

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



2019 Annual Performance Report

State: Massachusetts

Agency: Division of Marine Fisheries

Project Title: Massachusetts Fishery Resource Assessment

FA Grant Agreement: F-56-R

Segment Number: 24

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Date Submitted: 1/1/2020

Sport Fish Program
Massachusetts Fishery Resource Assessment: F-56-R-24
2019 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-second annual spring and fall bottom trawl surveys of Massachusetts territorial waters in 2019. 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-fourth 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 2019 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 - 2019.

[Appendix C:](#) Corrections to the trawl survey database in 2019.

CRUISE RESULTS

R/V GLORIA MICHELLE

2019 Massachusetts Inshore Spring
Bottom Trawl Survey
Cruise No. 201991

CRUISE PERIOD AND AREA

From May 6 through May 23, 2019 the Massachusetts Division of Marine Fisheries conducted its 42nd 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 net's headrope.

Twenty-six MADMF employees participated in the survey as part of the scientific party, joined by one volunteer from the Massachusetts Department of Fish and Game (Table 1).

CRUISE SUMMARY

106 stations were attempted in 18 sampling days (Figs 1 and 2, Table 2). 102 completed stations were considered acceptable for assessment of all species, SHG <=136 (Table 3). Only one station assignment was not completed with an acceptable trawl haul due to adverse weather conditions and time constraints. Strong Northerly and Easterly winds forced us to make several schedule changes during the survey. Four attempted tows were aborted due to crossed doors and hard bottom (Table 5, Fig. 3).

The primary goal of tallying weight, number, and a representative length frequency of each fish species in the catches was accomplished (Tables 6a and 6b). A few records were set on the 2019 spring survey. The first spring Greenland halibut was recorded at station 39 off Halibut Point. The largest abundance of female American lobster (384) was recorded at station 40 East of Rockport and the largest abundance of Northern puffer was recorded at station 56 South of Westport in Buzzards Bay. Moderate catches of YOY Atlantic cod, longhorn sculpin and winter flounder were taken North of Cape Cod. Scup, longfin squid, Northern searobin and YOY Atlantic cod were abundant throughout Nantucket Sound, Vineyard Sound and Buzzard's Bay.

Additional sampling goals were achieved (Table 7). To aid cooperative fisheries assessments, over 1,000 otolith samples, as well as sex and maturity observations, were taken from Atlantic cod, haddock, summer flounder, yellowtail flounder, winter flounder, black sea bass, scup, tautog, American lobster and jonah crabs. 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 Matthew Camisa at (508) 742-9743.

Table 1. MADMF 2019 Spring Cruise Staffing List

Scientific Party

Name	Affiliation	Num. Days
Mark Szymanski	MADMF	11
Vincent Manfredi	MADMF	11
Matthew Camisa	MADMF	10
Nick Buchan	MADMF	6
Steve Voss	MADMF	5
Brad Schondelmeier	MADMF	4
Brendan Reilly	MADMF	4
Greg Decelles	MADMF	4
John Logan	MADMF	4
Nicole Ward	MADMF	4
Ross Kessler	MADMF	4
Bob Glenn	MADMF	3
Steve Wilcox	MADMF	3
Alex Boeri	MADMF	2
Kim Trull	MADMF	2
Anna Webb	MADMF	1
Derek Perry	MADMF	1
Elise Koob	MADMF	1
Erich Druskat	MADMF	1
Harriet Booth	MADMF	1
Jared Silva	MADMF	1
Kate Frew	MADMF	1
Mark Rousseau	MADMF	1
Mike Pol	MADMF	1
Scott Elzey	MADMF	1
Tracy Pugh	MADMF	1
Ron Amidon	MADFG	1
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R/V Gloria Michelle Crew

Name	Affiliation	Num. Days
<i>Officers</i>		
Chris Gallagher	NOAA OIC	18
Ben VanDine	NOAA JOIC	18
Tyler Fifield	NOAA-CORPS	5
<i>Deck Crew</i>		
George Morton	Contract Fisherman	18
Ashley Griffin	NMFS-Woods Hole	18
Pete Plantamura	NMFS-Sandy Hook	8

Table 2. Station Information for the 2019 Massachusetts Spring Inshore Bottom Trawl Survey
Cruise No. 201991

Station	Stratum	Date	Time (est)	Depth (m)	Latitude	Longitude	Course	Distance (nmi)	Bottom temp °C
1	27	5/6/2019	7:01	19	41°46.60	-70°22.33	35	0.73	7.4
2	27	5/6/2019	8:43	25	41°48.58	-70°19.48	35	0.81	6.9
3	26	5/6/2019	10:21	14	41°48.70	-70°12.99	31	0.82	7.6
4	26	5/6/2019	11:18	15	41°48.78	-70°13.03	35	0.82	7.5
5	25	5/6/2019	13:00	10	41°48.58	-70°04.20	298	0.77	9.3
6	26	5/6/2019	14:59	18	41°47.59	-70°15.19	83	0.79	7.6
7	25	5/6/2019	16:20	8	41°44.82	-70°18.15	87	0.78	9.2
8	27	5/7/2019	6:11	22	41°49.12	-70°23.12	247	0.86	7.1
9	28	5/7/2019	7:39	33	41°54.14	-70°25.93	160	0.80	6.2
10	28	5/7/2019	8:55	32	41°54.26	-70°27.19	336	0.83	7.3
11	26	5/7/2019	10:37	15	41°57.55	-70°33.77	310	0.83	8.6
12	25	5/7/2019	11:38	11	41°58.51	-70°35.98	212	0.82	8.6
14	29	5/7/2019	13:42	48	41°59.72	-70°24.58	197	0.82	4.5
15	29	5/7/2019	15:05	42	41°56.76	-70°23.24	194	0.80	5.3
17	26	5/7/2019	16:59	15	41°51.35	-70°29.50	198	0.86	7.8
18	29	5/8/2019	7:39	42	42°03.98	-70°30.83	353	0.60	5.3
19	32	5/8/2019	10:16	14	42°13.73	-70°44.11	332	0.59	9.1
20	32	5/8/2019	12:13	18	42°17.00	-70°48.76	114	0.01	N/A
21	31	5/8/2019	13:03	11	42°17.42	-70°51.79	194	0.68	9.4
22	35	5/8/2019	14:47	42	42°19.12	-70°43.11	94	0.66	5.0
23	33	5/8/2019	16:13	20	42°18.29	-70°48.86	70	0.83	6.5
24	33	5/9/2019	6:16	26	42°23.90	-70°53.39	254	0.83	6.3
25	32	5/9/2019	7:48	10	42°24.76	-70°56.70	119	0.55	8.0
26	34	5/9/2019	9:24	34	42°26.41	-70°50.46	50	0.67	5.3
27	36	5/9/2019	11:43	73	42°25.27	-70°39.67	150	0.80	4.4
28	35	5/9/2019	14:05	56	42°27.73	-70°43.46	148	0.73	4.6
29	35	5/9/2019	15:29	49	42°31.40	-70°41.98	176	0.83	4.6
30	34	5/9/2019	16:47	33	42°32.66	-70°44.25	89	0.83	5.1
31	33	5/10/2019	7:48	25	42°46.82	-70°45.55	165	0.83	5.6
32	33	5/10/2019	9:10	21	42°44.68	-70°44.95	159	0.83	5.6
33	31	5/10/2019	10:29	9	42°43.30	-70°45.50	166	0.84	6.2
34	31	5/10/2019	11:47	11	42°40.93	-70°42.13	135	0.83	6.2
35	32	5/10/2019	12:49	19	42°41.85	-70°42.26	138	0.84	5.8
36	34	5/10/2019	14:00	33	42°42.95	-70°40.69	103	0.82	4.7
37	34	5/10/2019	15:28	33	42°41.78	-70°35.89	147	0.79	4.6
38	36	5/11/2019	7:17	62	42°43.32	-70°35.76	344	0.82	4.5
39	35	5/11/2019	8:35	37	42°42.03	-70°35.68	318	0.79	4.5
40	35	5/11/2019	10:03	47	42°38.20	-70°32.74	12	0.82	4.5
41	30	5/12/2019	9:21	61	42°07.12	-70°24.66	102	0.82	4.4

Table 2 continued.

Station	Stratum	Date	Time	Depth	Latitude	Longitude	Course	Distance	Bottom
			(est)	(m)				(nmi)	temp °C
42	30	5/12/2019	11:17	58	42°04.12	-70°15.75	209	0.86	5.0
43	29	5/12/2019	12:52	49	42°00.48	-70°22.00	91	0.84	4.6
44	28	5/12/2019	14:38	33	41°55.25	-70°14.05	59	0.83	6.6
45	28	5/12/2019	16:03	35	41°54.48	-70°19.54	102	0.84	5.6
46	27	5/13/2019	6:51	29	41°51.50	-70°14.96	76	0.83	6.8
47	28	5/13/2019	8:07	30	41°53.28	-70°12.48	65	0.85	7.0
48	26	5/13/2019	9:23	12	41°53.50	-70°07.99	45	0.84	8.0
49	25	5/13/2019	10:32	9	41°54.84	-70°06.57	36	0.82	8.4
50	27	5/13/2019	11:47	23	41°57.83	-70°08.17	38	0.53	6.5
51	12	5/14/2019	6:23	12	41°35.26	-70°43.08	25	0.82	11.4
52	11	5/14/2019	7:48	8	41°40.01	-70°42.14	30	0.51	11.6
53	11	5/14/2019	8:54	9	41°37.65	-70°44.93	38	0.84	11.5
54	12	5/14/2019	10:49	15	41°31.13	-70°53.01	48	0.83	10.8
55	11	5/14/2019	13:20	10	41°29.36	-71°03.01	357	0.81	10.8
56	12	5/14/2019	14:41	16	41°29.19	-70°59.35	262	0.85	11.0
57	12	5/14/2019	16:49	16	41°31.13	-70°48.67	66	0.82	10.9
58	15	5/15/2019	5:54	9	41°32.48	-70°30.21	280	0.81	11.8
59	15	5/15/2019	7:45	10	41°34.97	-70°22.08	277	0.84	11.9
60	15	5/15/2019	9:18	10	41°34.68	-70°16.68	167	0.65	11.1
61	16	5/15/2019	11:03	14	41°34.33	-70°11.30	71	0.81	9.5
62	16	5/15/2019	12:01	12	41°33.18	-70°10.70	68	0.83	9.2
63	17	5/15/2019	15:01	9	41°24.28	-69°58.23	236	0.84	8.0
64	16	5/15/2019	17:30	12	41°22.22	-70°05.33	224	0.83	10.1
65	15	5/16/2019	5:21	9	41°19.18	-70°04.33	251	0.80	10.9
66	15	5/16/2019	7:07	9	41°23.47	-70°10.78	268	0.82	11.1
67	16	5/16/2019	8:39	12	41°27.14	-70°09.94	283	0.88	10.0
68	15	5/16/2019	9:52	11	41°28.87	-70°16.41	142	0.83	10.7
69	16	5/16/2019	11:38	14	41°25.51	-70°14.61	97	0.84	10.9
70	16	5/16/2019	12:37	13	41°24.95	-70°16.79	63	0.85	11.5
71	16	5/16/2019	13:49	21	41°27.32	-70°20.09	106	0.82	11.1
72	15	5/16/2019	16:15	8	41°26.46	-70°29.03	266	0.52	11.9
73	11	5/17/2019	6:59	8	41°24.66	-70°25.59	194	0.80	11.8
74	15	5/17/2019	10:44	8	41°36.66	-70°08.83	95	0.70	11.6
75	15	5/17/2019	11:57	8	41°37.11	-70°01.37	250	0.82	10.6
76	16	5/17/2019	12:56	12	41°35.62	-70°05.12	57	0.82	10.7
77	15	5/17/2019	14:05	10	41°34.86	-70°02.42	107	0.85	10.0
78	20	5/18/2019	8:45	35	41°49.12	-69°53.29	358	0.81	7.3
79	18	5/18/2019	10:40	14	41°38.68	-69°55.10	37	0.81	8.3
80	17	5/18/2019	11:45	11	41°35.79	-69°56.65	37	0.84	8.5
81	18	5/18/2019	12:45	15	41°36.11	-69°54.25	19	0.86	8.6

Table 2 continued.

Station	Stratum	Date	Time	Depth	Latitude	Longitude	Course	Distance	Bottom
			(est)	(m)				(nmi)	temp °C
82	12	5/19/2019	6:28	17	41°29.76	-70°49.08	224	0.81	11.5
83	14	5/19/2019	8:45	29	41°21.59	-70°54.53	223	0.85	9.3
84	14	5/19/2019	10:08	33	41°19.22	-70°52.92	160	0.82	9.6
85	13	5/19/2019	11:37	27	41°22.81	-70°51.83	256	0.82	9.7
86	13	5/19/2019	13:17	22	41°23.14	-70°46.37	57	0.82	10.6
87	13	5/19/2019	15:02	20	41°27.71	-70°43.52	57	0.52	12.5
88	16	5/20/2019	7:27	19	41°26.52	-70°22.44	296	0.80	12.6
89	16	5/20/2019	8:49	16	41°26.95	-70°26.43	255	0.01	N/A
90	16	5/20/2019	9:29	15	41°26.90	-70°26.61	256	0.82	12.6
91	16	5/20/2019	10:43	16	41°27.66	-70°28.80	294	0.62	12.8
92	29	5/21/2019	7:36	46	42°01.24	-70°13.59	359	0.81	5.4
93	21	5/21/2019	9:26	64	42°06.49	-70°13.44	331	0.82	5.1
94	21	5/21/2019	11:31	43	42°05.00	-70°02.03	329	0.84	6.4
95	20	5/21/2019	12:56	38	42°05.80	-70°06.42	298	0.05	N/A
96	20	5/21/2019	13:49	34	42°06.11	-70°09.37	290	0.66	6.1
97	11	5/22/2019	8:29	10	41°17.23	-70°24.50	215	0.81	12.8
98	19	5/22/2019	10:09	21	41°14.46	-70°16.12	298	0.84	10.4
99	18	5/22/2019	11:35	17	41°12.83	-70°09.53	296	0.82	11.0
100	18	5/22/2019	13:00	14	41°13.33	-70°03.83	250	0.82	11.1
101	19	5/22/2019	14:01	22	41°12.62	-70°06.04	260	0.84	11.0
102	17	5/22/2019	15:12	10	41°15.35	-70°11.17	131	0.80	11.7
103	18	5/22/2019	16:30	15	41°16.86	-70°17.07	156	0.81	10.8
104	12	5/23/2019	5:07	12	41°19.78	-70°32.28	105	0.83	11.5
105	17	5/23/2019	7:25	9	41°17.02	-70°21.10	99	0.64	12.7
106	13	5/23/2019	9:41	21	41°18.87	-70°36.88	101	0.85	11.0
107	13	5/23/2019	10:54	23	41°18.30	-70°37.92	274	0.84	10.4
108	12	5/23/2019	11:58	15	41°19.72	-70°39.87	282	0.81	12.1

Table 3. Sampling Effort Assigned and Accomplished by Stratum, Cruise 201991.

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	
16	2	11	11		11	1
17	3	5	4		4	
18	3	5	5		5	
19	3	2	2		2	
20	3	2	2		2	1
21	3	2	2		2	
25	4	4	4		4	
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	1
33	5	4	4		4	
34	5	4	4		4	
35	5	5	5		5	
36	5	2	2		2	
TOTALS		103	102	0	102	4

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) Completed on Cruise 201991.
Not Advised for Indices of Abundance other than Spiny Dogfish.

Station	Stratum	SHG Location	Description
No sub-standard tows on cruise 201991			

Table 5. Attempted Tows Aborted During Cruise 201991.

Station	Stratum	SHG Location	Description
3	26	177	Doors crossed
20	32	173 East of Nantasket Beach	Hung down
89	16	174 North of Cape Pogue	Hung down
95	20	171 East of P'town	Hauled due to sign on sounder

Table 6a. Total Catch Numbers and Weights Observed on the 2019
Massachusetts Spring Inshore Bottom Trawl Survey - Cruise 201991- Sorted by Number

Species Code	Common Name	Count	Weight (kg)
143	SCUP	16,252	3,356.634
73	ATLANTIC COD	16,015	55.718
163	LONGHORN SCULPIN	4,519	677.807
106	WINTER FLOUNDER	4,486	523.257
171	NORTHERN SEAROBIN	2,896	612.854
503	LONGFIN SQUID	2,592	120.822
32	ATLANTIC HERRING	2,506	42.153
72	SILVER HAKE	1,973	155.394
105	YELLOWTAIL FLOUNDER	1,937	371.352
77	RED HAKE	1,802	258.102
301	AMERICAN LOBSTER	1,353	437.091
74	HADDOCK	1,017	813.586
26	LITTLE SKATE	1,013	540.488
193	OCEAN POUT	859	157.864
181	NORTHERN SAND LANCE	806	6.303
313	ATLANTIC ROCK CRAB	741	120.069
33	ALEWIFE	708	31.306
102	AMERICAN PLAICE	398	46.506
108	WINDOWPANE	391	79.884
78	SPOTTED HAKE	340	14.472
401	SEA SCALLOP	229	12.135
141	BLACK SEA BASS	224	87.688
177	TAUTOG	216	178.473
103	SUMMER FLOUNDER	146	61.592
34	BLUEBACK HERRING	135	3.998
23	WINTER SKATE	132	109.413
318	HORSESHOE CRAB	128	106.134
35	AMERICAN SHAD	112	4.145
172	STRIPED SEAROBIN	109	47.307
131	BUTTERFISH	105	9.839
336	CHANNELED WHELK	104	16.160
322	LADY CRAB	100	9.990
348	NORTHERN MOONSNAIL	81	10.057
117	SMALLMOUTH FLOUNDER	71	0.938
312	JONAH CRAB	61	13.077
104	FOURSPOT FLOUNDER	53	11.986
337	KNOBBED WHELK	48	15.305
164	SEA RAVEN	40	9.781
121	ATLANTIC MACKEREL	38	2.889
176	CUNNER	38	2.152
75	POLLOCK	32	0.091

Table 6a continued.

Species Code	Common Name	Count	Weight (kg)
116	NORTHERN PIPEFISH	30	0.215
343	BLUE MUSSEL	17	1.567
13	SMOOTH DOGFISH	14	37.166
180	ROCK GUNNEL	7	0.089
196	NORTHERN PUFFER	6	0.738
349	SHARK EYE	6	0.410
45	RAINBOW SMELT	5	0.053
146	NORTHERN KINGFISH	5	1.490
36	ATLANTIC MENHADEN	5	1.885
155	ACADIAN REDFISH	5	0.374
76	WHITE HAKE	5	0.374
166	GRUBBY	5	0.097
197	GOOSEFISH	4	1.545
182	SNAKEBLENNY	4	0.175
43	BAY ANCHOVY	3	0.013
139	STRIPED BASS	3	5.501
107	WITCH FLOUNDER	3	0.737
409	OCEAN QUAHOG	2	0.691
15	SPINY DOGFISH	2	3.450
314	BLUE CRAB	2	0.274
162	SHORTHORN SCULPIN	1	0.002
185	OYSTER TOADFISH	1	0.318
402	BAY SCALLOP	1	0.025
403	ATLANTIC SURFCLAM	1	0.038
165	ALLIGATORFISH	1	0.014
184	RADIATED SHANNY	1	0.006
183	DAUBED SHANNY	1	0.009
99	GREENLAND HALIBUT	1	0.667
37	HICKORY SHAD	1	1.147
168	LUMPFISH	1	2.336
28	THORNY SKATE	1	1.010
453	ATLANTIC TOMCOD	1	0.005
Totals		64,951	9,197.233

Table 6b. Total Catch Numbers and Weights Observed on the 2019
Massachusetts Spring Inshore Bottom Trawl Survey - Cruise 201991- Sorted by Weight

SPP CODE	COMMON NAME	COUNT	WEIGHT(kg)
143	SCUP	16,252	3,356.634
74	HADDOCK	1,017	813.586
163	LONGHORN SCULPIN	4,519	677.807
171	NORTHERN SEAROBIN	2,896	612.854
26	LITTLE SKATE	1,013	540.488
106	WINTER FLOUNDER	4,486	523.257
301	AMERICAN LOBSTER	1,353	437.091
105	YELLOWTAIL FLOUNDER	1,937	371.352
77	RED HAKE	1,802	258.102
177	TAUTOG	216	178.473
193	OCEAN POUT	859	157.864
72	SILVER HAKE	1,973	155.394
503	LONGFIN SQUID	2,592	120.822
313	ATLANTIC ROCK CRAB	741	120.069
23	WINTER SKATE	132	109.413
318	HORSESHOE CRAB	128	106.134
141	BLACK SEA BASS	224	87.688
108	WINDOWPANE	391	79.884
103	SUMMER FLOUNDER	146	61.592
73	ATLANTIC COD	16,015	55.718
172	STRIPED SEAROBIN	109	47.307
102	AMERICAN PLAICE	398	46.506
32	ATLANTIC HERRING	2,506	42.153
13	SMOOTH DOGFISH	14	37.166
33	ALEWIFE	708	31.306
336	CHANNELED WHELK	104	16.160
337	KNOBBED WHELK	48	15.305
78	SPOTTED HAKE	340	14.472
312	JONAH CRAB	61	13.077
401	SEA SCALLOP	229	12.135
104	FOURSPOT FLOUNDER	53	11.986
348	NORTHERN MOONSNAIL	81	10.057
322	LADY CRAB	100	9.990
131	BUTTERFISH	105	9.839
164	SEA RAVEN	40	9.781
181	NORTHERN SAND LANCE	806	6.303
139	STRIPED BASS	3	5.501
35	AMERICAN SHAD	112	4.145
34	BLUEBACK HERRING	135	3.998

Table 6b continued.

