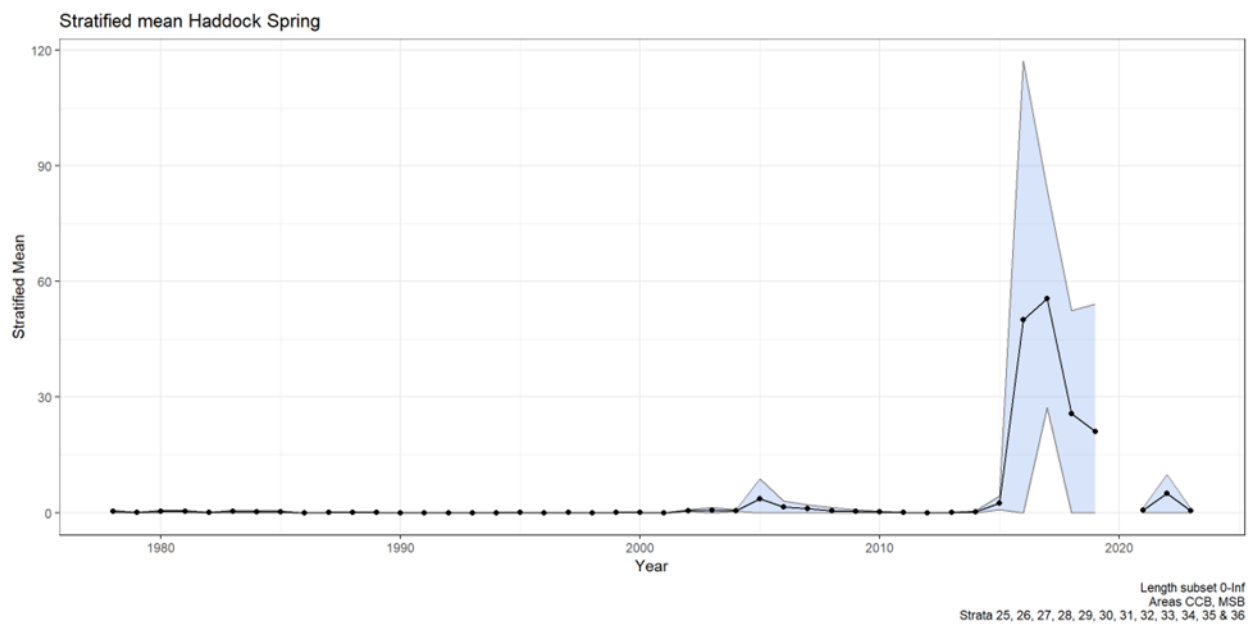


Figure 2ff. Stratified mean weight per tow (kg) 1978 – 2023 spring Haddock GOM.

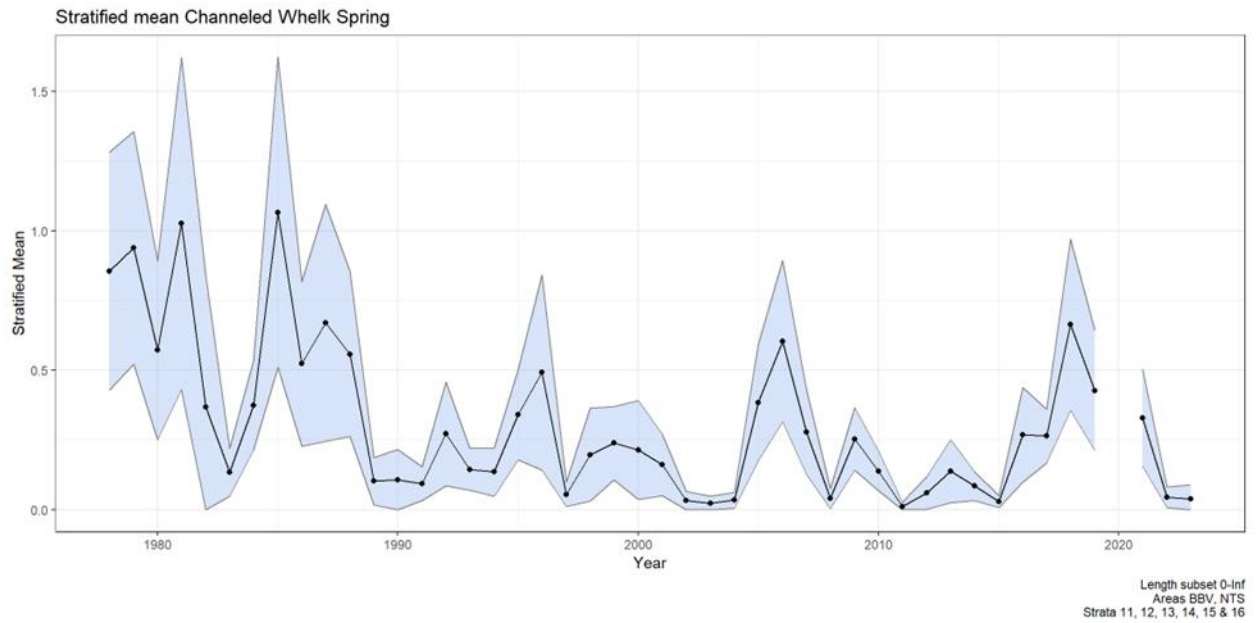


Figure 3a. Stratified mean number per tow 1978 – 2023 spring Channeled Whelk regions 1&2.

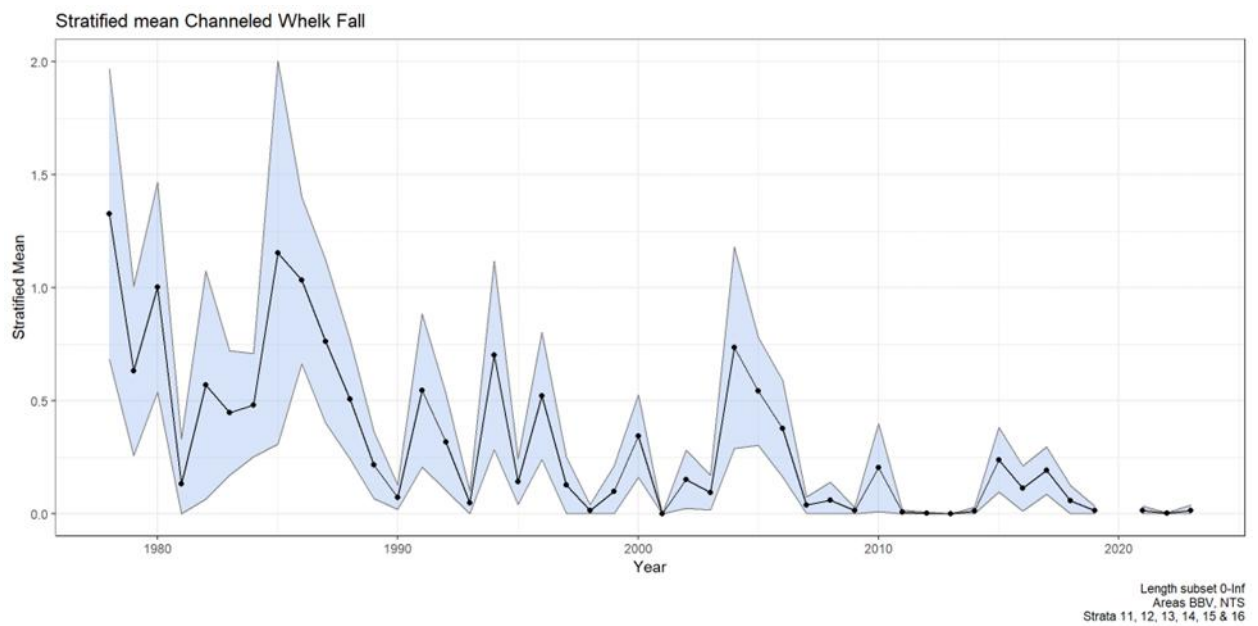


Figure 3b. Stratified mean number per tow 1978 – 2023 fall Channeled Whelk regions 1&2.