SPP CODE	COMMON NAME	COUNT	WEIGHT(kg)
15	SPINY DOGFISH	2	3.450
121	ATLANTIC MACKEREL	38	2.889
168	LUMPFISH	1	2.336
176	CUNNER	38	2.152
36	ATLANTIC MENHADEN	5	1.885
343	BLUE MUSSEL	17	1.567
197	GOOSEFISH	4	1.545
146	NORTHERN KINGFISH	5	1.490
37	HICKORY SHAD	1	1.147
28	THORNY SKATE	1	1.010
117	SMALLMOUTH FLOUNDER	71	0.938
196	NORTHERN PUFFER	6	0.738
107	WITCH FLOUNDER	3	0.737
409	OCEAN QUAHOG	2	0.691
99	GREENLAND HALIBUT	1	0.667
349	SHARK EYE	6	0.410
76	WHITE HAKE	5	0.374
155	ACADIAN REDFISH	5	0.374
185	OYSTER TOADFISH	1	0.318
314	BLUE CRAB	2	0.274
116	NORTHERN PIPEFISH	30	0.215
182	SNAKEBLENNY	4	0.175
166	GRUBBY	5	0.097
75	POLLOCK	32	0.091
180	ROCK GUNNEL	7	0.089
45	RAINBOW SMELT	5	0.053
403	ATLANTIC SURFCLAM	1	0.038
402	BAY SCALLOP	1	0.025
165	ALLIGATORFISH	1	0.014
43	BAY ANCHOVY	3	0.013
183	DAUBED SHANNY	1	0.009
184	RADIATED SHANNY	1	0.006
453	ATLANTIC TOMCOD	1	0.005
162	SHORTHORN SCULPIN	1	0.002
Totals		64,951	9,197.233

Table 7. Number of individuals obtained for age, growth, maturity and special studies during Massachusetts DMF Cruise 201991.

Species	Maturity Observation	Age and Growth Collection		
		Scales	Otoliths	YOY
Atlantic Cod	46		46	
Haddock	36		36	
Summer Flounder	91		88	
Yellowtail Flounder	192		189	
Winter Flounder	459		458	
Black Sea Bass	81		79	
Scup	65		65	
Tautog	44		43	
American Lobster	466			
Jonah crab (Female)	0			
TOTAL	1,480	0	1,004	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).

YOY Atlantic cod saved for age and growth study (Dean).

Nantucket Sound whelk saved for age and growth study (Wilcox).

River herring saved for age and growth study (Armstrong).

Longfin squid egg mops saved for mortality study (Hendrickson).

Longfin squid were saved for Black Sea Bass rod and reel sampling (Glenn)

Figure 1.

Massachusetts Division of Marine Fisheries Inshore Bottom Trawl Survey

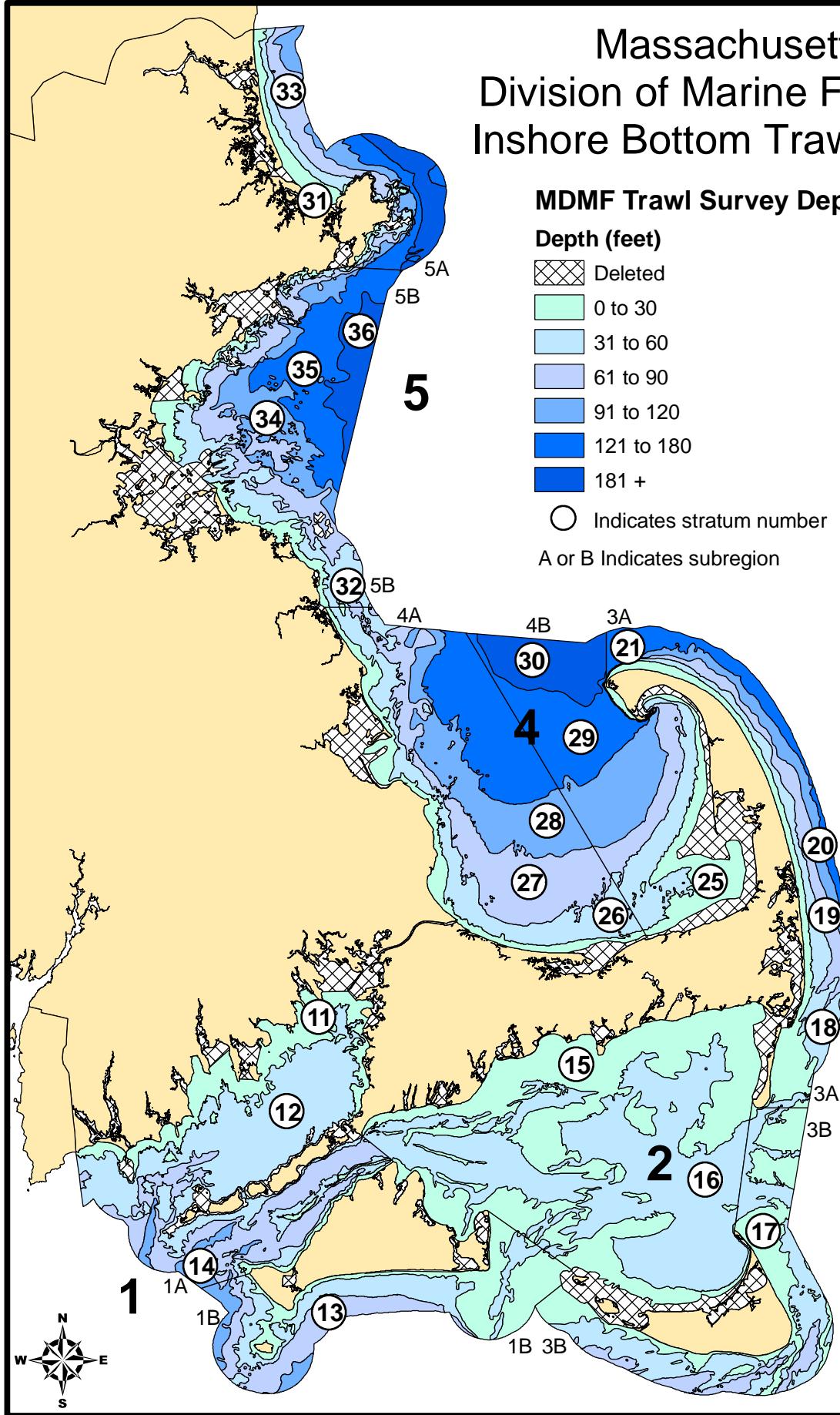


Figure 2.

Spring 2019 Mass Division of Marine Fisheries Bottom Trawl Survey Tow Locations

○ Proposed Tow Circles

— 201991 Completed Tow Tracks

* 201991 Aborted Tows

Data label indicates day of month (May)

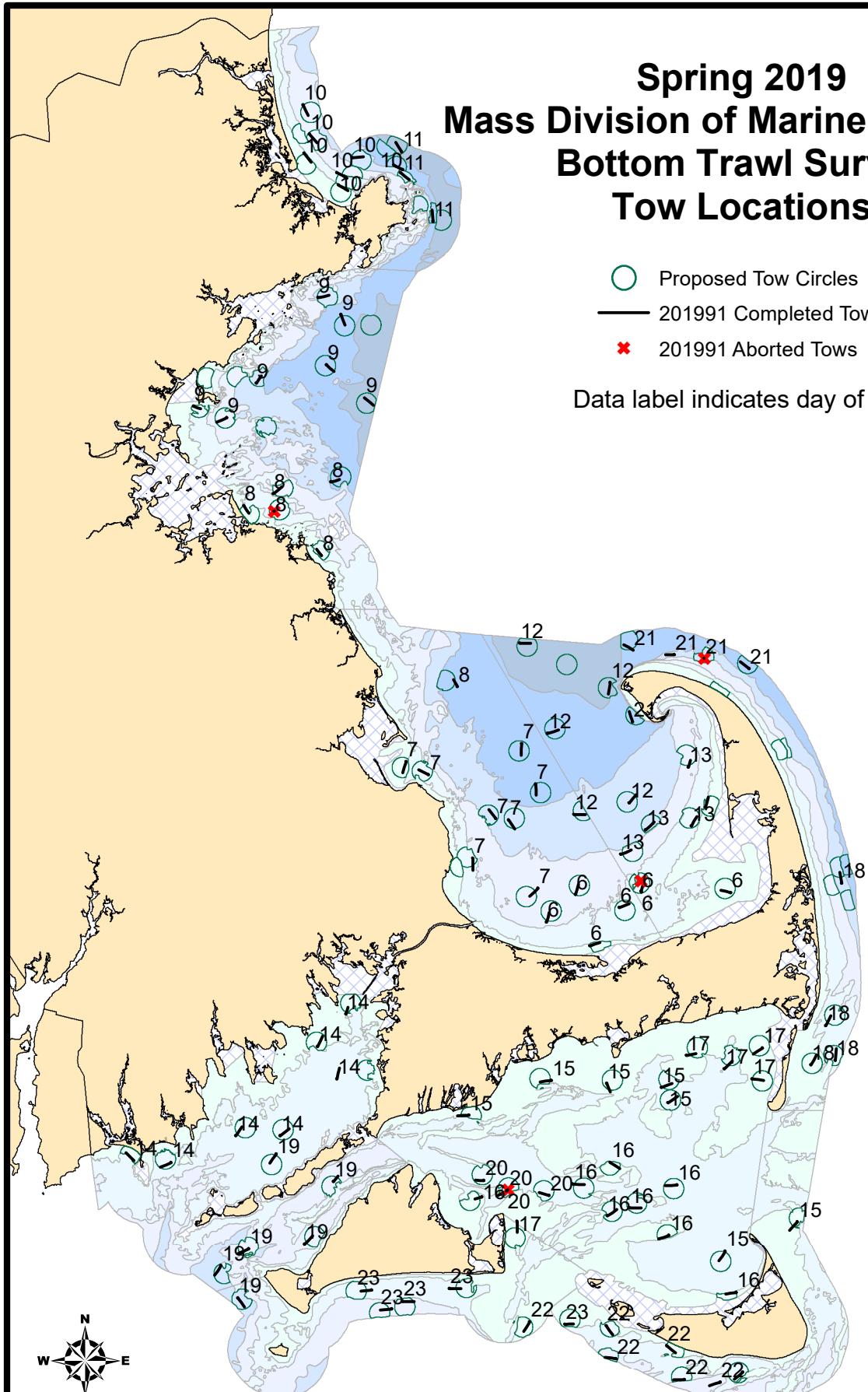


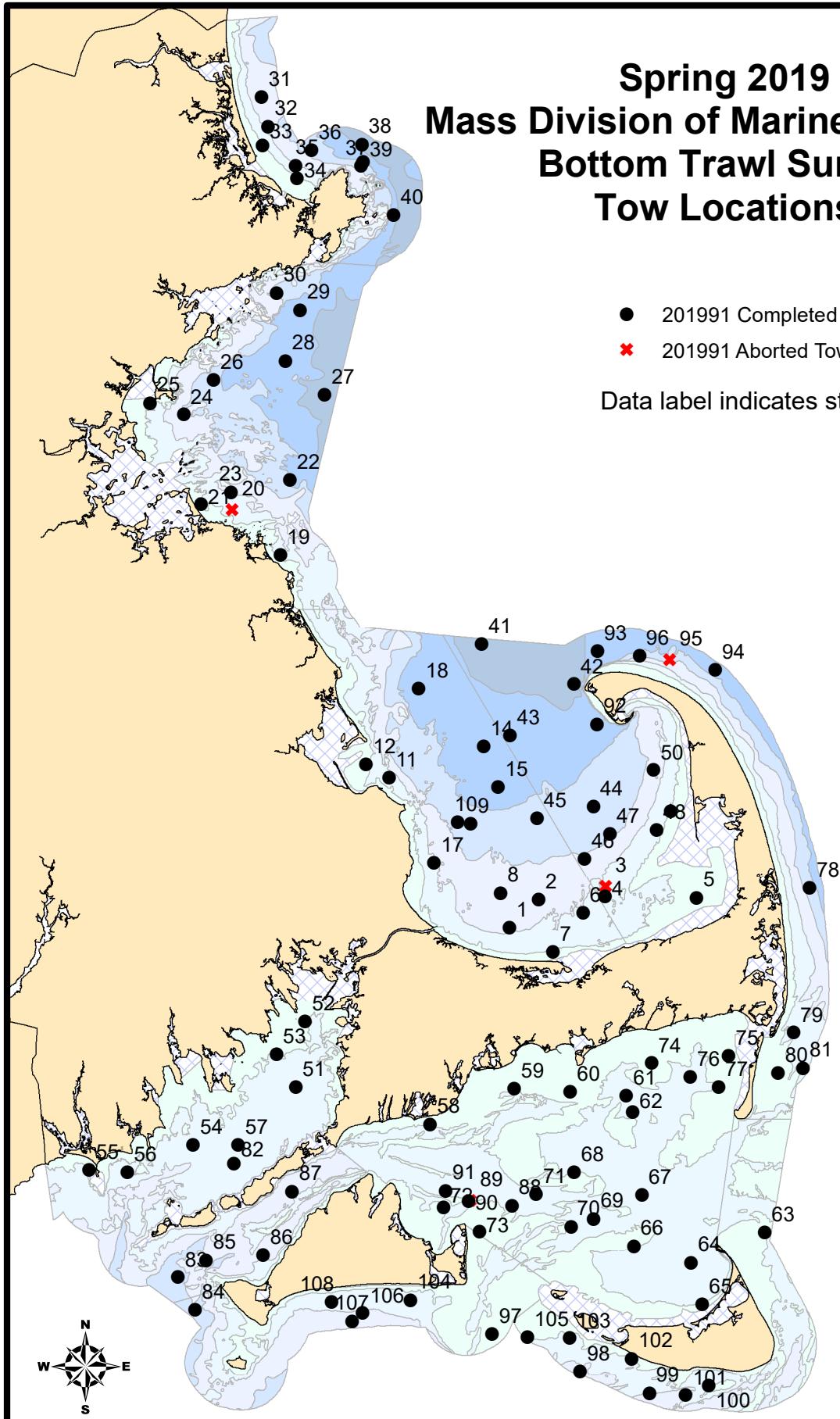
Figure 3.

Spring 2019 Mass Division of Marine Fisheries Bottom Trawl Survey Tow Locations

● 201991 Completed Tows

✖ 201991 Aborted Tows

Data label indicates station number



CRUISE RESULTS

R/V GLORIA MICHELLE

2019 Massachusetts Inshore Fall
Bottom Trawl Survey
Cruise No. 201992

CRUISE PERIOD AND AREA

From September 3 through September 25, 2019 the Massachusetts Division of Marine Fisheries conducted its 42nd 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. 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 net's headrope.

Twenty-six MADMF employees participated in the survey as part of the scientific party, joined by one student from UMASS Boston and one volunteer from NMFS GARFO (Table 1).

CRUISE SUMMARY

102 stations were attempted in 17 sampling days (Figs 1 and 2, Table 2). 90 completed stations were considered acceptable for assessment of all species, SHG <=136 (Table 3). 13 station assignments were not completed with acceptable trawl hauls due to adverse weather conditions, hard bottom, time constraints and fixed gear. Heavy seas and fixed gear prevented us from completing 7 stations in strata 29, 34, 35 and 36. Two stations were dropped in stratum 15 due to weather and weed and four stations were dropped in strata 17 and 18 due to time constraints. Twelve attempted tows were aborted due to hangs, weed, fixed gear, crossed doors, winch operator error and hard bottom (Table 5, Fig. 3).

The primary goal of tallying weight, number, and a representative length frequency of each fish species in the catches was accomplished (Tables 6a and 6b). A few records were set on the 2019 fall survey. The first spiny butterfly ray was recorded at station 57 in Western Nantucket Sound and the first loggerhead sea turtle was recorded at station 91 East of Horseshoe Shoal. The loggerhead sea turtle was processed, biopsied and tagged following NEFSC Protected Species protocols. The largest abundance of Northern kingfish (78) was recorded at station 65 in Nantucket Bight. Moderate catches of winter flounder, silver hake and red hake were taken North of Cape Cod. Scup, longfin squid and butterfish were abundant throughout Nantucket Sound, Vineyard Sound and Buzzard's Bay.

Additional sampling goals were achieved (Table 7). To aid cooperative fisheries assessments, over 740 otolith samples, as well as 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 Matthew Camisa at (508) 742-9743.

Table 1. MADMF 2019 Fall Cruise Staffing List

Scientific Party

Name	Affiliation	Num. Days
Mark Szymanski	MADMF	12
Matthew Camisa	MADMF	10
Vincent Manfredi	MADMF	10
Steve Voss	MADMF	6
Elise Koob	MADMF	5
Brendan Reilly	MADMF	4
Greg Decelles	MADMF	4
John Logan	MADMF	4
Nicole Ward	MADMF	4
Kim Fine	MADMF	3
Brad Schondelmeier	MADMF	2
Derek Perry	MADMF	2
John Sheppard	MADMF	2
Ross Kessler	MADMF	2
Steve Wilcox	MADMF	2
Rachel Labella	UMASS Boston	2
Chrissy Petipas	MADMF	1
Crystal Cano	MADMF	1
Erin Burke	MADMF	1
Joe Holbeche	MADMF	1
Kristen Schmicker	MADMF	1
Mike Armstrong	MADMF	1
Meredith Langford	MADMF	1
Mike Pol	MADMF	1
Nathalie Staiger	MADMF	1
Sam Truesdell	MADMF	1
Scott Elzey	MADMF	1
Diana Glinos	NMFS GARFO	1
		86

R/V Gloria Michelle Crew

Name	Affiliation	Num. Days
<i>Officers</i>		
Chris Gallagher	NOAA OIC	18
Ben VanDine	NOAA JOIC	18
Mike Doig	NOAA Corps Officer	6
<i>Deck Crew</i>		
George Morton	Contract Fisherman	18
Pete Plantamura	NMFS-Sandy Hook	5
Ben Church	NMFS-Woods Hole	4
Kristof Ketch	NMFS-Woods Hole	3
Greg DeYoung	USCG	2
Mike Bergman	NMFS-Woods Hole	2
Mike Thompson	USCG	1

Table 2. Station Information for the 2019 Massachusetts Fall Inshore Bottom Trawl Survey
Cruise No. 201992

Station	Stratum	Date	Time (est)	Depth (m)	Latitude	Longitude	Course	Distance (nmi)	Bottom temp °C
1	26	9/3/2019	5:50	17	41°49.85	-70°29.62	195	0.85	11.4
2	27	9/3/2019	7:09	24	41°50.81	-70°27.41	163	0.84	9.7
3	28	9/3/2019	8:24	27	41°51.84	-70°25.67	349	0.84	9.1
4	28	9/3/2019	9:59	33	41°56.29	-70°28.59	359	0.60	8.7
5	29	9/3/2019	11:28	45	41°58.99	-70°24.80	94	0.83	7.6
6	29	9/3/2019	12:38	42	41°56.68	-70°24.41	16	0.58	7.8
7	28	9/3/2019	13:59	34	41°53.58	-70°21.76	66	0.84	8.5
8	27	9/3/2019	15:20	26	41°49.80	-70°22.39	50	0.86	9.3
9	26	9/3/2019	17:09	18	41°48.11	-70°28.29	115	0.36	11.6
10	25	9/4/2019	5:54	9	41°46.04	-70°27.70	125	0.81	15.2
11	26	9/4/2019	7:14	15	41°45.42	-70°23.58	122	0.84	13.2
12	27	9/4/2019	9:29	21	41°47.99	-70°18.78	76	0.87	10.4
13	25	9/4/2019	11:31	7	41°49.31	-70°05.43	298	0.84	19.9
14	25	9/4/2019	12:57	9	41°50.04	-70°09.90	48	0.86	16.9
15	26	9/5/2019	7:51	13	41°52.99	-70°08.81	35	0.62	13.7
16	26	9/5/2019	8:50	10	41°54.26	-70°07.32	10	0.52	15.4
17	27	9/5/2019	10:08	21	41°54.20	-70°09.70	51	0.81	9.9
18	28	9/5/2019	11:23	29	41°57.43	-70°09.64	26	0.83	8.7
19	27	9/5/2019	12:24	23	42°00.90	-70°09.06	185	0.84	8.7
20	27	9/5/2019	13:20	27	41°59.00	-70°08.78	356	0.83	8.7
21	28	9/5/2019	15:26	31	41°52.50	-70°15.92	84	0.84	8.9
22	12	9/6/2019	6:34	10	41°39.28	-70°40.82	6	0.85	20.6
23	11	9/6/2019	7:30	7	41°38.96	-70°43.72	70	0.54	21.8
24	11	9/6/2019	8:51	7	41°36.25	-70°48.96	166	0.84	22.4
25	12	9/6/2019	9:53	14	41°33.64	-70°46.71	59	0.25	20.8
26	12	9/6/2019	10:19	14	41°33.85	-70°46.42	66	0.56	21.0
27	12	9/6/2019	11:16	14	41°34.45	-70°41.22	266	0.86	21.0
28	13	9/8/2019	7:30	22	41°24.13	-70°53.93	261	0.84	16.1
29	14	9/8/2019	8:59	31	41°23.27	-71°00.12	16	0.85	16.0
30	13	9/8/2019	10:17	23	41°26.00	-71°00.88	7	0.83	18.8
31	12	9/8/2019	11:55	17	41°29.75	-70°51.43	273	0.83	19.6
32	11	9/8/2019	13:20	9	41°34.92	-70°54.19	194	0.65	20.6
33	25	9/8/2019	17:15	9	41°50.05	-70°30.73	201	0.43	17.0
34	25	9/8/2019	17:45	9	41°50.11	-70°30.72	207	0.56	17.1
35	26	9/9/2019	7:20	16	41°58.06	-70°34.46	352	0.55	16.5
36	29	9/9/2019	9:33	54	42°05.86	-70°27.60	360	0.64	8.1
37	32	9/9/2019	12:09	11	42°13.33	-70°43.81	329	0.23	N/A
38	33	9/9/2019	15:04	21	42°18.61	-70°48.83	122	0.53	14.8
39	31	9/9/2019	16:09	10	42°17.44	-70°51.80	177	0.77	17.0

Table 2 continued.