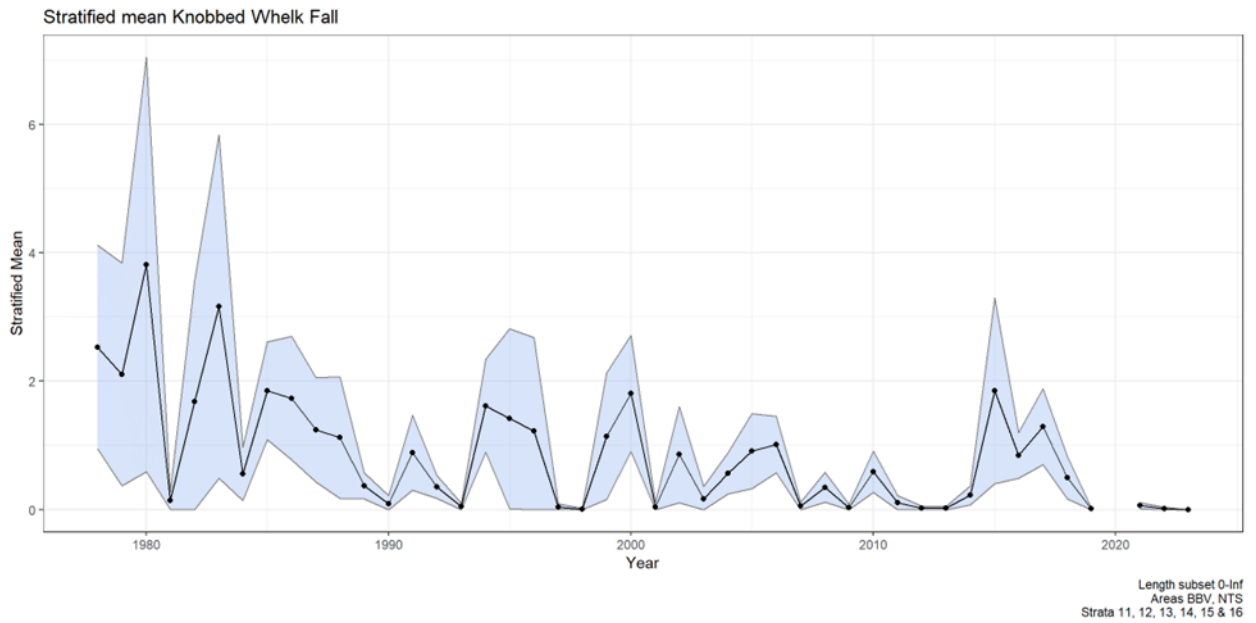


Figure 3c. Stratified mean number per tow 1978 – 2023 fall Knobbed Whelk regions 1&2.

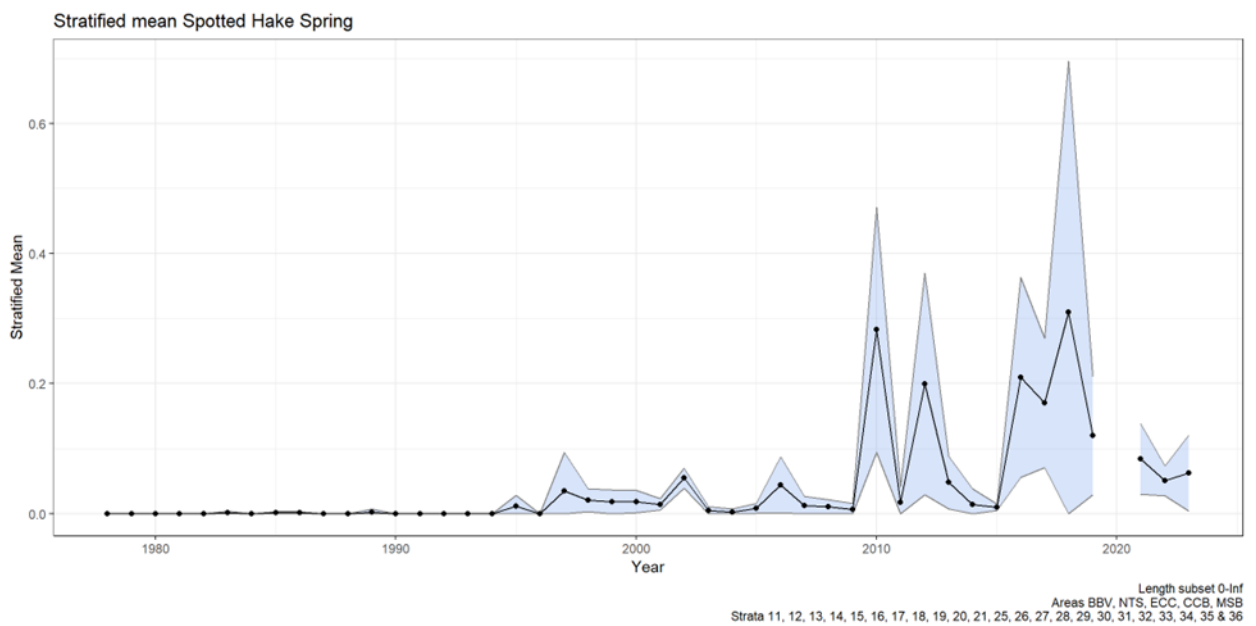


Figure 3d. Stratified mean number per tow 1978 – 2023 spring Spotted Hake.

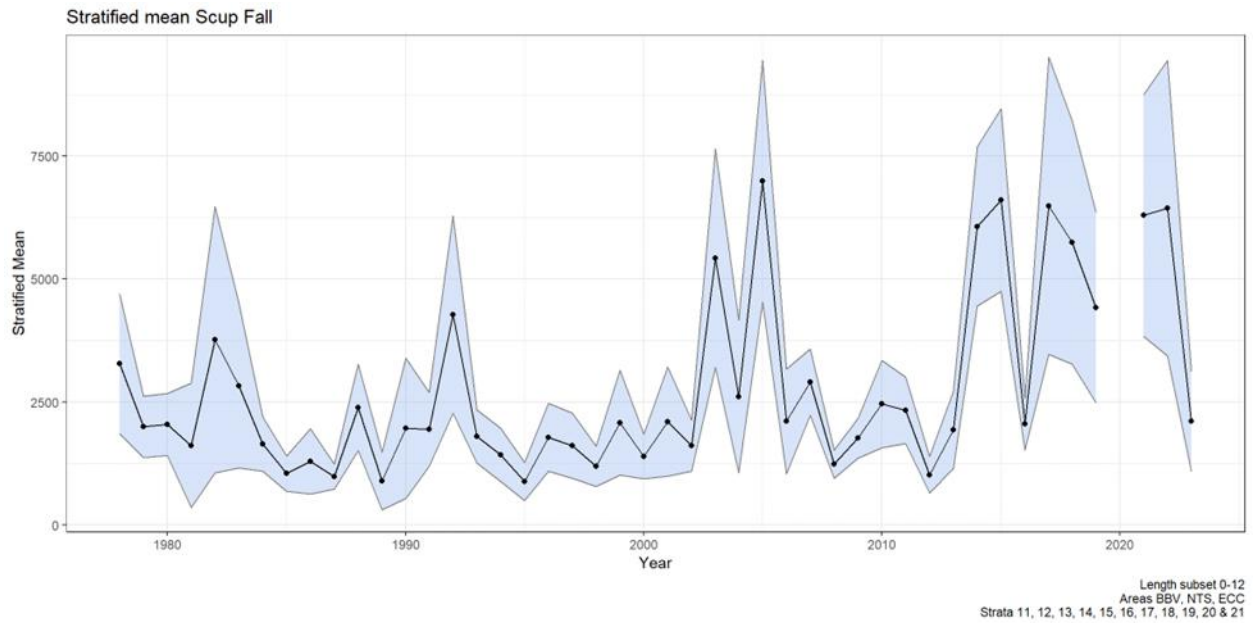


Figure 4a. Pre-recruit (<12 cm) stratified mean number per tow 1978 – 2023 fall Scup SNE.

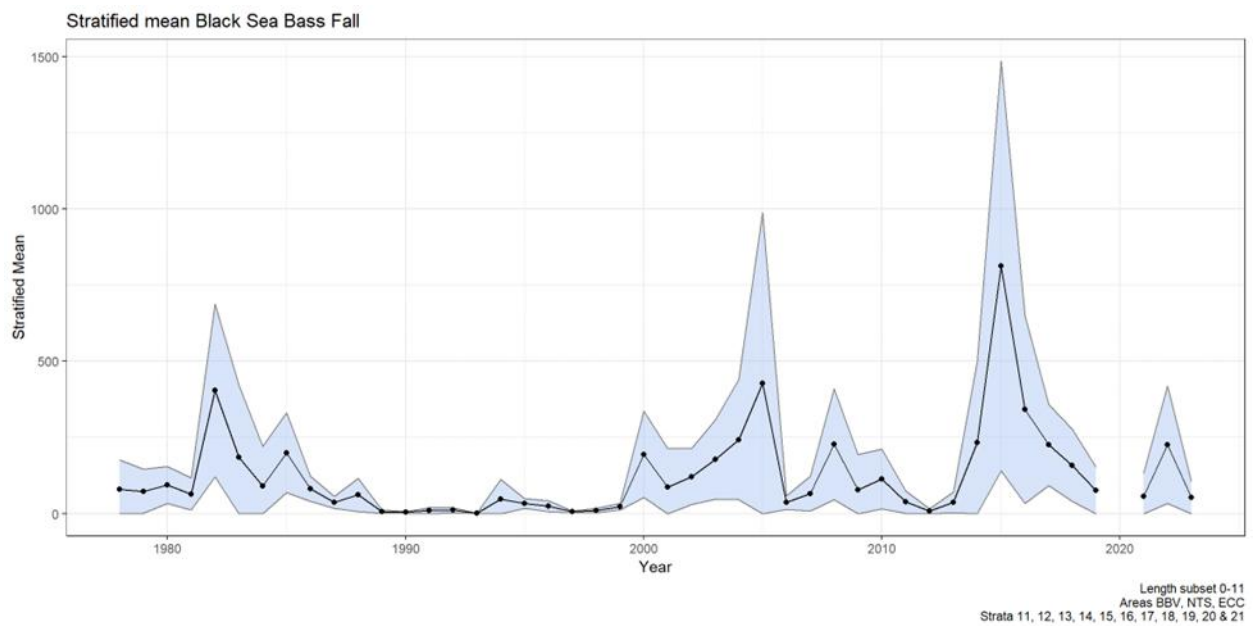


Figure 4b. Pre-recruit (<12 cm) stratified mean number per tow 1978 – 2023 fall Black Sea Bass SNE.