Station	Stratum	Date	Time (est)	Depth (m)	Latitude	Longitude	Course	Distance (nmi)	Bottom temp °C
40	32	9/9/2019	17:01	11	42°17.47	-70°51.75	150	0.55	16.9
41	33	9/10/2019	6:31	26	42°23.77	-70°54.06	77	0.63	12.8
42	32	9/10/2019	8:05	13	42°26.30	-70°54.75	23	0.74	16.2
43	34	9/10/2019	10:10	34	42°23.51	-70°49.80	130	0.00	N/A
44	34	9/10/2019	10:32	34	42°23.53	-70°49.83	138	0.61	10.3
45	35	9/10/2019	13:45	53	42°27.80	-70°43.44	146	0.50	8.1
46	33	9/11/2019	7:38	24	42°44.64	-70°44.71	335	0.56	12.0
47	31	9/11/2019	8:33	9	42°46.08	-70°47.57	179	0.85	15.3
48	32	9/11/2019	9:38	15	42°44.48	-70°45.89	154	0.83	13.7
49	31	9/11/2019	10:48	11	42°42.89	-70°45.02	157	0.71	14.9
50	33	9/11/2019	11:49	25	42°42.67	-70°42.63	167	0.64	11.8
51	34	9/11/2019	12:50	30	42°44.61	-70°43.10	170	0.65	10.6
52	34	9/11/2019	13:46	34	42°43.42	-70°40.04	327	0.30	9.8
53	34	9/11/2019	14:58	34	42°43.44	-70°40.09	334	0.54	9.7
54	35	9/12/2019	6:39	53	42°34.90	-70°35.19	56	0.16	N/A
55	35	9/13/2019	6:35	52	42°35.08	-70°34.92	66	0.51	8.4
56	35	9/13/2019	8:39	48	42°30.79	-70°43.23	55	0.52	8.2
57	16	9/14/2019	6:12	17	41°31.52	-70°36.78	96	0.84	20.7
58	16	9/14/2019	7:22	11	41°32.25	-70°31.79	278	0.83	20.5
59	16	9/14/2019	8:29	11	41°31.58	-70°29.15	293	0.83	20.7
60	16	9/14/2019	11:07	15	41°33.78	-70°10.75	252	0.86	19.7
61	15	9/14/2019	12:38	8	41°32.68	-70°05.50	200	0.58	16.8
62	16	9/14/2019	14:00	13	41°28.39	-70°10.48	106	0.58	18.3
63	16	9/14/2019	15:54	14	41°27.05	-70°06.91	177	0.85	16.3
64	15	9/14/2019	17:06	9	41°24.68	-70°08.97	271	0.82	19.0
65	15	9/15/2019	5:41	9	41°19.20	-70°08.94	102	0.85	19.8
66	15	9/15/2019	8:38	7	41°34.67	-70°01.41	296	0.83	16.6
67	15	9/15/2019	9:50	9	41°37.74	-70°05.11	239	0.84	19.4
68	16	9/15/2019	10:40	13	41°35.61	-70°06.84	32	0.87	19.3
69	15	9/15/2019	11:35	8	41°36.67	-70°09.18	100	0.53	20.1
70	15	9/15/2019	12:47	10	41°35.52	-70°09.74	103	0.83	20.2
71	16	9/15/2019	15:07	20	41°27.29	-70°19.57	102	0.84	20.5
72	11	9/16/2019	8:05	12	41°17.41	-70°24.69	224	0.86	18.6
73	18	9/16/2019	9:50	12	41°16.17	-70°16.18	342	0.84	18.3
74	19	9/16/2019	10:56	19	41°14.33	-70°15.60	304	0.83	18.2
75	18	9/16/2019	12:20	15	41°13.57	-70°10.46	299	0.84	18.3
76	18	9/16/2019	13:45	13	41°13.28	-70°09.23	74	0.52	18.5
77	17	9/16/2019	14:51	9	41°14.29	-70°07.81	119	0.74	19.0
78	17	9/16/2019	16:33	11	41°14.32	-70°02.19	118	0.82	19.0
79	12	9/17/2019	6:56	13	41°20.00	-70°39.79	107	0.85	18.8

Table 2 continued.

Station	Stratum	Date	Time	Depth	Latitude	Longitude	Course	Distance	Bottom
			(est)	(m)				(nmi)	temp °C
80	13	9/17/2019	8:01	22	41°18.32	-70°41.27	83	0.84	18.5
81	14	9/17/2019	10:02	29	41°13.24	-70°46.10	55	0.86	17.9
82	12	9/17/2019	11:40	15	41°18.29	-70°49.21	350	0.84	18.8
83	13	9/17/2019	12:42	23	41°18.01	-70°50.65	353	0.84	18.0
84	13	9/17/2019	14:44	19	41°23.05	-70°46.09	37	0.82	18.8
85	12	9/17/2019	16:21	12	41°25.33	-70°45.85	67	0.84	19.3
86	16	9/19/2019	7:03	16	41°27.51	-70°29.21	107	0.85	19.9
87	11	9/19/2019	8:49	7	41°24.42	-70°25.63	192	0.85	18.9
88	15	9/19/2019	10:28	8	41°25.97	-70°19.87	270	0.86	19.3
89	15	9/19/2019	12:00	10	41°24.33	-70°18.25	257	0.60	18.8
90	16	9/19/2019	13:55	13	41°30.46	-70°18.42	326	0.84	19.5
91	16	9/19/2019	15:10	16	41°30.23	-70°17.14	132	0.84	19.4
92	29	9/22/2019	7:22	41	41°57.81	-70°19.06	140	0.86	9.0
93	30	9/22/2019	8:52	57	42°03.48	-70°16.55	193	0.79	8.1
94	30	9/22/2019	10:15	56	42°03.60	-70°18.93	321	0.84	8.0
95	21	9/22/2019	13:11	41	42°05.37	-70°03.06	131	0.77	9.1
96	20	9/22/2019	14:20	36	42°4.04	-70°01.72	167	0.85	9.9
97	21	9/25/2019	9:31	41	41°48.66	-69°52.29	353	0.68	10.9
98	20	9/25/2019	10:34	36	41°49.41	-69°53.20	348	0.58	12.6
99	19	9/25/2019	11:23	21	41°49.12	-69°54.71	5	0.85	15.3
100	17	9/25/2019	12:34	9	41°46.45	-69°55.39	14	0.85	16.3
101	18	9/25/2019	14:33	15	41°39.02	-69°53.79	218	0.06	N/A
102	18	9/25/2019	14:55	15	41°38.88	-69°53.83	214	0.34	N/A

Table 3. Sampling Effort Assigned and Accomplished by Stratum, Cruise 201992.

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	1
13	1	5	5		5	
14	1	2	2		2	
15	2	10	8		8	1
16	2	11	11		11	
17	3	5	3		3	
18	3	5	3		3	2
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	1
27	4	5	5		5	1
28	4	5	5		5	
29	4	5	4		4	
30	4	2	2		2	
31	5	3	3		3	
32	5	3	3		3	1
33	5	4	4		4	
34	5	4	3		3	2
35	5	5	2		2	2
36	5	2	0		0	
TOTALS		103	90	0	90	12

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) Completed on Cruise 201992.
Not Advised for Indices of Abundance other than Spiny Dogfish.

Station	Stratum	SHG Location	Description
No sub-standard tows on cruise 201992			

Table 5. Attempted Tows Aborted During Cruise 201992.

Station	Stratum	SHG Location	Description
9	26	179 East of Cape Cod Canal	Hard bottom and net damage
19	27	176 South of Provincetown harbor	Ghost gear interaction
25	12	171 Middle of Buzzard's Bay	Hauled early due to slowing
33	25	171 East of Ellisville	Fixed gear interaction
37	32	179 North of Scituate	Hung down
43	34	177 Middle of Massachusetts Bay	Winch Operator Error
45	35	172 South of Gloucester	Hauled early due to sign on sounder
52	34	177 North of Rockport	Crossed Doors
54	35	171 East of Gloucester	Fixed gear interaction
69	15	171 Southeast of Hyannis	Weed tow
101	18	171 East of Chatham	Hung down
102	18	171 East of Chatham	Hauled early due to sign on sounder

Table 6a. Total Catch Numbers and Weights Observed on the 2019
Massachusetts Fall Inshore Bottom Trawl Survey - Cruise 201992- Sorted by Number

Species Code	Common Name	Count	Weight (kg)
143	SCUP	215,569	1,697.819
503	LONGFIN SQUID	43,350	218.701
131	BUTTERFISH	22,009	254.325
106	WINTER FLOUNDER	4,410	697.588
77	RED HAKE	3,752	415.499
141	BLACK SEA BASS	3,704	67.410
72	SILVER HAKE	3,591	386.506
301	AMERICAN LOBSTER	1,804	722.972
181	NORTHERN SAND LANCE	1,192	5.215
322	LADY CRAB	1,057	60.401
105	YELLOWTAIL FLOUNDER	722	140.132
26	LITTLE SKATE	682	393.743
343	BLUE MUSSEL	581	3.513
163	LONGHORN SCULPIN	568	64.595
313	ATLANTIC ROCK CRAB	498	50.958
108	WINDOWPANE	381	72.240
43	BAY ANCHOVY	346	0.602
317	SPIDER CRAB UNCL	326	40.787
211	ROUND SCAD	295	0.951
33	ALEWIFE	288	14.683
13	SMOOTH DOGFISH	282	274.977
132	ATLANTIC MOONFISH	269	1.133
103	SUMMER FLOUNDER	211	109.222
74	HADDOCK	142	74.190
401	SEA SCALLOP	131	3.206
45	RAINBOW SMELT	124	0.799
104	FOURSPOT FLOUNDER	119	22.666
116	NORTHERN PIPEFISH	112	0.113
193	OCEAN POUT	110	11.017
32	ATLANTIC HERRING	109	4.971
76	WHITE HAKE	104	8.521
23	WINTER SKATE	93	76.134
146	NORTHERN KINGFISH	91	4.787
73	ATLANTIC COD	68	20.988
78	SPOTTED HAKE	60	7.245
176	CUNNER	60	1.794
312	JONAH CRAB	55	7.315
177	TAUTOG	50	2.835
502	NORTHERN SHORTFIN SQUID	46	5.459
135	BLUEFISH	31	1.121
102	AMERICAN PLAICE	29	3.219

Table 6a continued.

Species Code	Common Name	Count	Weight (kg)
196	NORTHERN PUFFER	20	0.443
117	SMALLMOUTH FLOUNDER	20	0.319
171	NORTHERN SEAROBIN	19	1.150
145	WEAKFISH	18	0.628
155	ACADIAN REDFISH	17	0.838
172	STRIPED SEAROBIN	16	5.344
107	WITCH FLOUNDER	16	4.122
75	POLLOCK	16	0.938
318	HORSESHOE CRAB	12	14.044
35	AMERICAN SHAD	10	0.775
139	STRIPED BASS	9	21.906
164	SEA RAVEN	9	4.680
34	BLUEBACK HERRING	9	1.026
36	ATLANTIC MENHADEN	8	1.577
212	ROUGH SCAD	7	0.244
180	ROCK GUNNEL	6	0.029
15	SPINY DOGFISH	5	10.933
348	NORTHERN MOONSNAIL	5	0.801
336	CHANNELED WHELK	4	0.691
121	ATLANTIC MACKEREL	4	0.492
409	OCEAN QUAHOG	4	0.372
435	INSHORE LIZARDFISH	4	0.073
208	MACKEREL SCAD	3	0.059
556	GLASSEYE SNAPPER	3	0.037
4	ROUGHTAIL STINGRAY	2	138.488
197	GOOSEFISH	2	1.032
403	ATLANTIC SURFCLAM	2	0.214
134	BIGEYE	2	0.049
695	GUAGUANCHE	2	0.010
375	SPINY BUTTERFLY RAY	1	88.730
950	LOGGERHEAD SEATURTLE	1	29.500
12	SAND TIGER	1	8.132
185	OYSTER TOADFISH	1	0.753
337	KNOBBED WHELK	1	0.311
314	BLUE CRAB	1	0.220
118	HOGCHOKER	1	0.197
191	WRYMOUTH	1	0.144
489	RED CORNETFISH	1	0.059
83	FOURBEARD ROCKLING	1	0.059
109	GULF STREAM FLOUNDER	1	0.034
120	BLUESPOTTED CORNETFISH	1	0.024
596	VERMILION SNAPPER	1	0.018
Totals		307,688	6,289.847

Table 6b. Total Catch Numbers and Weights Observed on the 2019
Massachusetts Fall Inshore Bottom Trawl Survey - Cruise 201992- Sorted by Weight

Species Code	Common Name	Count	Weight (kg)
143	SCUP	215,569	1,697.819
301	AMERICAN LOBSTER	1,804	722.972
106	WINTER FLOUNDER	4,410	697.588
77	RED HAKE	3,752	415.499
26	LITTLE SKATE	682	393.743
72	SILVER HAKE	3,591	386.506
13	SMOOTH DOGFISH	282	274.977
131	BUTTERFISH	22,009	254.325
503	LONGFIN SQUID	43,350	218.701
105	YELLOWTAIL FLOUNDER	722	140.132
4	ROUGHTAIL STINGRAY	2	138.488
103	SUMMER FLOUNDER	211	109.222
375	SPINY BUTTERFLY RAY	1	88.730
23	WINTER SKATE	93	76.134
74	HADDOCK	142	74.190
108	WINDOWPANE	381	72.240
141	BLACK SEA BASS	3,704	67.410
163	LONGHORN SCULPIN	568	64.595
322	LADY CRAB	1,057	60.401
313	ATLANTIC ROCK CRAB	498	50.958
317	SPIDER CRAB UNCL	326	40.787
950	LOGGERHEAD SEATURTLE	1	29.500
104	FOURSPOT FLOUNDER	119	22.666
139	STRIPED BASS	9	21.906
73	ATLANTIC COD	68	20.988
33	ALEWIFE	288	14.683
318	HORSESHOE CRAB	12	14.044
193	OCEAN POUT	110	11.017
15	SPINY DOGFISH	5	10.933
76	WHITE HAKE	104	8.521
12	SAND TIGER	1	8.132
312	JONAH CRAB	55	7.315
78	SPOTTED HAKE	60	7.245
502	NORTHERN SHORTFIN SQUID	46	5.459
172	STRIPED SEAROBIN	16	5.344
181	NORTHERN SAND LANCE	1,192	5.215
32	ATLANTIC HERRING	109	4.971
146	NORTHERN KINGFISH	91	4.787
164	SEA RAVEN	9	4.680
107	WITCH FLOUNDER	16	4.122

Table 6b continued.

Species Code	Common Name	Count	Weight (kg)
343	BLUE MUSSEL	581	3.513
102	AMERICAN PLAICE	29	3.219
401	SEA SCALLOP	131	3.206
177	TAUTOG	50	2.835
176	CUNNER	60	1.794
36	ATLANTIC MENHADEN	8	1.577
171	NORTHERN SEAROBIN	19	1.150
132	ATLANTIC MOONFISH	269	1.133
135	BLUEFISH	31	1.121
197	GOOSEFISH	2	1.032
34	BLUEBACK HERRING	9	1.026
211	ROUND SCAD	295	0.951
75	POLLOCK	16	0.938
155	ACADIAN REDFISH	17	0.838
348	NORTHERN MOONSNAIL	5	0.801
45	RAINBOW SMELT	124	0.799
35	AMERICAN SHAD	10	0.775
185	OYSTER TOADFISH	1	0.753
336	CHANNELED WHELK	4	0.691
145	WEAKFISH	18	0.628
43	BAY ANCHOVY	346	0.602
121	ATLANTIC MACKEREL	4	0.492
196	NORTHERN PUFFER	20	0.443
409	OCEAN QUAHOG	4	0.372
117	SMALLMOUTH FLOUNDER	20	0.319
337	KNOBBED WHELK	1	0.311
212	ROUGH SCAD	7	0.244
314	BLUE CRAB	1	0.220
403	ATLANTIC SURFCLAM	2	0.214
118	HOGCHOKER	1	0.197
191	WRYMOUHT	1	0.144
116	NORTHERN PIPEFISH	112	0.113
435	INSHORE LIZARDFISH	4	0.073
489	RED CORNETFISH	1	0.059
208	MACKEREL SCAD	3	0.059
83	FOURBEARD ROCKLING	1	0.059
134	BIGEYE	2	0.049
556	GLASSEYE SNAPPER	3	0.037
109	GULF STREAM FLOUNDER	1	0.034
180	ROCK GUNNEL	6	0.029
120	BLUESPOTTED CORNETFISH	1	0.024
596	VERMILION SNAPPER	1	0.018
695	GUAGUANCHE	2	0.010
Totals		307,688	6,289.847

Table 7. Number of individuals obtained for age, growth, maturity and special studies during Massachusetts DMF Cruise 201992.

Species	Maturity Observation	Age and Growth Collection			YOY
		Scales	Otoliths	Opercula	
Atlantic Cod	26		26		
Haddock	27		27		
Summer Flounder	133		133		
Yellowtail Flounder	182		182		
Winter Flounder	257		257		
Black Sea Bass	59		59		
Scup	56		56		
Tautog	1		1		30
American Lobster	413				
TOTAL	1,154	0	741	0	30

OTHER COLLECTIONS:

Jonah crabs measured to 0.1 cm carapace width and egg bearing status recorded for size at maturity study (D. Perry).

Various fish species saved for age and growth sampling class (G. Decelles)

Various groundfish species saved for age and growth sampling class (M. Armstrong)

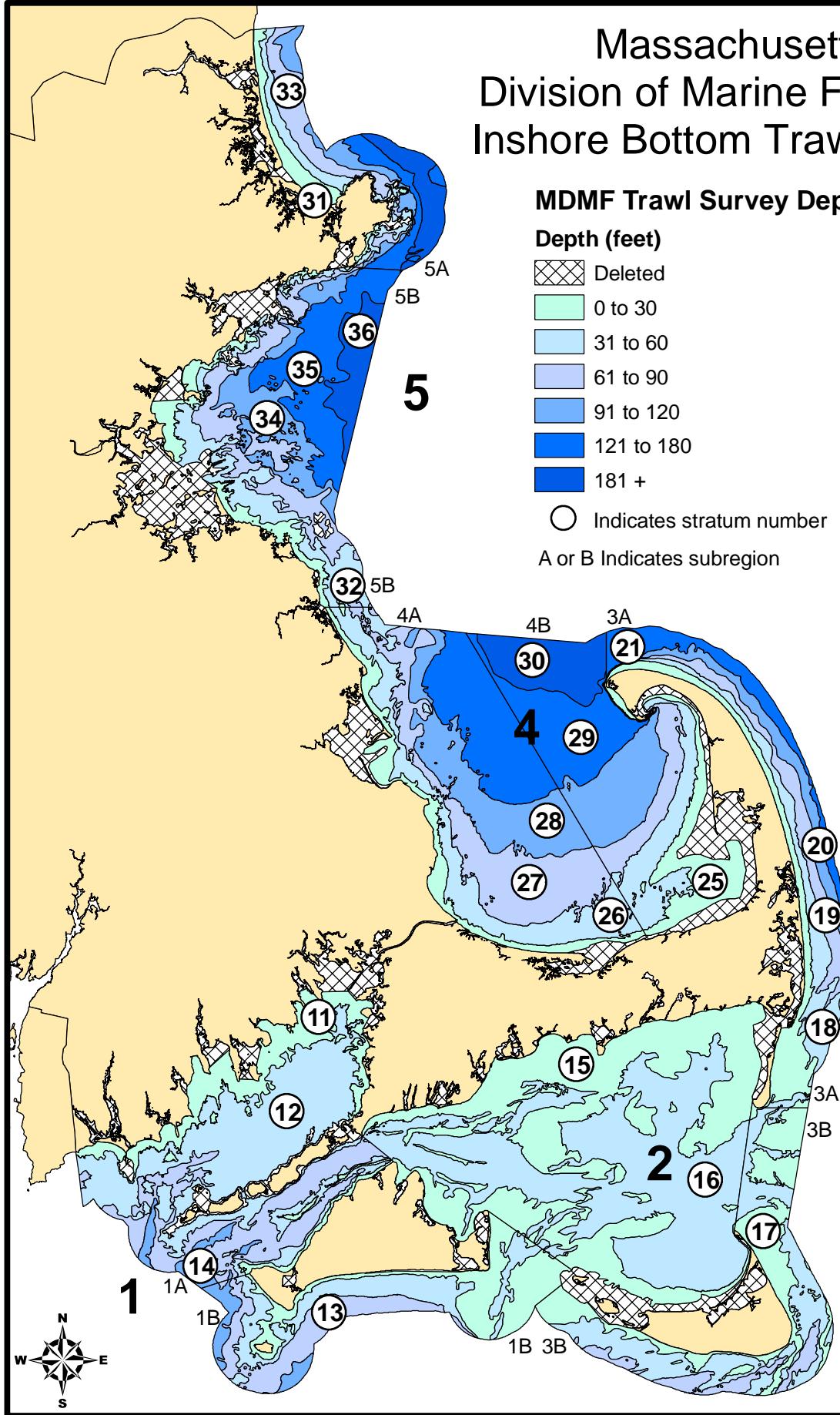
Longfin squid egg mops collected from 4 stations for genetics study (L. Hendrickson).

Glass Eye Snapper, Guaguaunche, Sand Lance and Vermilion Snapper saved for ID (V. Manfredi)

15 YOY Atlantic Cod saved for Age and Growth (M. Dean)

Figure 1.

Massachusetts Division of Marine Fisheries Inshore Bottom Trawl Survey



Camisa 2007

Figure 2.

Fall 2019 Mass Division of Marine Fisheries Bottom Trawl Survey Tow Locations

○ Proposed Tow Circles (1.5nm)

— Completed Tow Tracks

* 201992 Aborts

Data label indicates day of month (Sept)

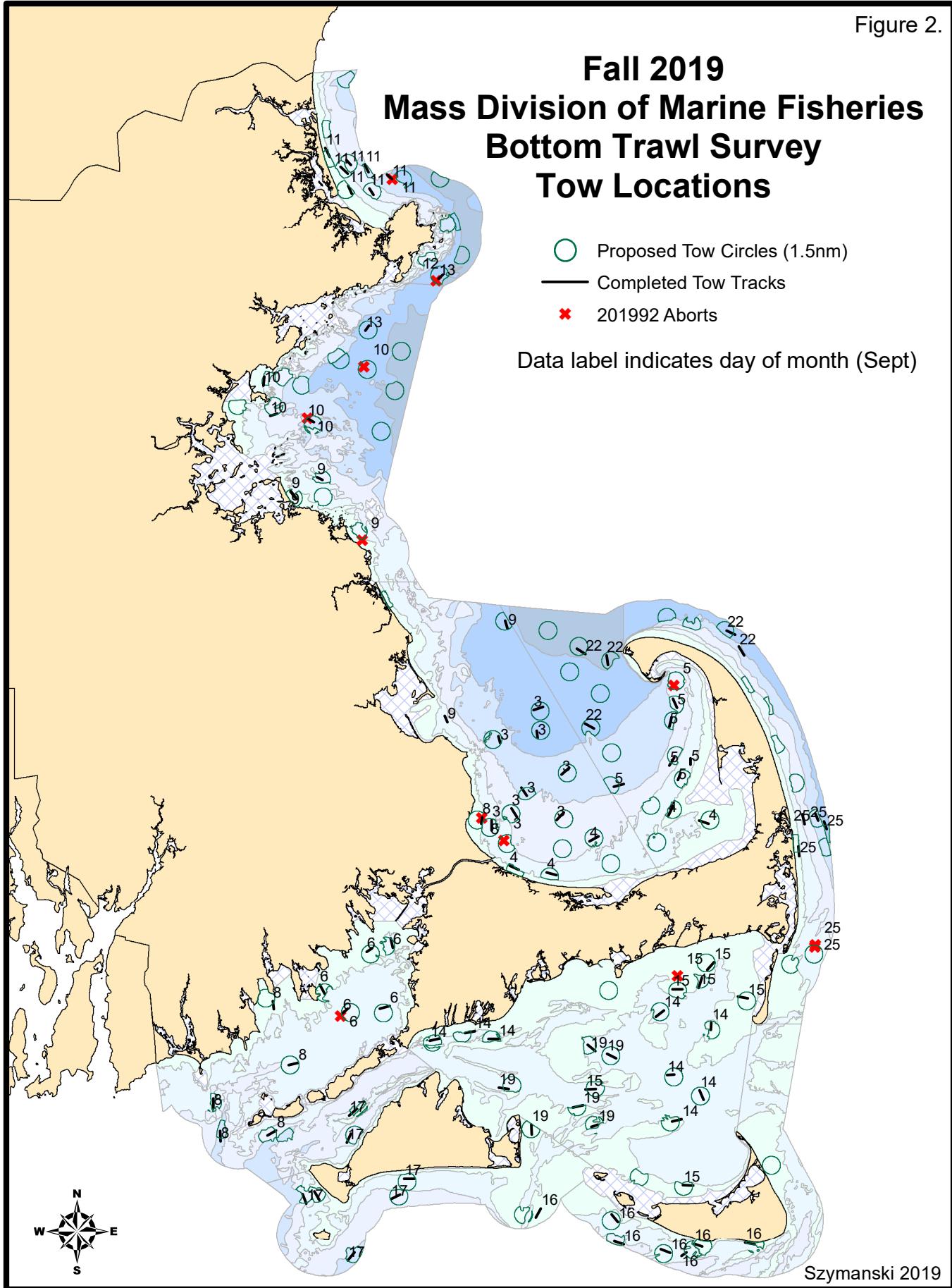


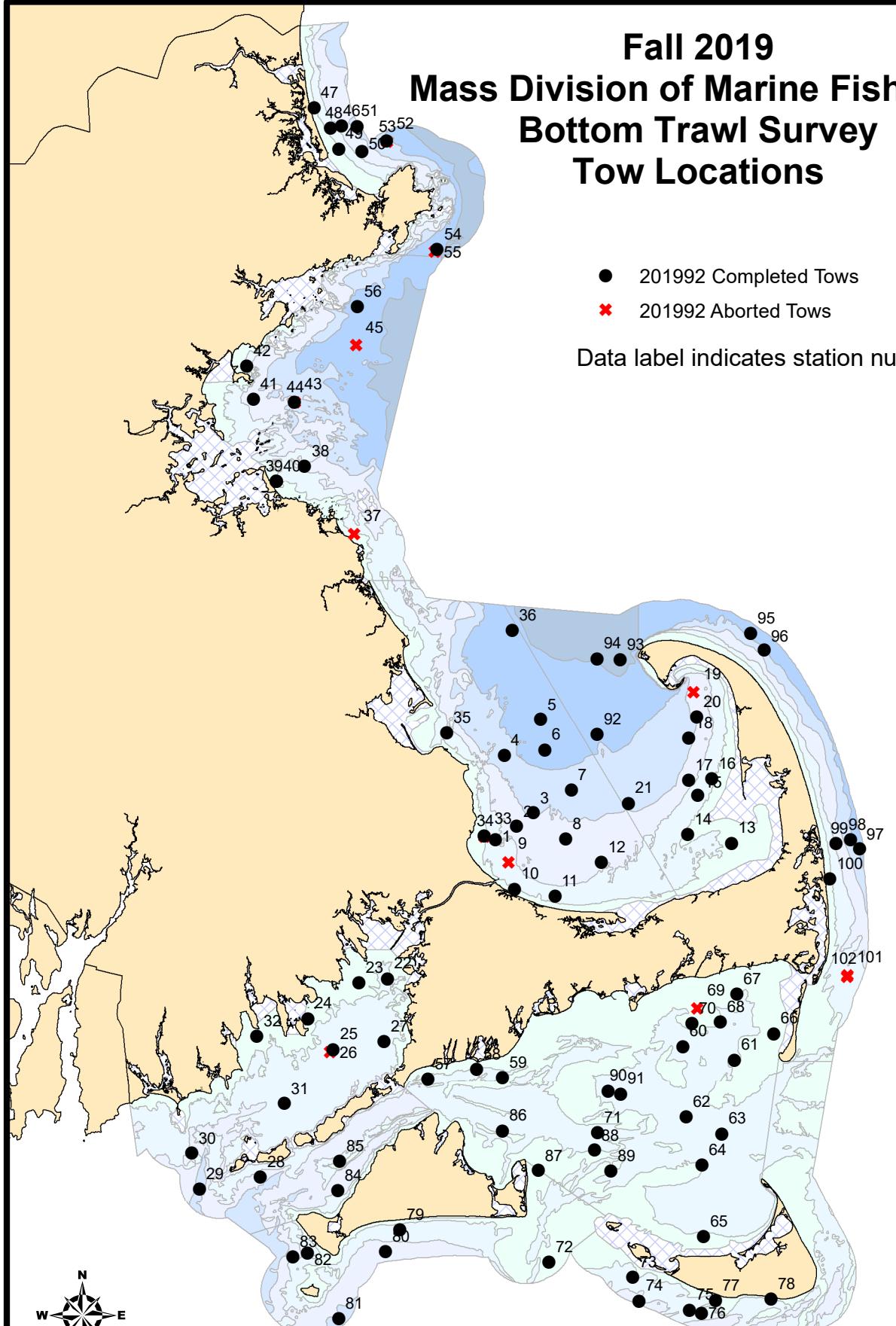
Figure 3.

Fall 2019 Mass Division of Marine Fisheries Bottom Trawl Survey Tow Locations

● 201992 Completed Tows

✖ 201992 Aborted Tows

Data label indicates station number





SURVEY REPORT
2019 Nantucket Sound Estuarine Winter Flounder
Young of the Year (YOY)
Seine Survey

SURVEY PERIOD AND AREA

From June 24 – July 11, 2019 the Massachusetts Division of Marine Fisheries (MDMF) conducted its 44th 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

Seining of intertidal and shallow subtidal zones occurs from two hours before until two hours after high tide. 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 Pro™) 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. Nine MADMF employees and one UMASS Dartmouth student participated in the survey as part of the scientific party (Table 1).

RESULTS

137 seine hauls were conducted at 49 stations over 9 sampling days. One haul was dropped at each of ten stations due to shoreline vegetation, shoreline alterations or obstructions and human activity; Washburn Island 4 in Waquoit Bay, Seapuit #2 in Cotuit Bay, Baxter Ave. in Lewis Bay, West Dennis Beach #1, Follins Pond, Harbor Haven, High Bank and Heirs Landing in Bass River, and Mill Pond and Vineyard Ave. in Stage Harbor.

Forty-five species were encountered in 2019 (Table 2). The 2019 pooled (all estuaries combined) winter flounder YOY index is (0.145 YOY / m²), increasing modestly from last year (Figure 2, Table 3) and the Age 1+ winter flounder index remained below the timeseries median for the 10th consecutive year (Figure 3). All estuary specific indices for YOY winter flounder increased in 2019 (Figure 4). The YOY Fluke index decreased to a level just above the timeseries median catch (Figure 5). The blue crab index decreased and is below the timeseries 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. 2019 Seine Survey Staffing List

Name	Affiliation	Num. Days
Vincent Manfredi	MDMF	9
Matthew Camisa	MDMF	2
Dr. Greg Decelles	MDMF	2
Lynne Besse	MDMF	1
David Chosid	MDMF	1
Tyler Fairclough	UMASS	1
Meredith Langford	MDMF	1
Brendan Riley	MDMF	1
Nathalie Staiger	MDMF	1
Mark Szymanski	MDMF	1

Table 2. Catch Observations of All Recorded Species During the 2019 Seine Survey
 (for species marked present, counts are not taken but presence is noted at all hauls)

Common Name	Taxonomic Name	Total Number	% Occurrence
Atlantic Silverside	<i>Menidia menidia</i>	Present	93.4%
YOY Winter Flounder	<i>Pseudopleuronectes americanus</i>	1222	81.8%
Sand Shrimp	<i>Crangon septemspinosa</i>	Present	73.7%
Mud Snail	<i>Nassarius obsoletus</i>	Present	61.3%
Striped Killifish	<i>Fundulus majalis</i>	Present	51.1%
Blue Crab	<i>Callinectes sapidus</i>	131	38.7%
Grass Shrimp	<i>Paelmonetes pugio</i>	Present	37.2%
Northern Pipefish	<i>Syngnathus fuscus</i>	Present	29.9%
Fourspine Stickleback	<i>Apeltes quadratus</i>	Present	25.5%
Mummichog	<i>Fundulus heteroclitus</i>	Present	23.4%
Northern Kingfish	<i>Menticirrhitus saxatilis</i>	161	19.7%
Alewife / Blueback Herring	<i>Alosa spp.</i>	81	16.8%
Spider Crab Uncl.	<i>Majidae</i>	43	13.9%
Rainwater Killifish	<i>Lucania parva</i>	131	13.1%
Green Crab	<i>Carcinus maenus</i>	34	11.7%
Lady Crab	<i>Ovalipes ocellatus</i>	15	10.2%
Northern Puffer	<i>Sphoeroides maculatus</i>	21	8.0%
Atlantic Needlefish	<i>Strongylura marina</i>	15	8.0%
YOY Summer Flounder	<i>Paralichthys dentatus</i>	10	7.3%
Sheepshead Minnow	<i>Cyprinodon variegatus</i>	10	5.1%
Scup YOY	<i>Stenotomus chrysops</i>	655	3.6%
Atlantic Herring	<i>Clupea harengus</i>	83	2.9%
Threespine Stickleback	<i>Gasterosteus aculeatus</i>	Present	2.9%
Spot	<i>Leiostomus xanthurus</i>	7	2.9%
Grubby	<i>Myoxocephalus aeneus</i>	6	2.9%
Mottled Dog Whelk	<i>Nassa vibex</i>	Present	2.9%
Northern Sand Lance	<i>Ammodytes dubius</i>	12	2.2%
Horseshoe Crab	<i>Limulus polyphemus</i>	4	2.2%
Naked Goby / Seaboard Goby	<i>Gobiosoma spp.</i>	7	2.2%
Smallmouth flounder	<i>Etropus microstomus</i>	2	1.5%
Striped Searobin	<i>Prionotus evolans</i>	2	1.5%
Ribbed Mussel	<i>Guekensia demissus</i>	1	1.5%
American Eel	<i>Anguilla rostrata</i>	2	1.5%
Oyster	<i>Crassostrea virginica</i>	Present	1.5%
Atlantic Menhaden	<i>Brevortia tyrannus</i>	66	0.7%
Red Hake	<i>Urophycis chuss</i>	1	0.7%
Northern Searobin	<i>Prionotus carolinus</i>	1	0.7%
Tautog	<i>Tautoga onitis</i>	1	0.7%
Mantis Shrimp Uncl.	<i>Stomatopoda</i>	1	0.7%
Knobbed Whelk	<i>Busycon carica</i>	Present	0.7%
Blue Mussel	<i>Mytilus edulis</i>	1	0.7%
Northern Quahog	<i>Mercenaria mercenaria</i>	1	0.7%
White Mullet	<i>Mugil curema</i>	13	0.7%
Fish Uncl.		4	0.7%
Mole Crab	<i>Emerita</i>	Present	0.7%

Table 3. YOY Winter Flounder Abundance, All Estuaries. MDMF Seine Survey 1976-2019