Appendix B.

Trends in Observed Bottom Temperatures

Massachusetts Bottom Trawl Survey.

1978 – 2023

A timeseries analysis of bottom temperatures recorded during spring and fall bottom trawl surveys is updated to include 2023 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 – 2023.

	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
2023	14.1	13.2	12.5	10.9	14.7	13.5	11.3	11.8	11.7	8.8	6.5	11.2	9.9	9.0	7.7	6.5	6.3	8.6	9.5	7.6	6.8	6.5	6.0
Median	12.1	11.5	11.0	9.9	12.2	11.5	9.9	9.5	9.2	6.6	5.8	9.2	8.3	7.2	6.3	5.1	4.8	7.8	7.3	5.9	5.2	4.7	4.4
Mean	12.2	11.5	10.8	9.7	12.3	11.5	10.0	9.7	9.3	6.6	5.8	9.2	8.6	7.2	6.4	5.4	4.8	7.8	7.3	5.9	5.4	5.0	4.5
Maximum	15.4	13.5	13.2	13.0	14.7	13.8	12.0	11.9	11.7	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 – 2023.

	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
2023	19.4	19.6	17.7	15.0	20.2	20.4	17.1	16.2	15.5	9.9	9.2	17.2	12.8	10.9	9.8	9.2	8.8	15.7	12.6	11.2	10.6	9.5	8.6
Median	19.1	18.9	17.7	16.5	19.6	19.7	16.5	16.3	15.1	9.8	8.7	16.2	13.0	10.3	9.4	8.6	8.1	14.5	12.3	10.6	9.6	8.5	7.8
Mean	19.0	18.8	17.7	16.6	19.6	19.5	16.4	15.9	15.0	9.9	8.5	15.9	13.5	10.8	9.6	8.4	7.8	14.4	12.7	10.8	9.4	8.5	7.9
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