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

**Figure 1. Station Locations
MDMF Seine Survey.**

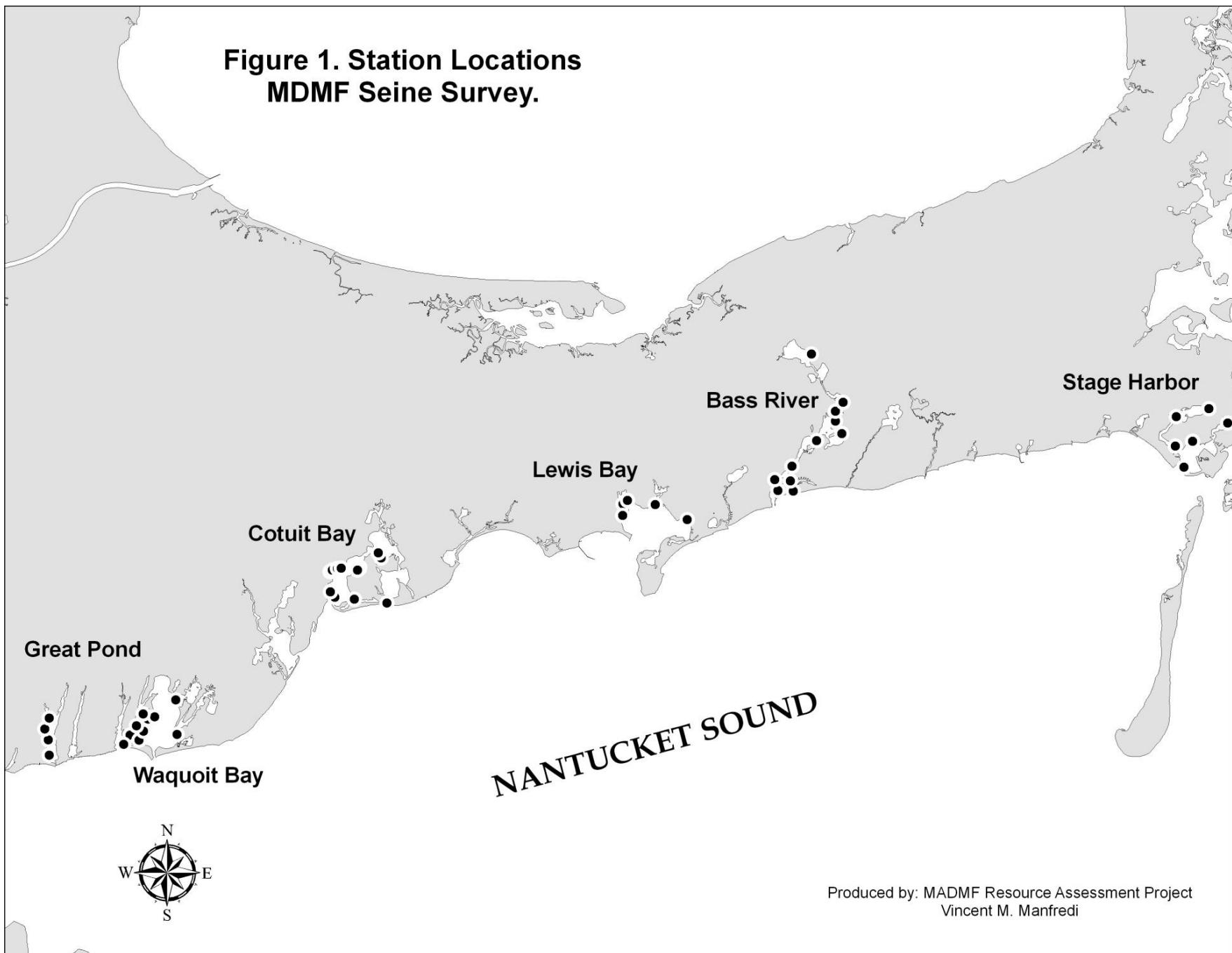


Figure 2. YOY Winter Flounder Abundance
MDMF Seine Survey: 1976-2019

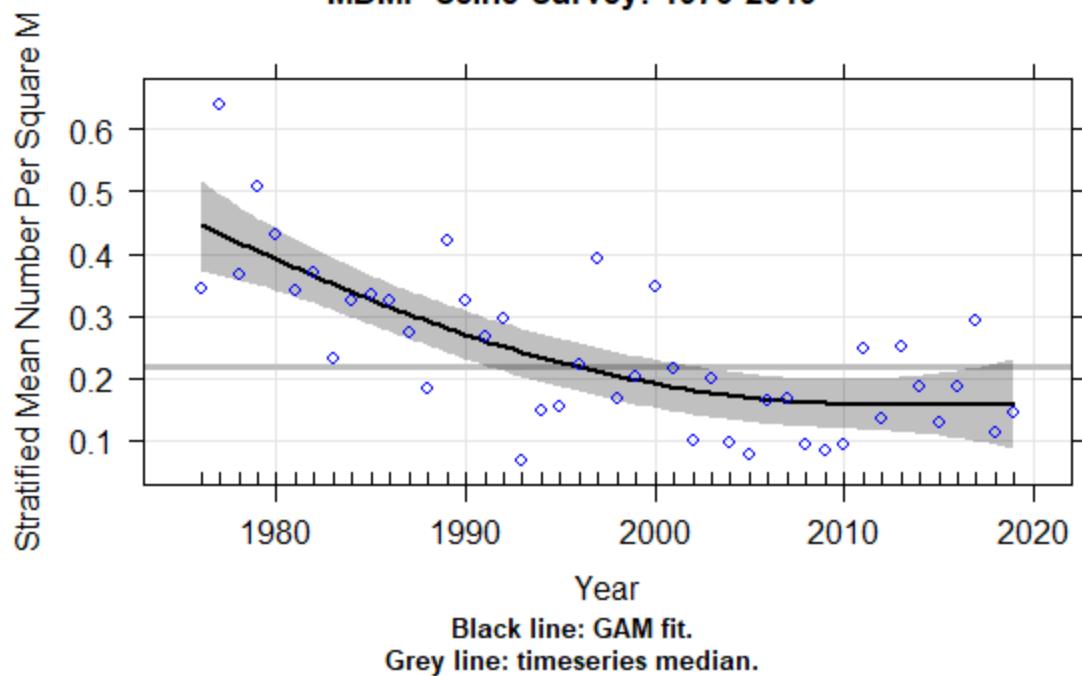


Figure 3. Age 1+ Winter Flounder Abundance
MDMF Seine Survey: 1983-2019

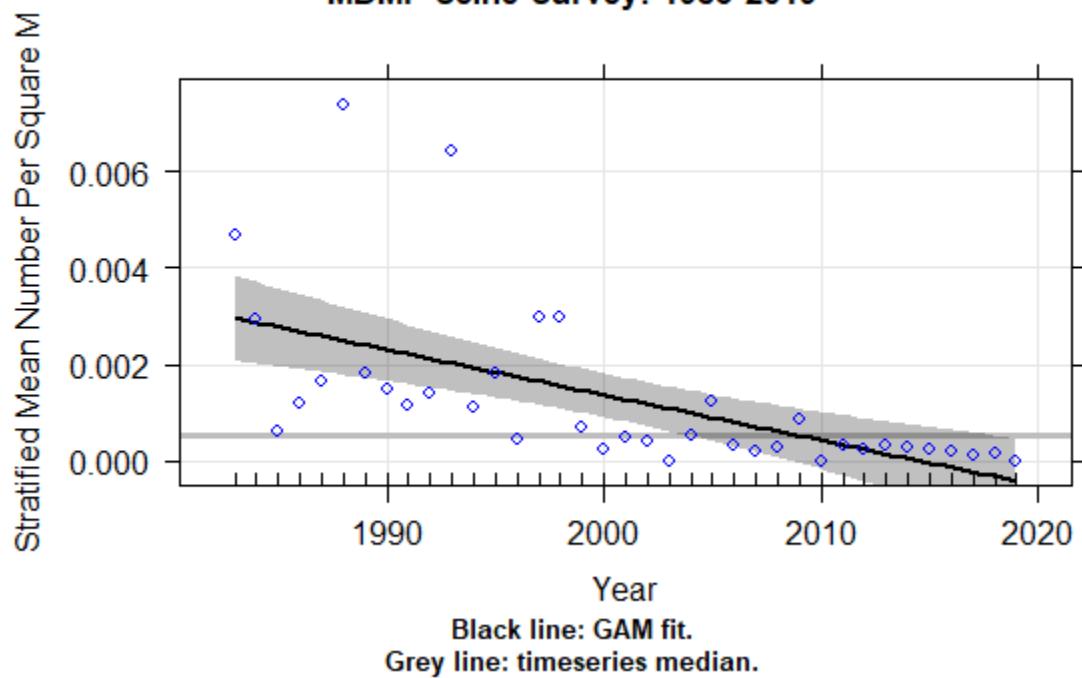
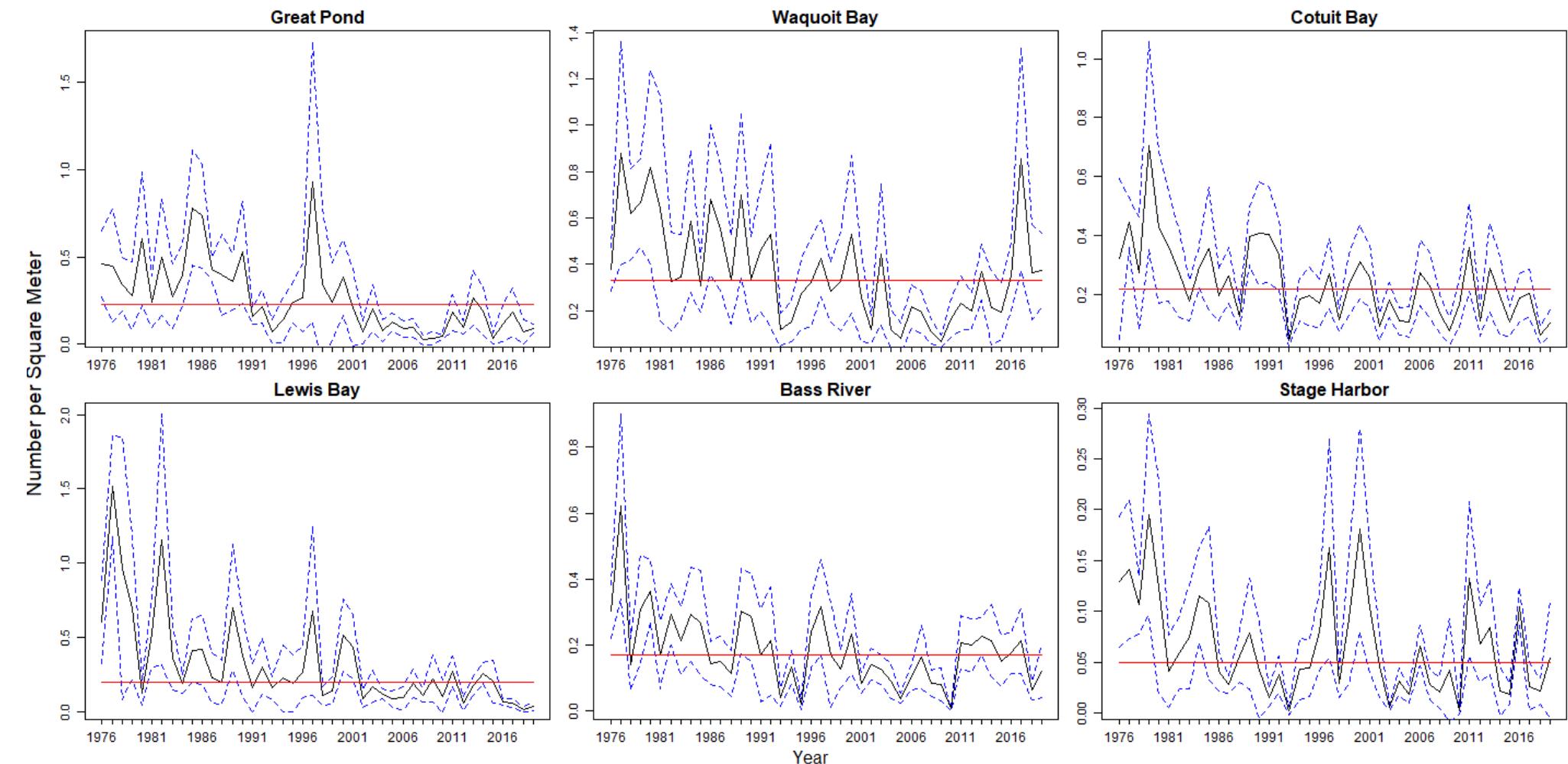


Figure 4. Abundance of YOY winter flounder by estuary, MDMF Seine Survey 1976 –2019.



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

Figure 5. YOY Summer Flounder Abundance
MDMF Seine Survey: 1976-2019

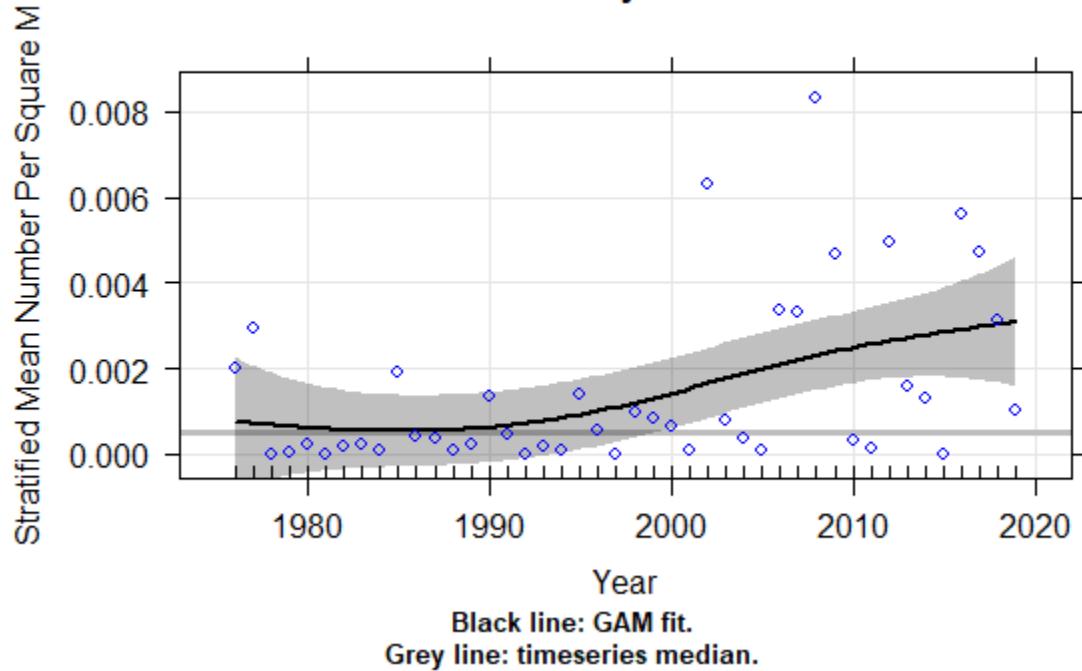
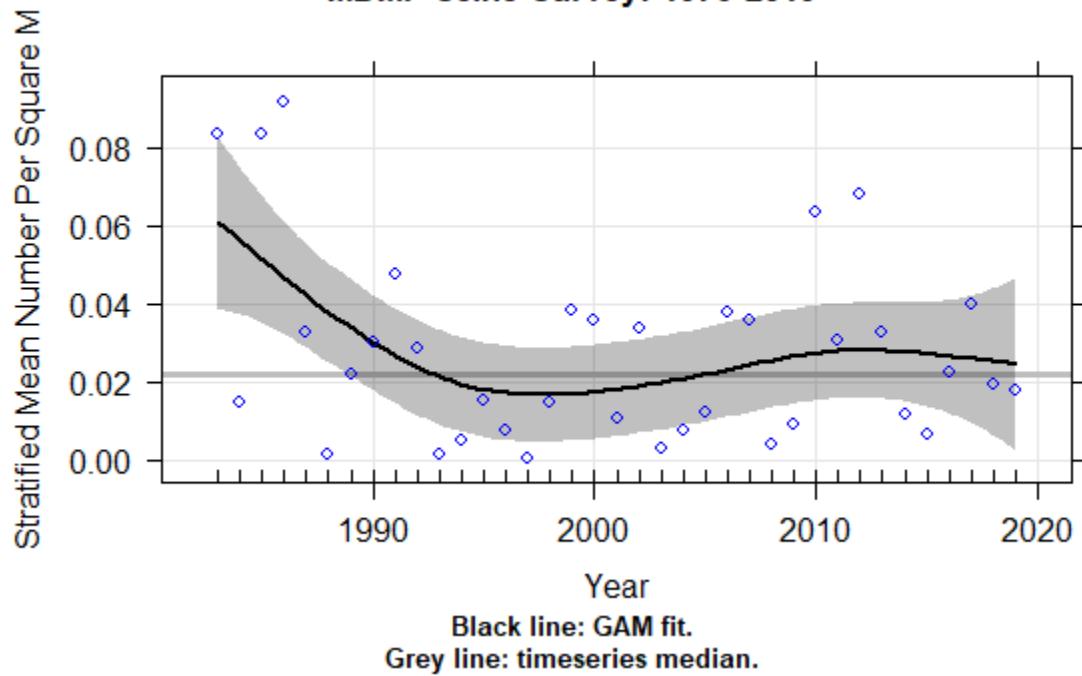
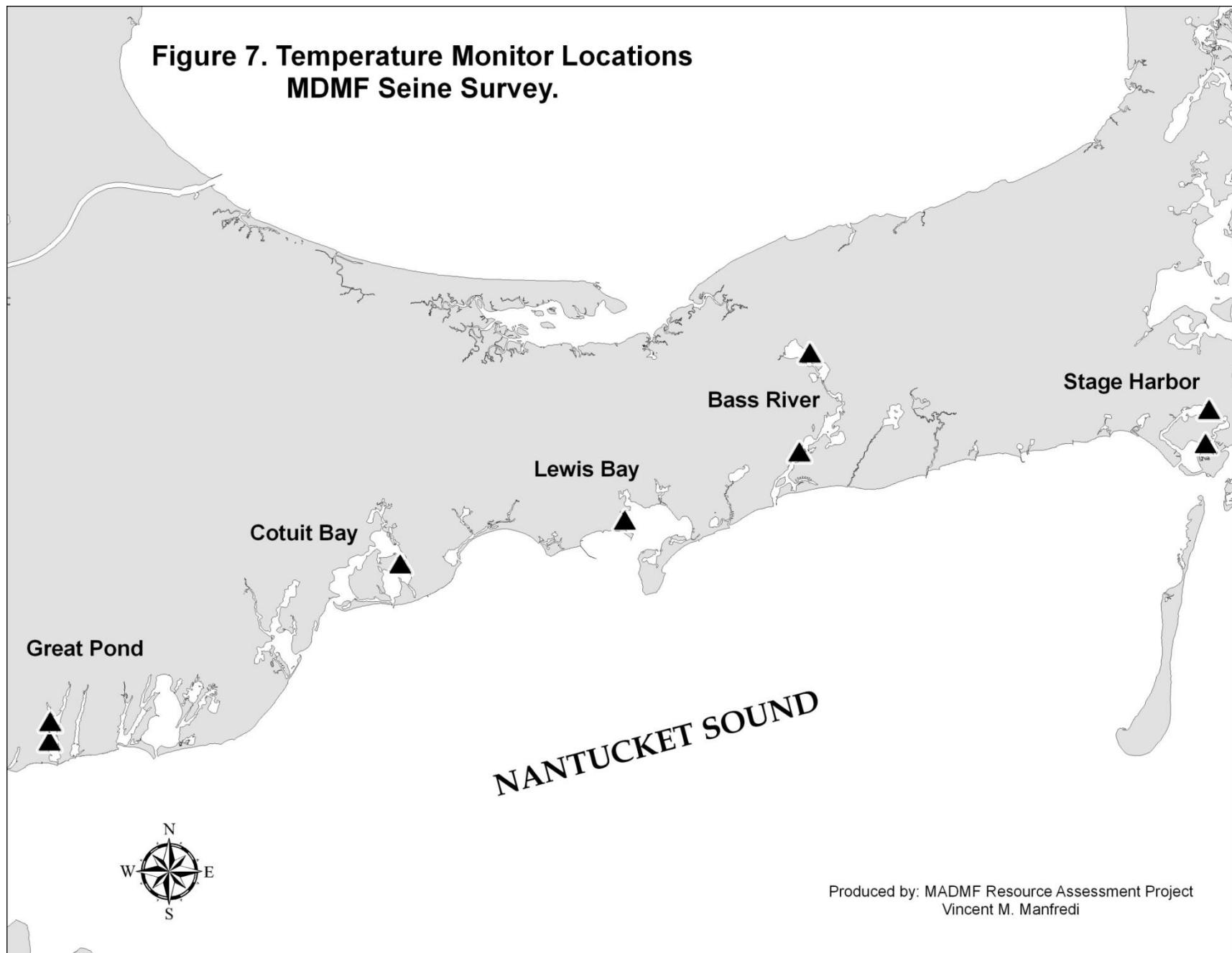


Figure 6. Blue Crab Abundance
MDMF Seine Survey: 1976-2019



**Figure 7. Temperature Monitor Locations
MDMF Seine Survey.**



2019 Seine Survey



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 Matthew Camisa at 508-742-9743 or matt.camisa@mass.gov.

Contents:

Figure 1. Massachusetts trawl survey regions.

Figure 2 (a-ff). Stratified mean weight per tow (kg) with GAM smoothed trend line.
1978–2019 Massachusetts DMF trawl survey.

- (a.) Spring **Winter Flounder** Regions 1 - 3
- (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
- (y.) Spring **Scup** Regions 1 - 3
- (z.) Spring **Black Sea Bass** Regions 1 - 3
- (aa.) Spring **Tautog** Regions 1 - 3
- (bb.) Fall **Tautog** Regions 1 - 3
- (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 with GAM smoothed trend line.
1978 – 2019 Massachusetts DMF 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 with GAM smoothed trend line.
1978 – 2019 Massachusetts DMF 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. Massachusetts trawl survey regions

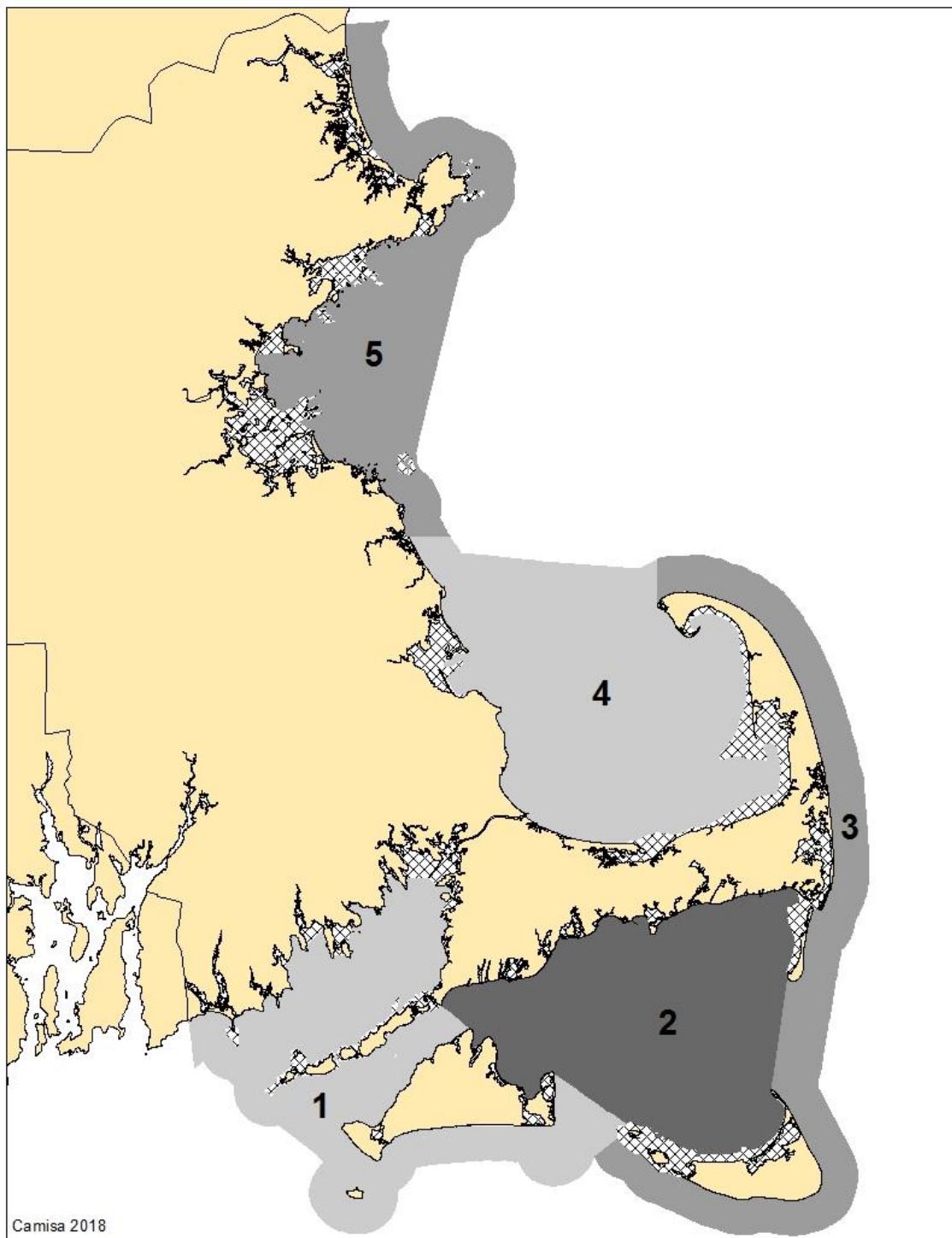


Figure 2. (a & b) Stratified mean weight per tow (kg) with GAM smoothed trend line.
1978 – 2019 Massachusetts DMF Trawl survey.

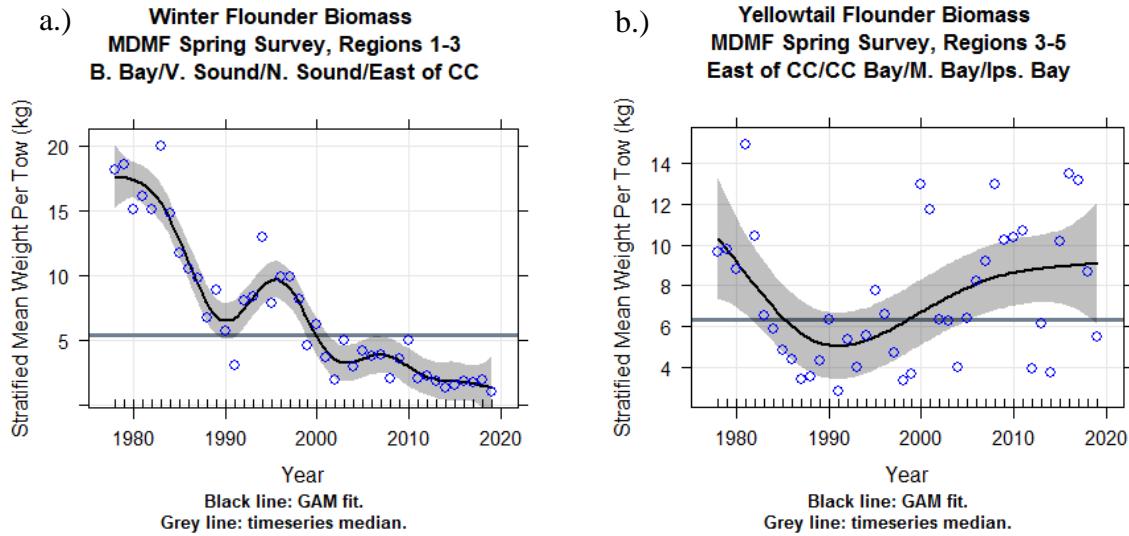


Figure 2. (c & d) Stratified mean weight per tow (kg) with GAM smoothed trend line.
1978 – 2019 Massachusetts DMF Trawl survey.

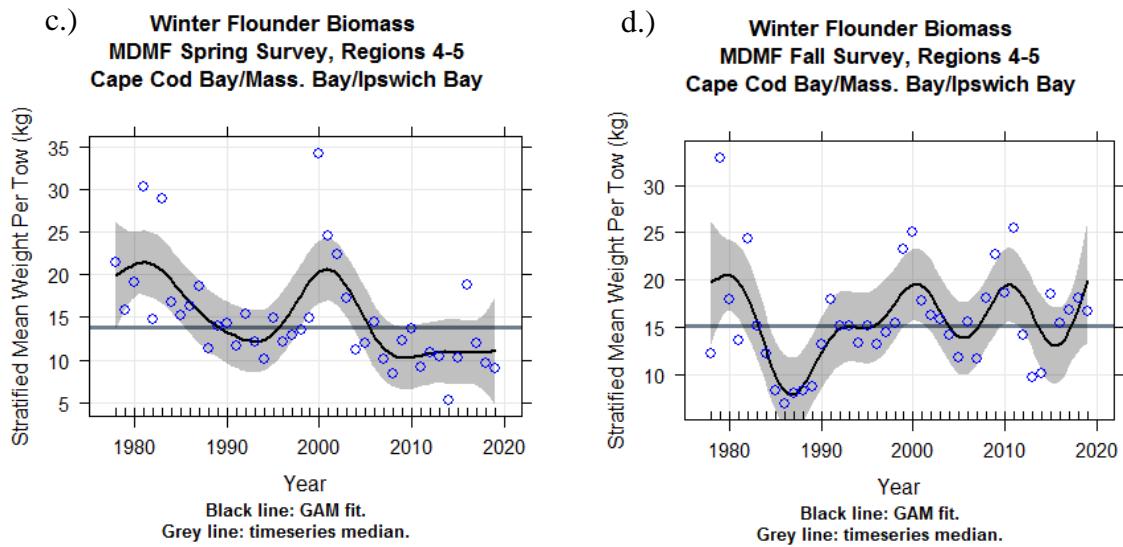


Figure 2. (e & f). Stratified mean weight per tow (kg) with GAM smoothed trend line.
1978 – 2019 Massachusetts DMF Trawl survey.

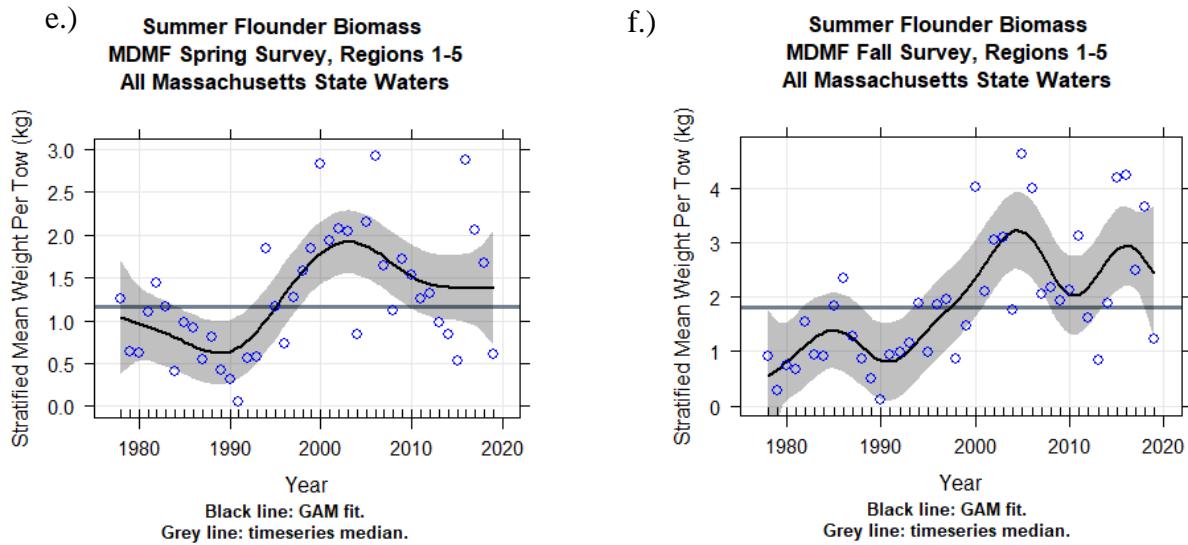


Figure 2. (g & h). Stratified mean weight per tow (kg) with GAM smoothed trend line.
1978 – 2019 Massachusetts DMF Trawl survey.

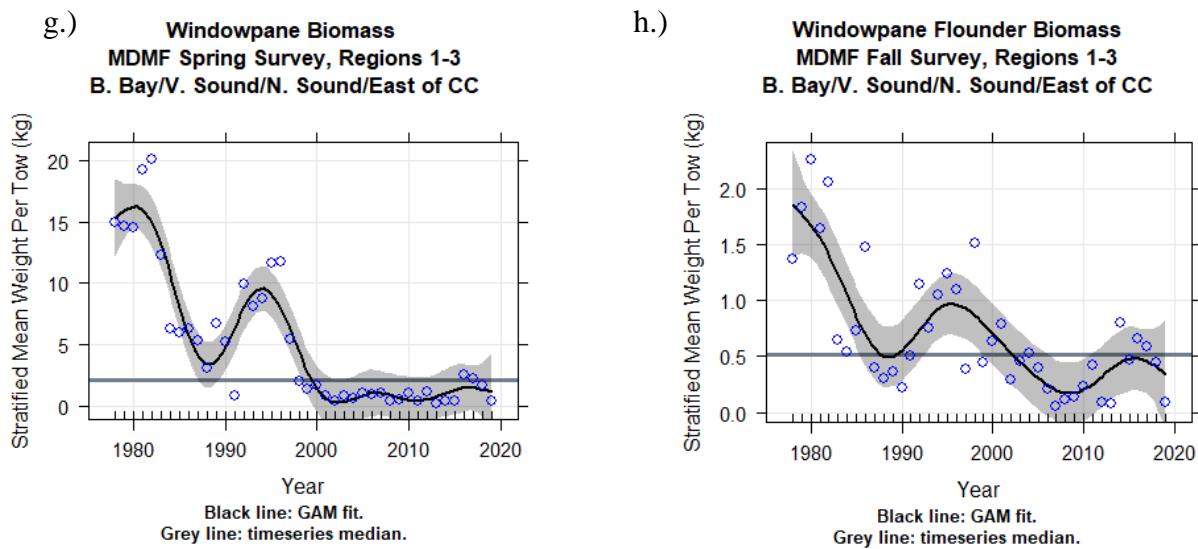


Figure 2. (i & j). Stratified mean weight per tow (kg) with GAM smoothed trend line.
1978 – 2019 Massachusetts DMF Trawl survey.

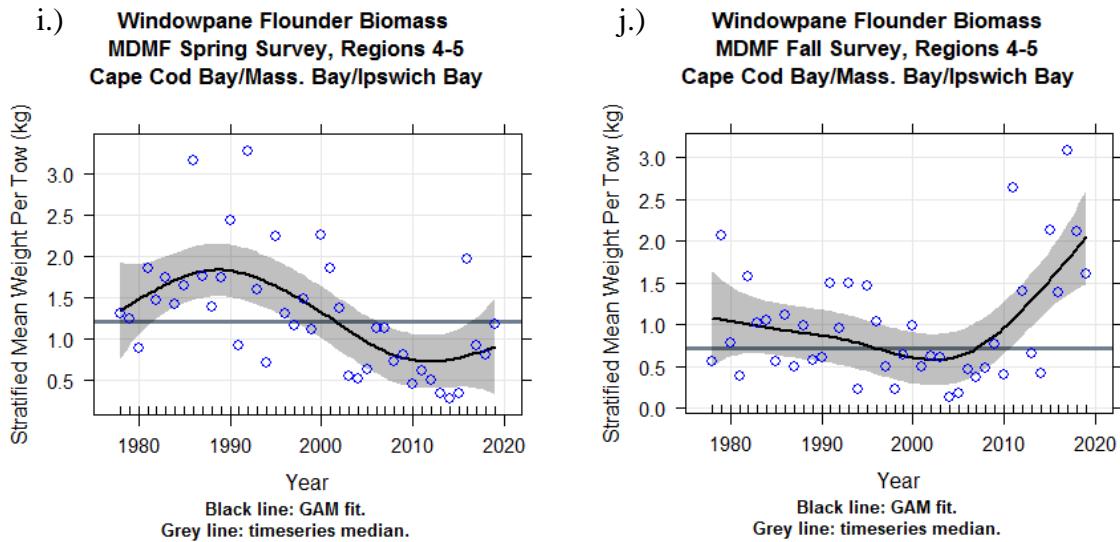


Figure 2. (k & l). Stratified mean weight per tow (kg) with GAM smoothed trend line.
1978 – 2019 Massachusetts DMF Trawl survey.

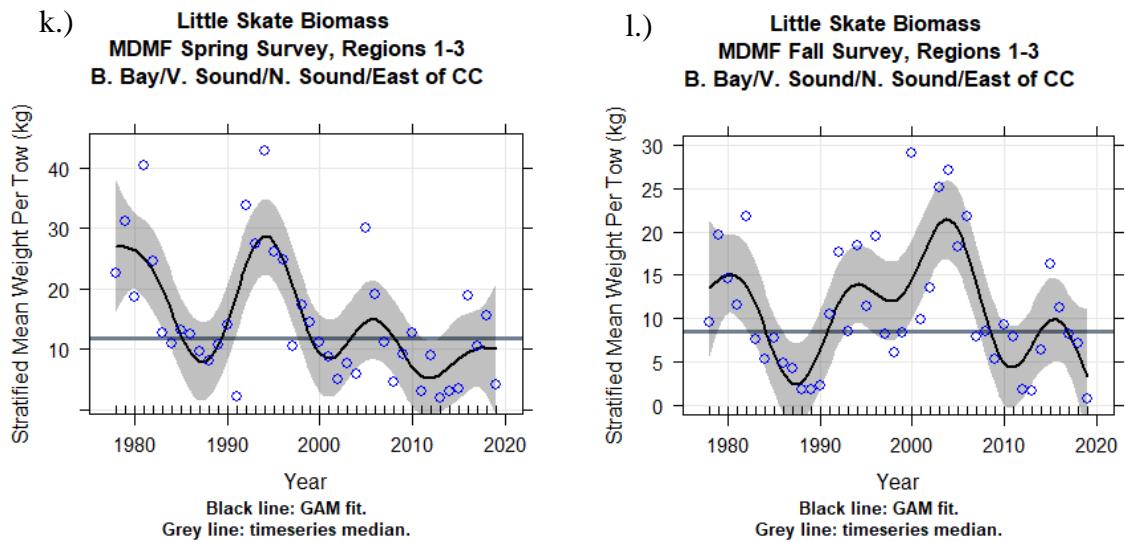


Figure 2. (m & n). Stratified mean weight per tow (kg) with GAM smoothed trend line.
1978 – 2019 Massachusetts DMF Trawl survey.

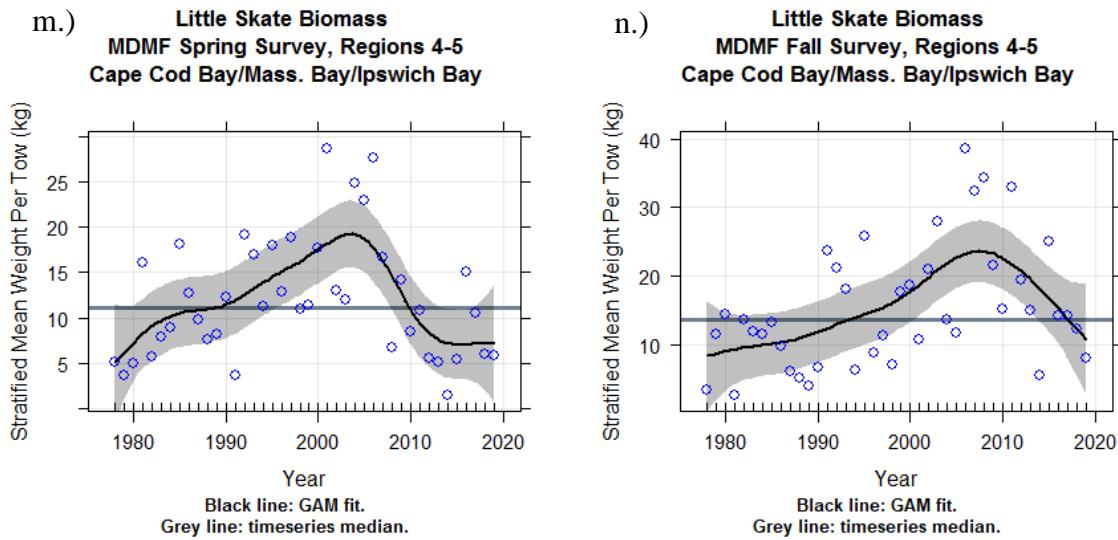


Figure 2. (o & p). Stratified mean weight per tow (kg) with GAM smoothed trend line.
1978 – 2019 Massachusetts DMF Trawl survey.

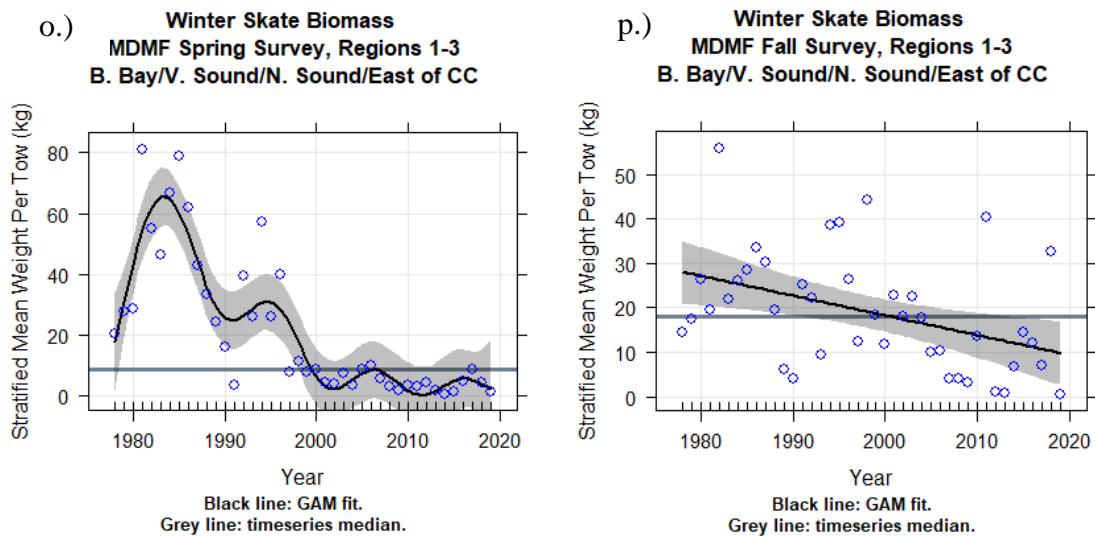


Figure 2. (q & r). Stratified mean weight per tow (kg) with GAM smoothed trend line.
1978 – 2019 Massachusetts DMF Trawl survey.

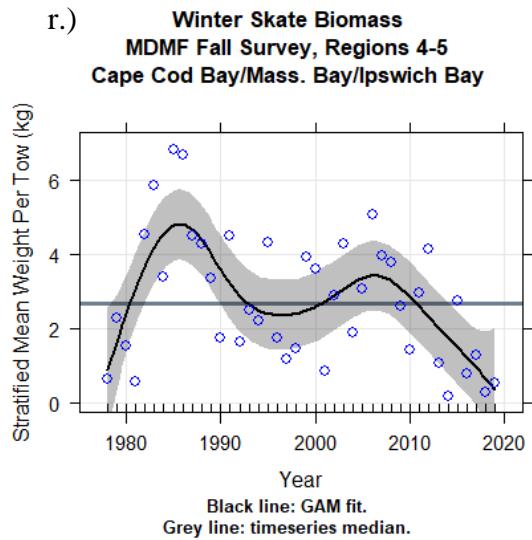
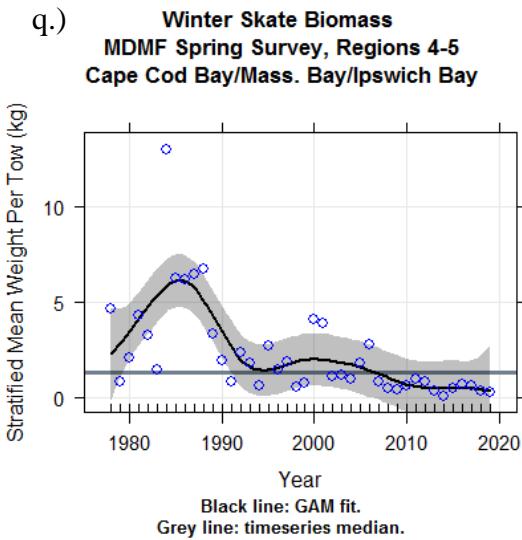


Figure 2. (s & t). Stratified mean weight per tow (kg) with GAM smoothed trend line.
1978 – 2019 Massachusetts DMF Trawl survey.