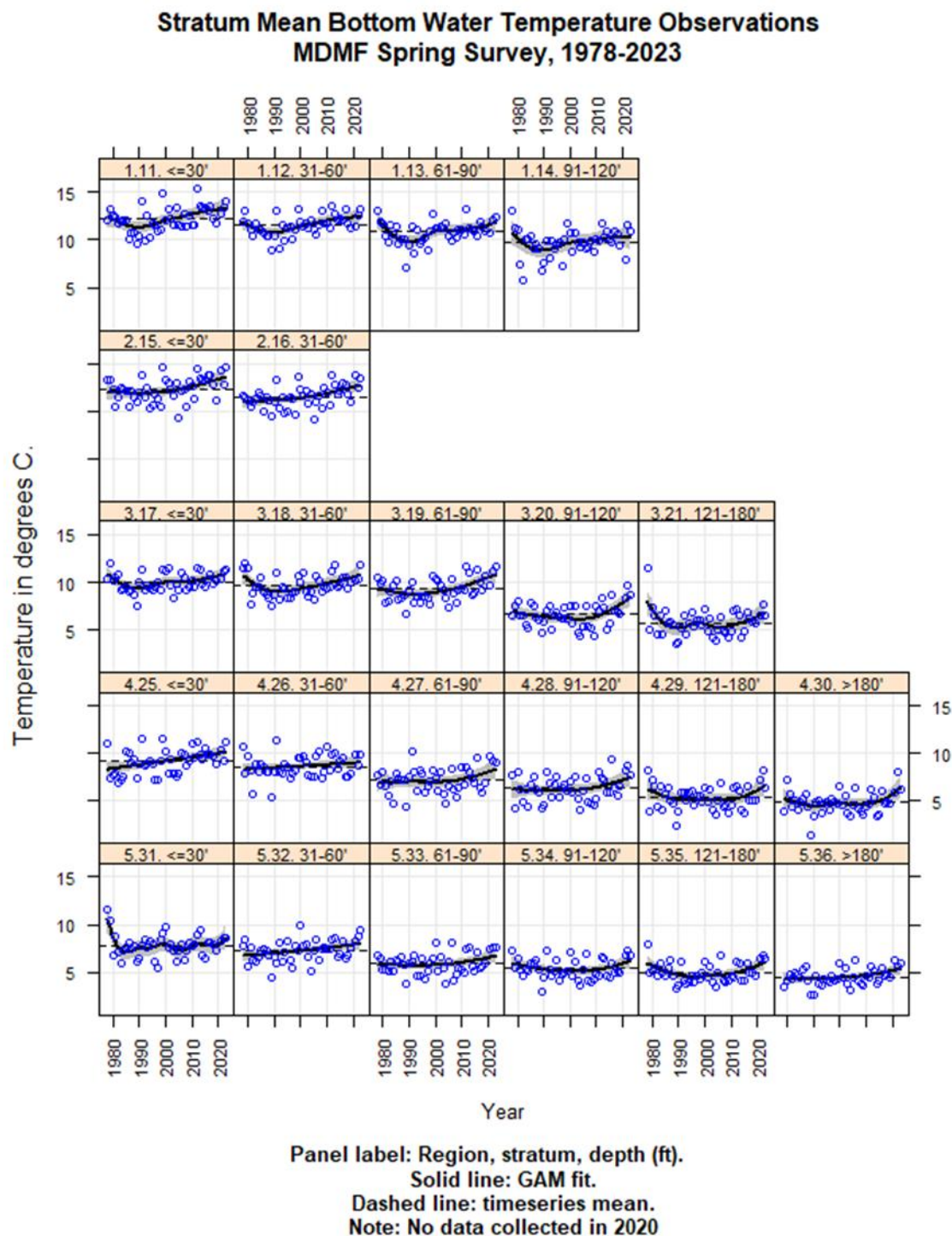


Figure 1. Stratum mean bottom water temperatures recorded on the MDMF spring survey by strata, 1978 – 2023.

**Stratified Mean Bottom Temperature by Region.
MDMF Spring Trawl Survey, 1978 - 2023.**

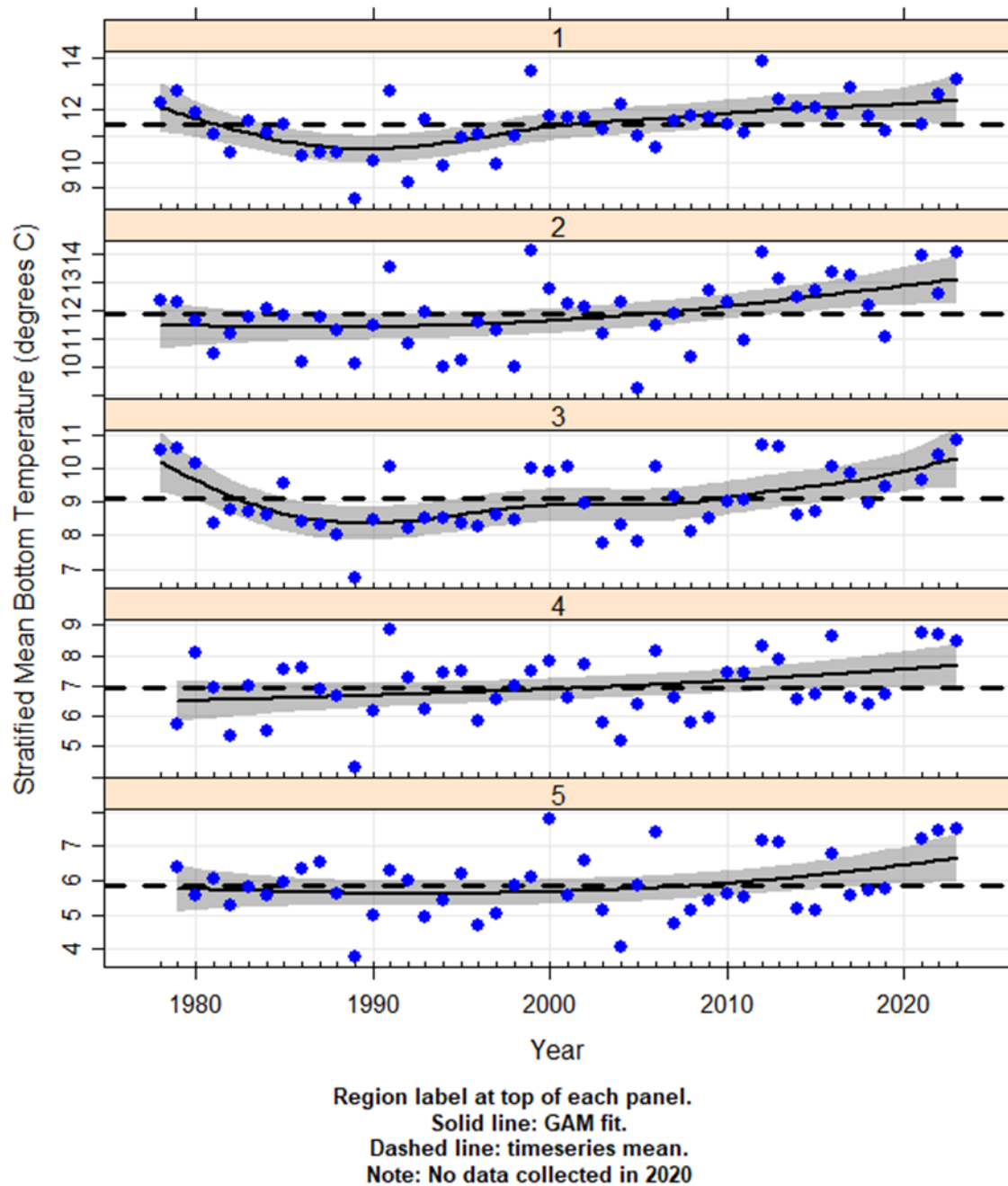


Figure 2. Stratum mean bottom water temperatures recorded on the MDMF spring survey by region, 1978 – 2023.

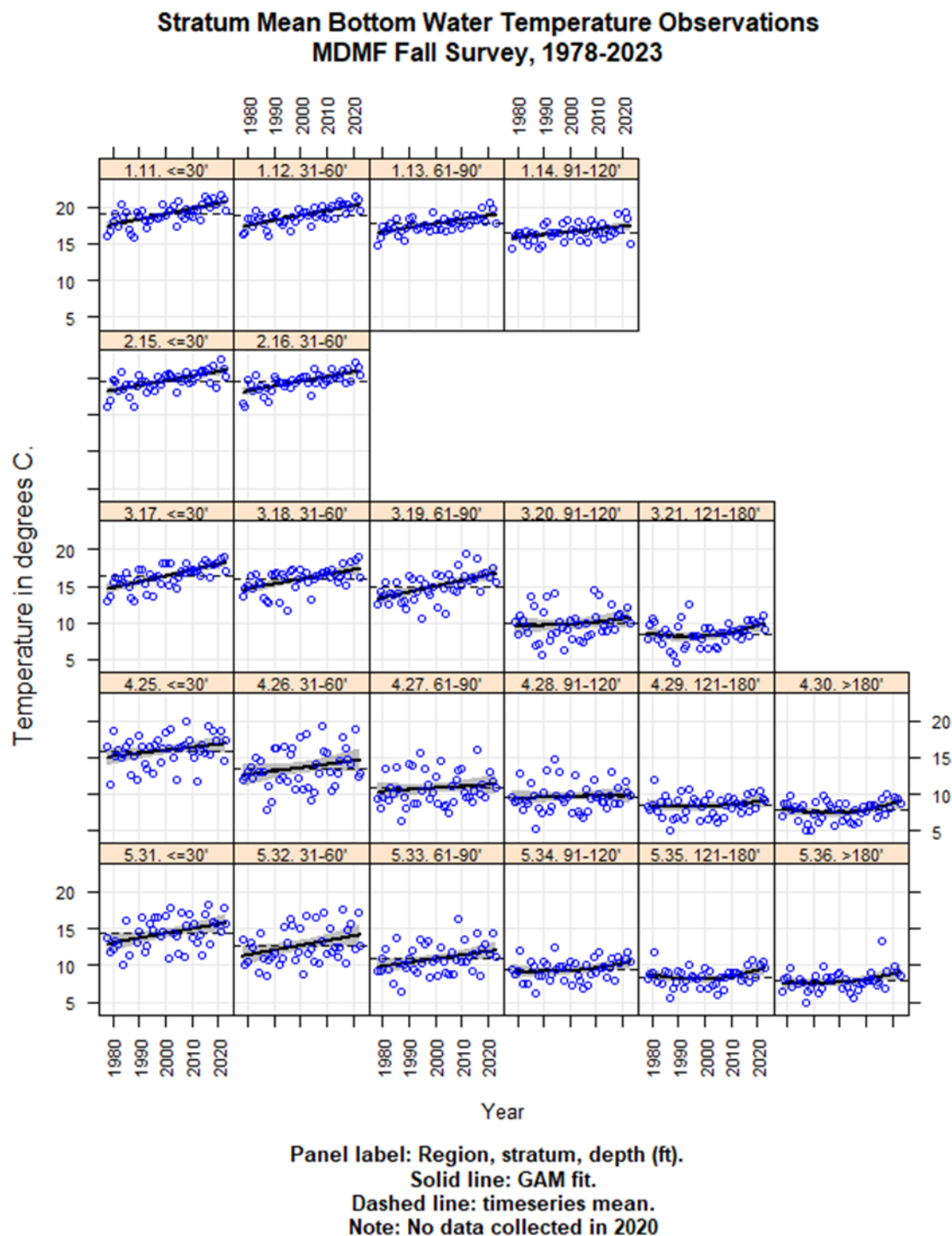
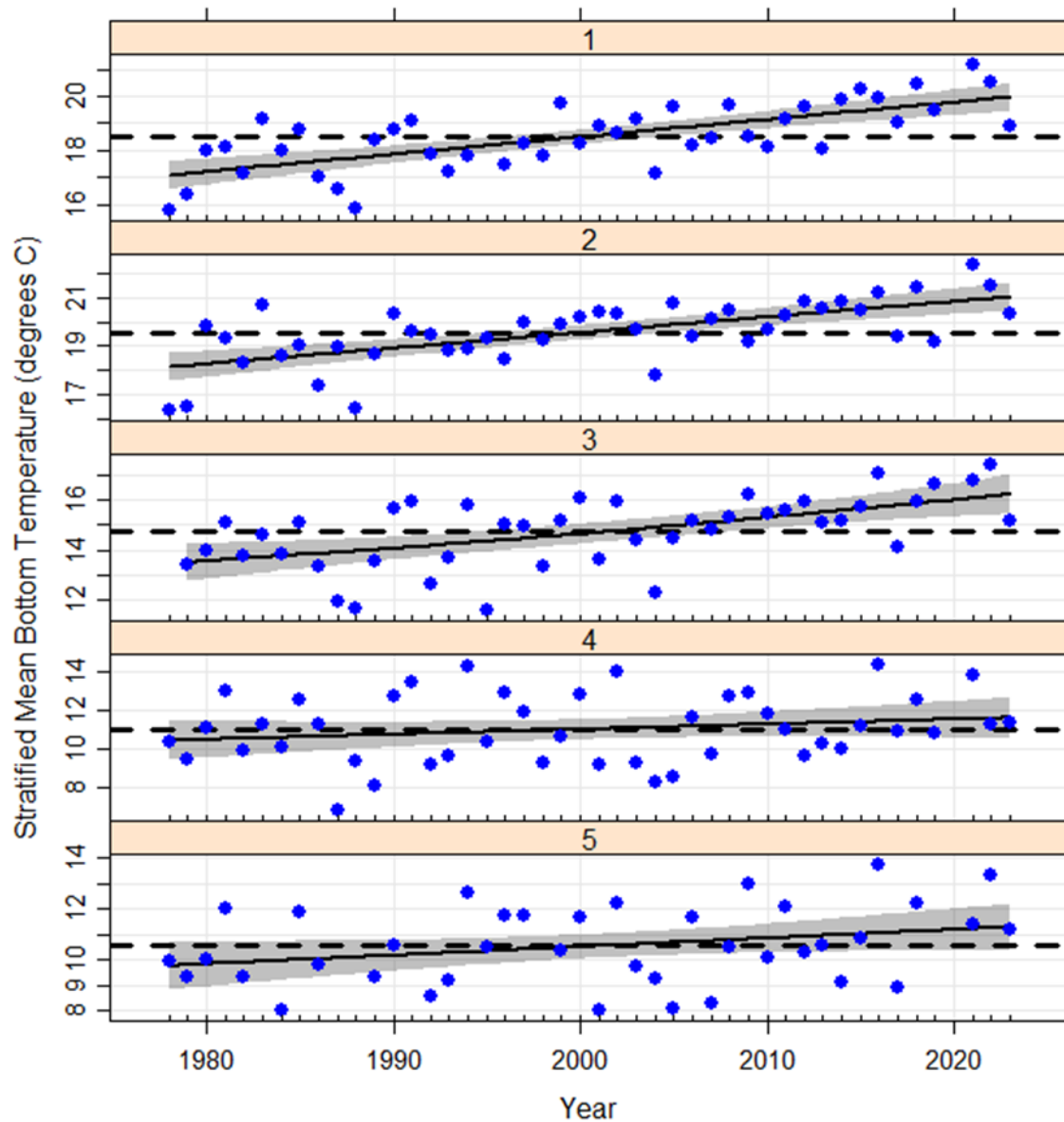


Figure 3. Stratum mean bottom water temperatures recorded on the MDMF fall survey by strata, 1978 – 2023.

**Stratified Mean Bottom Temperature by Region.
MDMF Fall Trawl Survey, 1978 - 2023.**



Region label at top of each panel.
Solid line: GAM fit.
Dashed line: timeseries mean.
Note: No data collected in 2020

Figure 4. Stratum mean bottom water temperatures recorded on the MDMF fall survey by region, 1978 – 2023.

Appendix C. Corrections to the trawl survey database in 2023

It was discovered that three male American lobsters from station10 in the fall 201992 cruise had lengths recorded in hundredths of centimeters. This was corrected to the appropriate tenth of centimeter format.

Cruise	Stratum	Station	Species	Catchsex	Original Length	Corrected Length	Number	Species
201992	9250	10	301	1	7.48	7.5	1	Homarus americanus (American lobster)
201992	9250	10	301	1	8.38	8.4	1	Homarus americanus (American lobster)
201992	9250	10	301	1	9.51	9.5	1	Homarus americanus (American lobster)