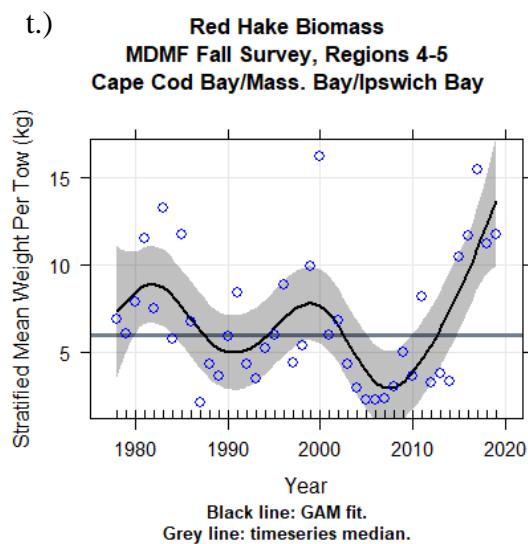
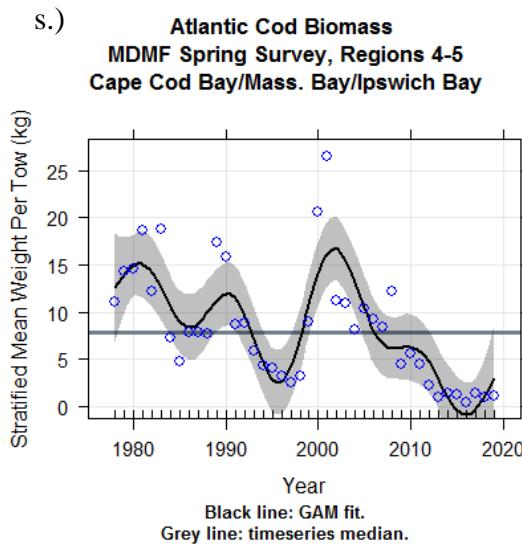


Figure 2. (u & v). Stratified mean weight per tow (kg) with GAM smoothed trend line.
1978 – 2019 Massachusetts DMF Trawl survey.

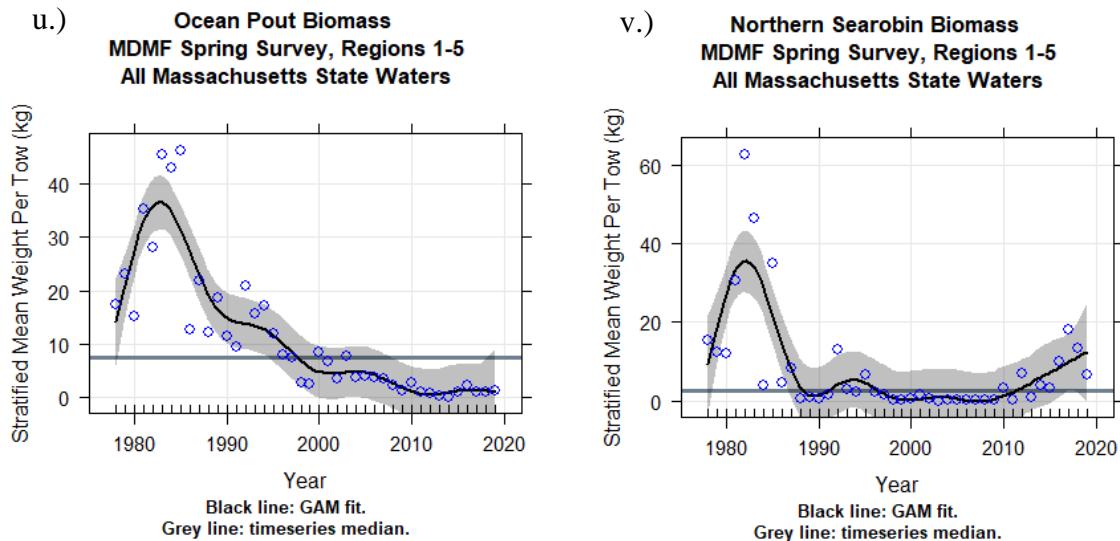


Figure 2. (w & x). Stratified mean weight per tow (kg) with GAM smoothed trend line.
1978 – 2019 Massachusetts DMF Trawl survey.

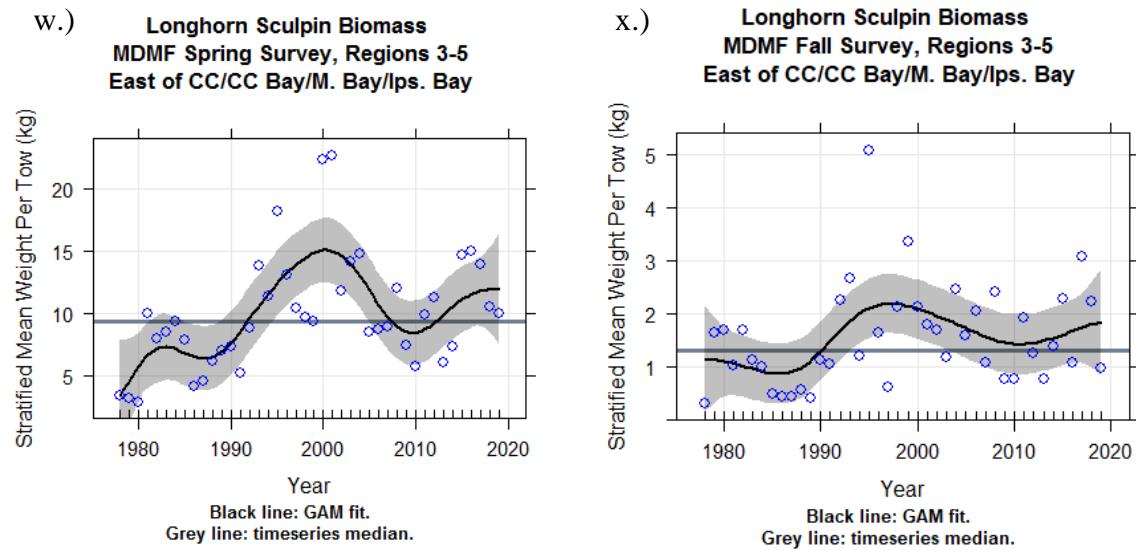


Figure 2. (y & z). Stratified mean weight per tow (kg) with GAM smoothed trend line.
1978 – 2019 Massachusetts DMF Trawl survey.

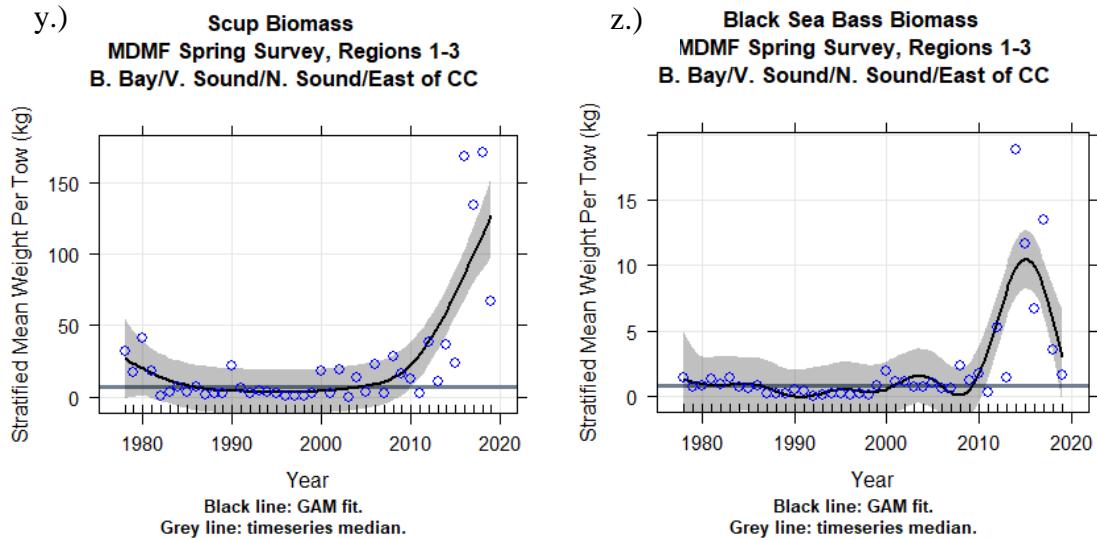


Figure 2. (aa & bb). Stratified mean weight per tow (kg) with GAM smoothed trend line.
1978 – 2019 Massachusetts DMF Trawl survey.

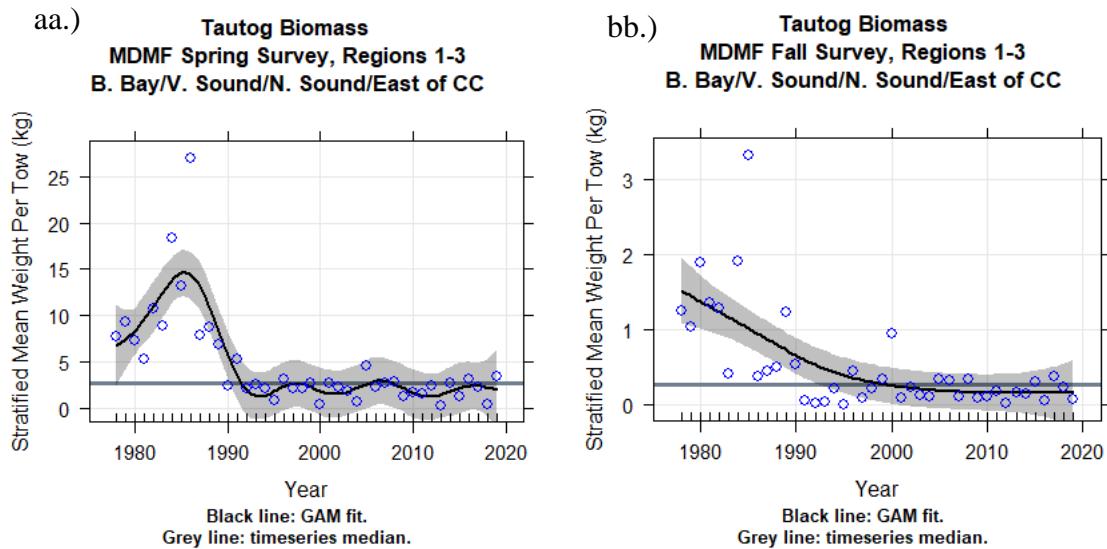


Figure 2. (cc & dd). Stratified mean weight per tow (kg) with GAM smoothed trend line.
1978 – 2019 Massachusetts DMF Trawl survey.

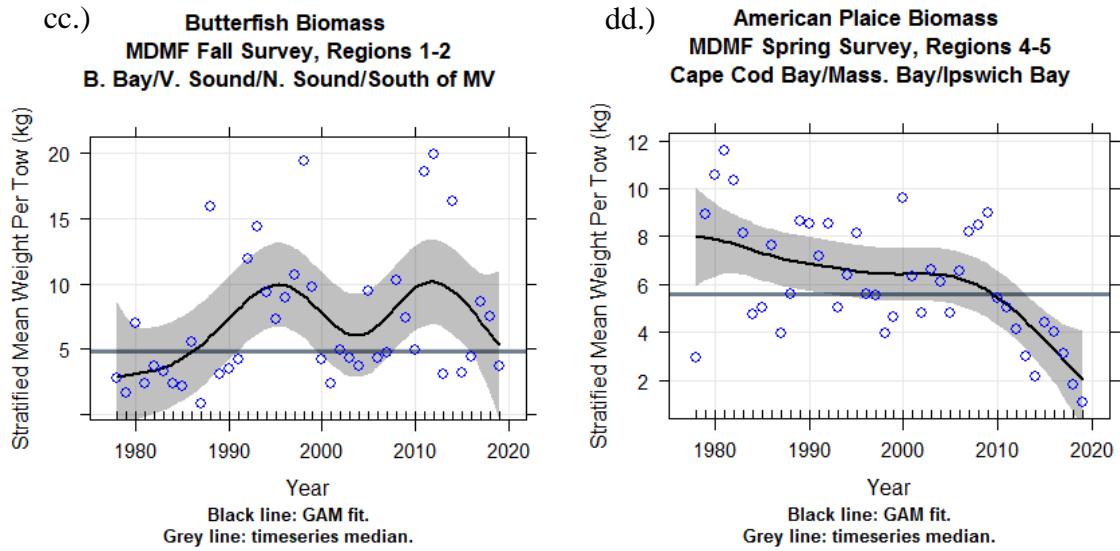


Figure 2. (ee & ff). Stratified mean weight per tow (kg) with GAM smoothed trend line.
1978 – 2019 Massachusetts DMF Trawl survey.

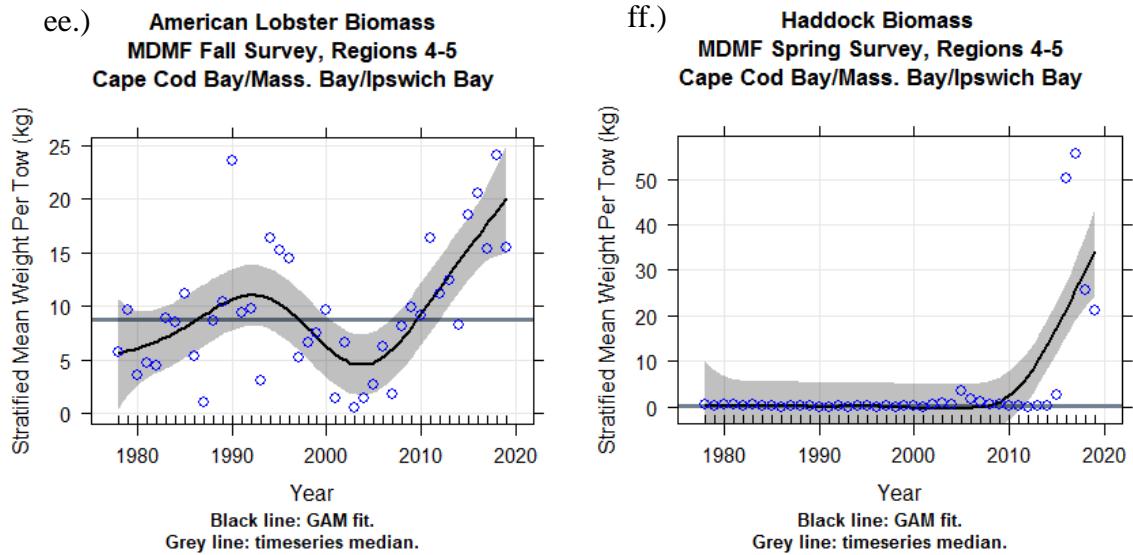


Figure 3. (a & b). Stratified mean number per tow with GAM smoothed trend line.
1978 – 2019 Massachusetts DMF Trawl survey.

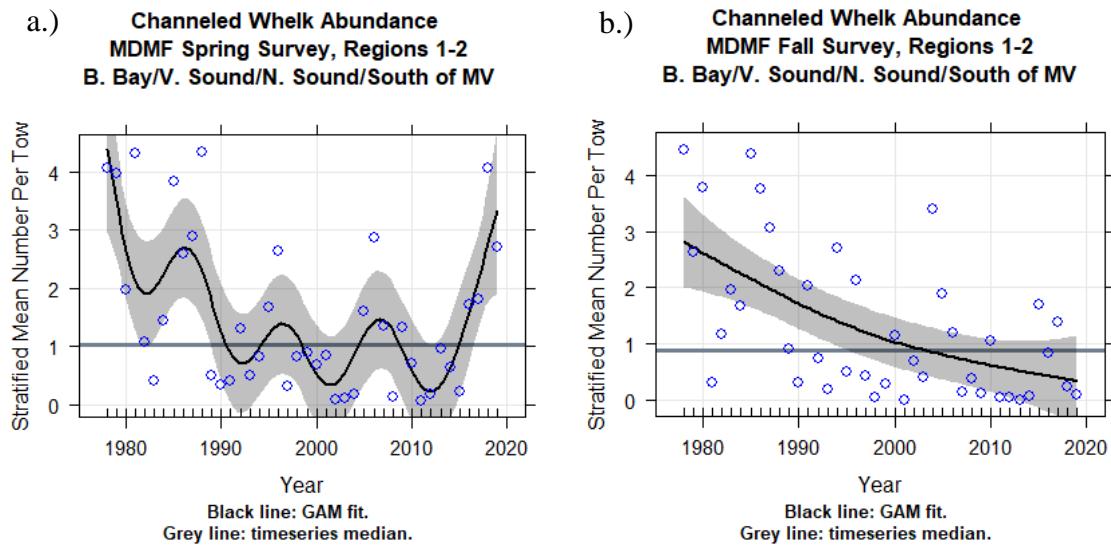


Figure 3. (c & d). Stratified mean number per tow with GAM smoothed trend line.
1978 – 2019 Massachusetts DMF Trawl survey.

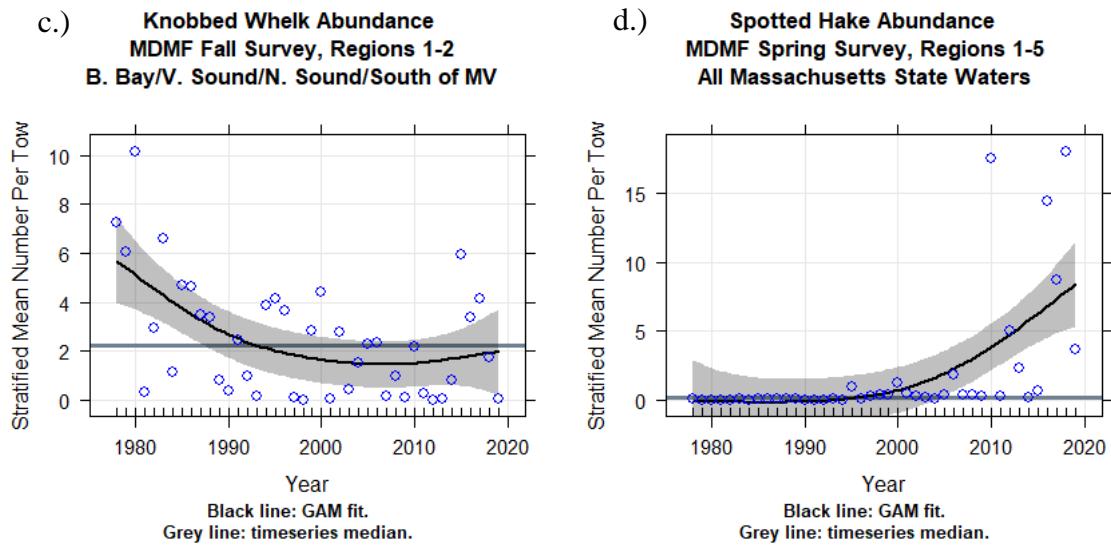
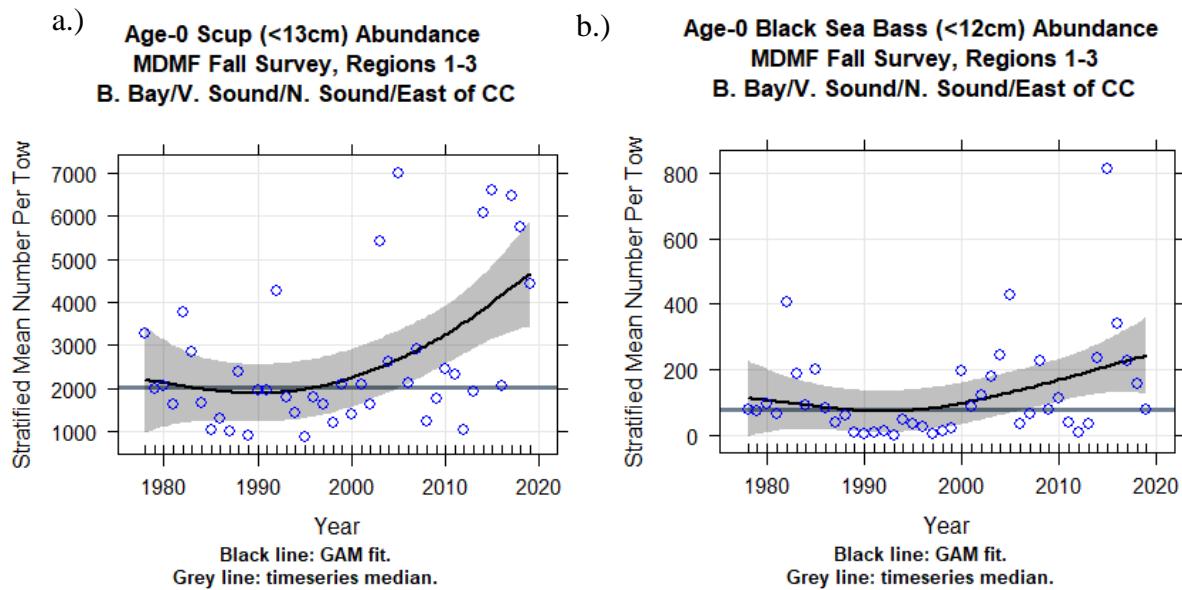


Figure 4. (a & b). Pre-recruit stratified mean number per tow with GAM smoothed trend line.
1978 – 2019 Massachusetts DMF Trawl survey.



Appendix B.

Trends in Observed Bottom Temperatures

Massachusetts Bottom Trawl Survey.

1978 – 2019

A timeseries analysis of bottom temperatures recorded during spring and fall bottom trawl surveys is updated here to include 2019 observations. 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 as long as 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 where large dogfish catches frequently result in hauls of less than 13 minutes duration. 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.

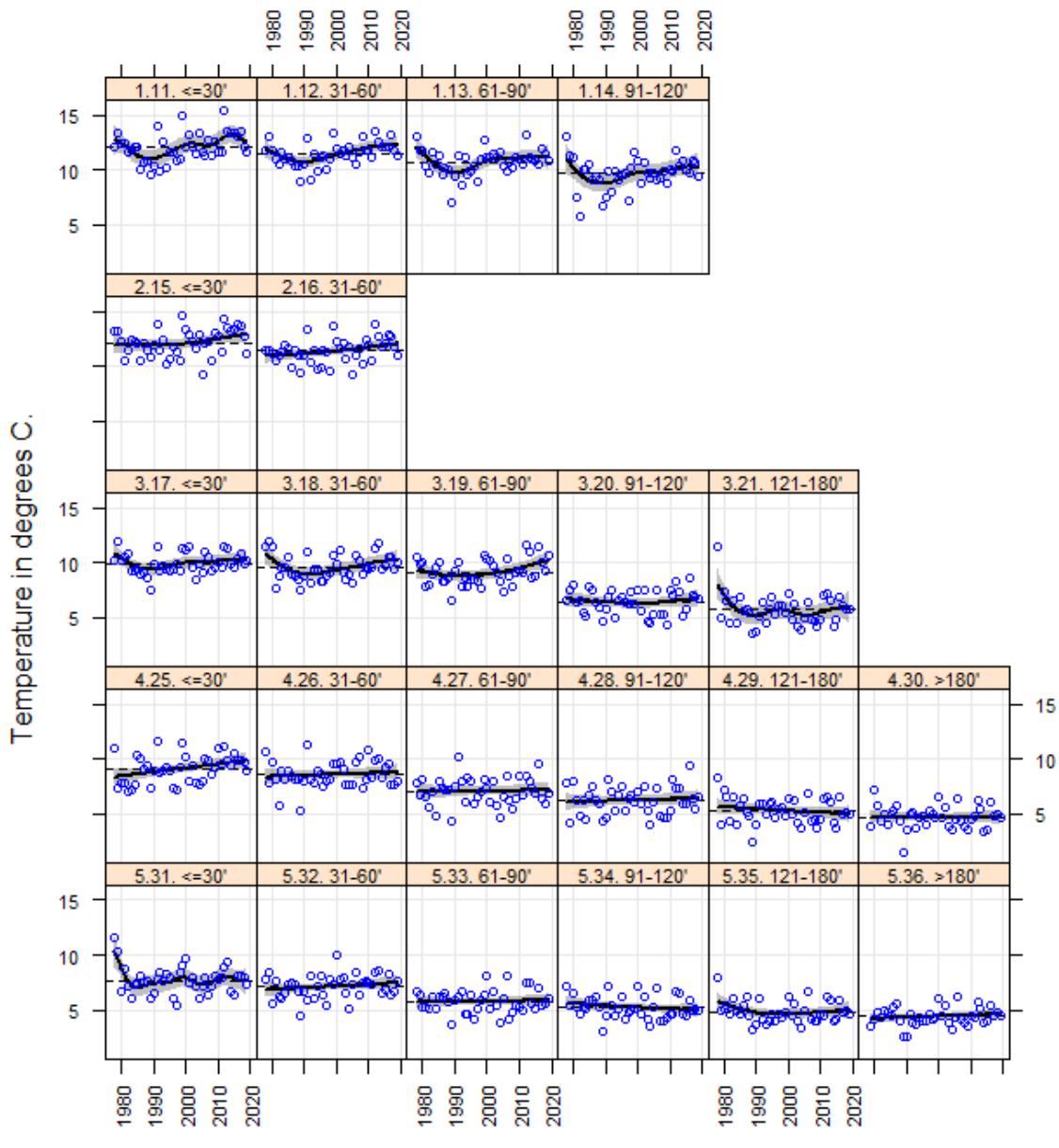
Year	Region 1				Region 2		Region 3					Region 4					Region 5						
	11	12	13	14	15	16	17	18	19	20	21	25	26	27	28	29	30	31	32	33	34	35	36
1978	12.1	11.8	13.1	13.0	13.2	11.5	10.3	11.5	10.5	6.5	11.5	11.1	10.7	7.8	7.8	8.2	N/A	11.7	7.8	6.8	7.2	7.9	N/A
1979	13.3	13.1	11.8	11.3	13.3	11.5	12.0	11.9	9.9	7.5	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
Median	12.1	11.5	10.9	9.8	12.2	11.5	9.9	9.4	9.1	6.5	5.7	9.2	8.2	7.0	6.2	5.1	4.7	7.7	7.3	5.7	5.1	4.7	4.4
Mean	12.1	11.5	10.8	9.7	12.2	11.4	9.9	9.6	9.2	6.4	5.7	9.1	8.6	7.0	6.2	5.3	4.7	7.7	7.1	5.8	5.3	4.9	4.4
Maximum	15.4	13.5	13.2	13.0	14.6	13.8	12.0	11.9	11.6	8.7	11.5	11.6	11.3	10.2	9.4	8.2	7.2	11.7	10.0	8.1	7.2	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 1. Stratum mean bottom temperatures recorded on the MDMF spring survey, 1978 – 2019.

Year	Region 1				Region 2		Region 3					Region 4					Region 5						
	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	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
Median	19.0	18.7	17.6	16.5	19.6	19.5	16.3	16.2	14.8	9.5	8.5	16.2	13.0	10.1	9.2	8.5	7.9	14.2	12.0	10.5	9.5	8.4	7.8
Mean	18.9	18.7	17.6	16.5	19.5	19.4	16.2	15.8	14.8	9.8	8.4	15.9	13.5	10.7	9.6	8.3	7.7	14.2	12.6	10.7	9.3	8.3	7.8
Maximum	21.5	20.7	19.9	19.0	21.7	21.3	18.7	18.4	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

Table 2. Stratum mean bottom temperatures recorded on the MDMF fall survey, 1978 – 2019.

Stratum Mean Bottom Water Temperature Observations
MDMF Spring Survey, 1978-2019



Panel label: Region, stratum, depth (ft).
 Solid line: GAM fit.
 Dashed line: timeseries mean.

Figure 1.

**Stratified Mean Bottom Temperature by Region.
MDMF Spring Trawl Survey, 1978 - 2019.**

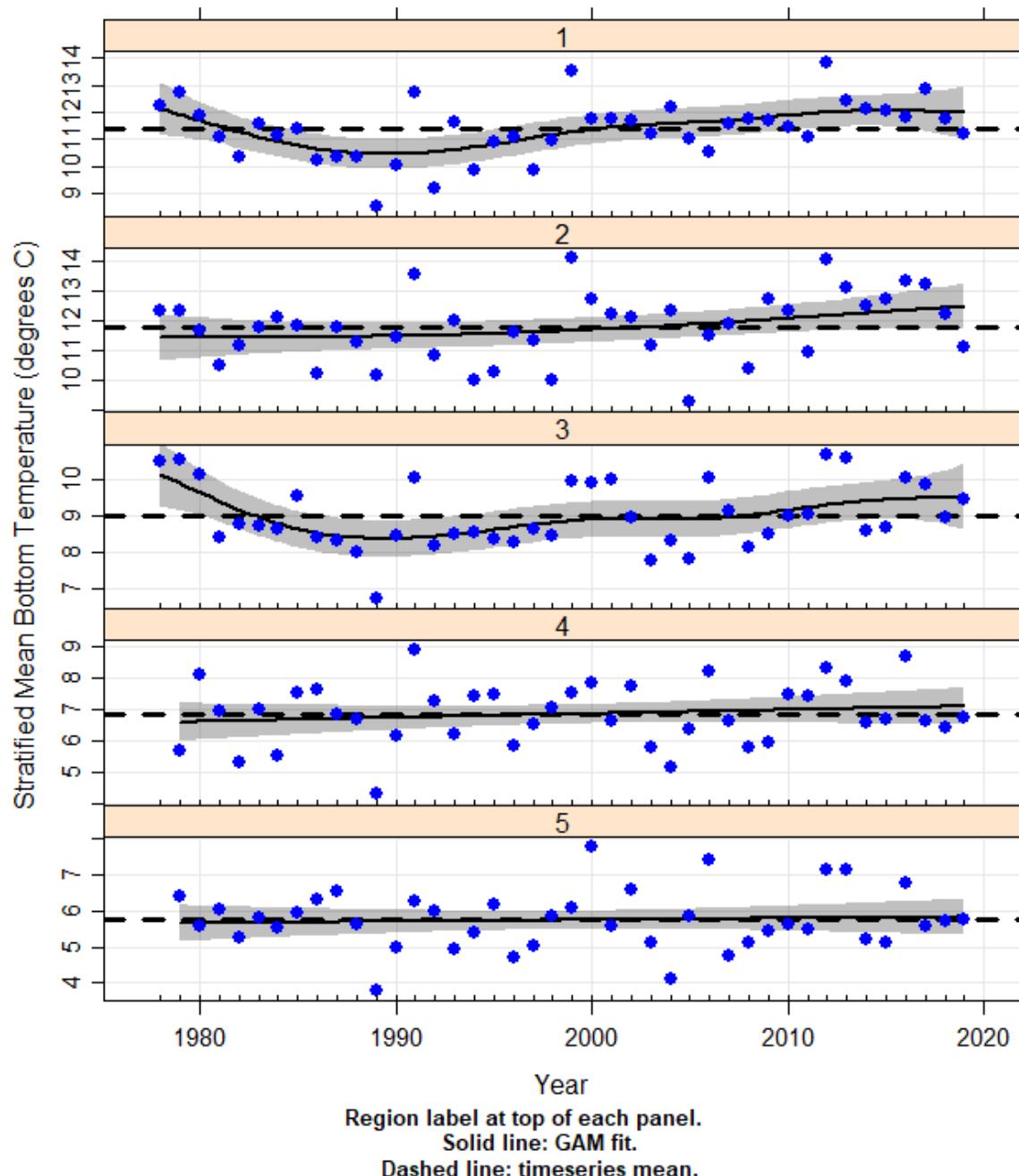


Figure 2.

Stratum Mean Bottom Water Temperature Observations
MDMF Fall Survey, 1978-2019

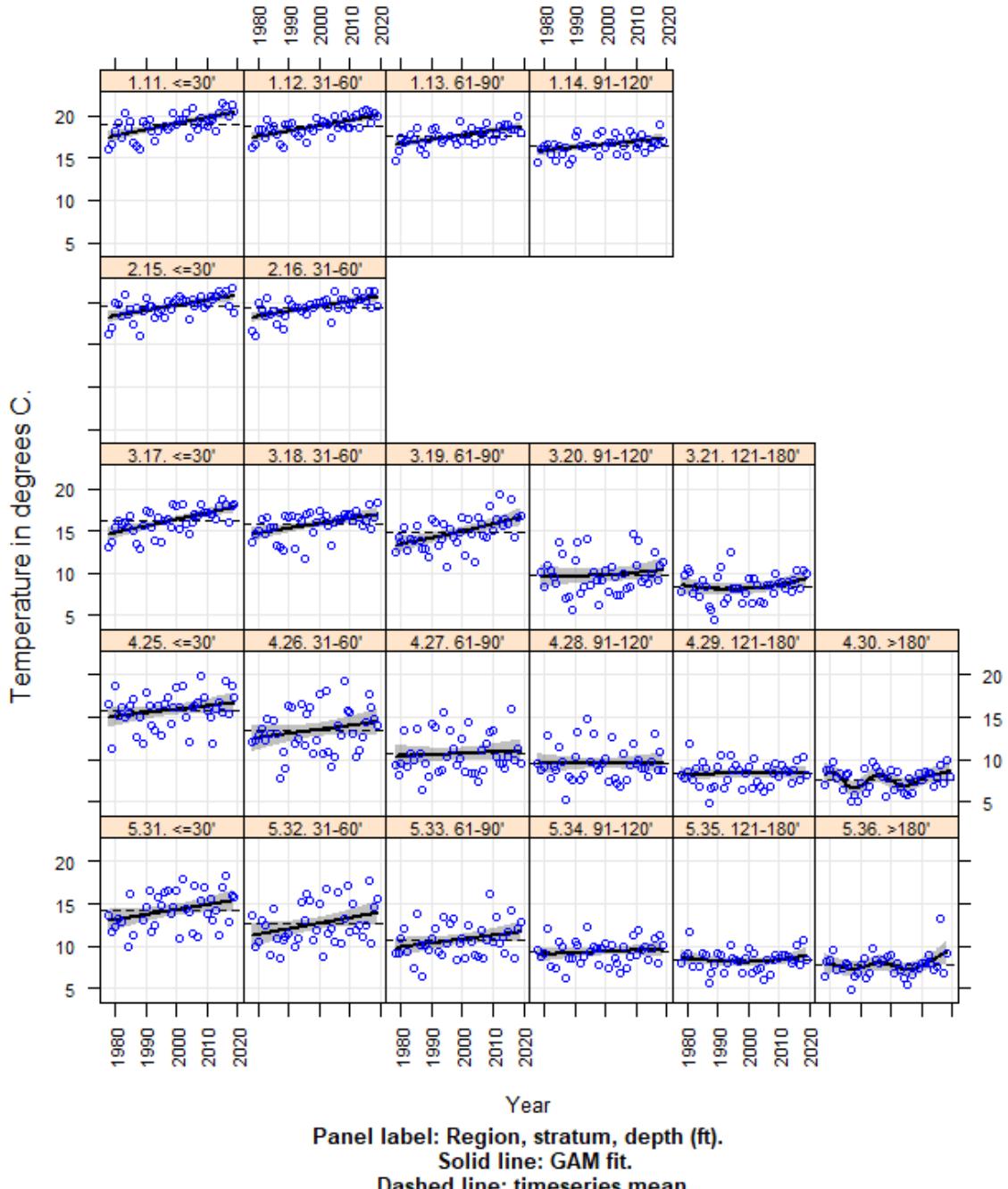


Figure 3.

**Stratified Mean Bottom Temperature by Region.
MDMF FALL Trawl Survey, 1978 - 2019.**

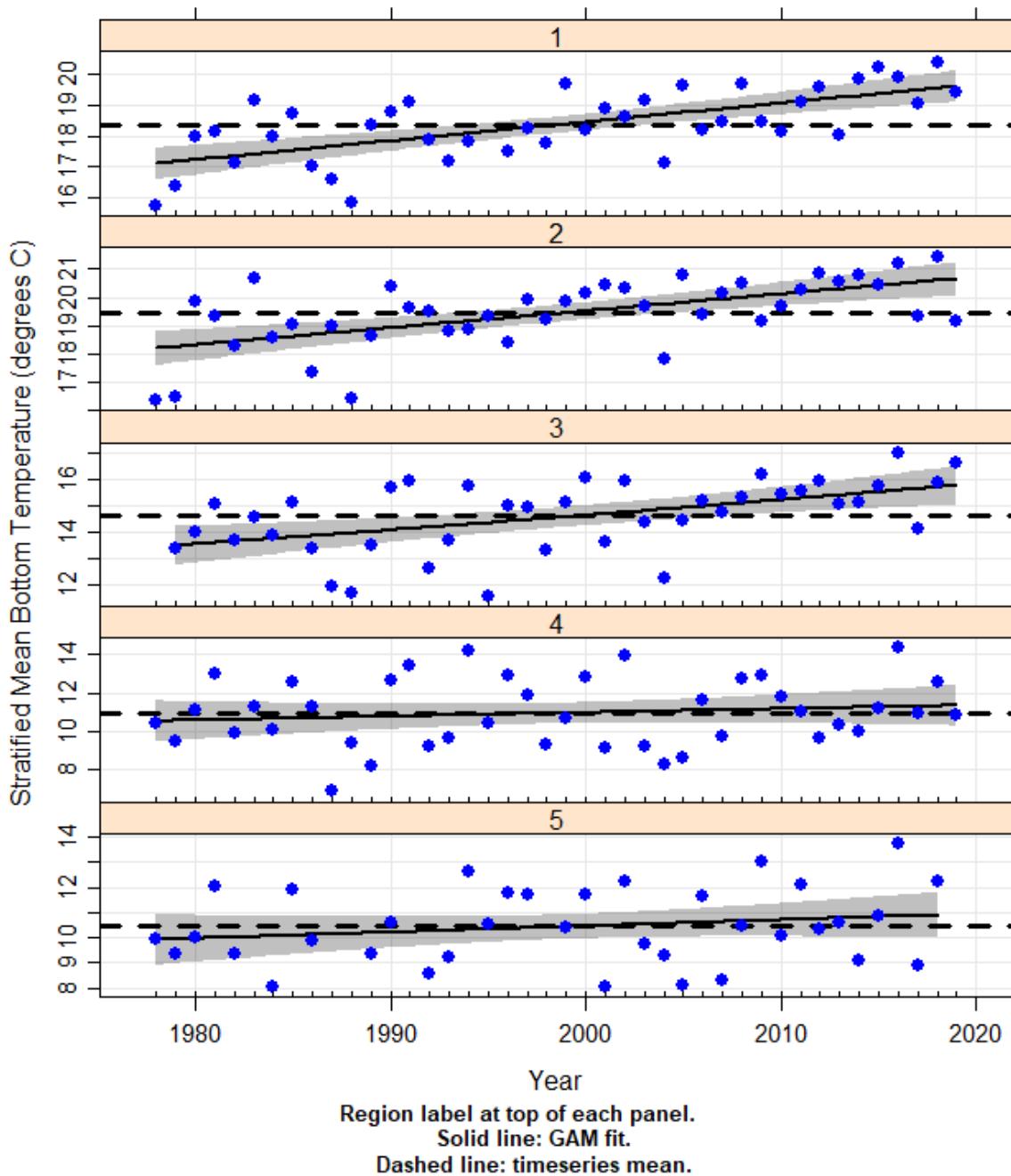


Figure 4.

Appendix C: Corrections to the trawl survey database in 2019

Miscellaneous database correction (cowfish)

Completed 2/26/2019 Camisa

Changes to UNION_FSCS_SVCAT

CRUISE6	STATION	SVSPP	DB READS		DB SHOULD READ		
			EXPCATCHNUM	EXPCATCHWT	SVSPP	EXPCATCHNUM	EXPCATCHWT
200792	92	978	1	0	839	1	0

Changes to UNION_FSCS_SVLEN

CRUISE6	STATION	SVSPP	DB READS		DB SHOULD READ		
			LENGTH	EXPNUMLEN	SVSPP	LENGTH	EXPNUMLEN
200792	92	978	2	1	839	2	1

Miscellaneous database corrections in UNION_FSCS_SVSTA

Completed 3/18/2019 Szymanski

DESSPEED updated to 2.5 at 66 stations in 198392