

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



2015 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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Period Covered: January 1, 2015 – December 31, 2015

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Date Submitted:

Sport Fish Program
Massachusetts Fishery Resource Assessment: F-56-R-24
2015 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 thirty-eighth annual spring and fall bottom trawl surveys of Massachusetts territorial waters in 2015. 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 fortieth 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 2015 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 - 2015.

[Appendix C:](#) Corrections to the trawl survey database in 2015.

CRUISE RESULTS

R/V GLORIA MICHELLE

2015 Massachusetts Inshore Spring
Bottom Trawl Survey
Cruise No. 201591

CRUISE PERIOD AND AREA

From May 4 through May 22, 2015 the Massachusetts Division of Marine Fisheries conducted its 38th 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. 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 Computer Tidbit™ attached to the net's headrope.

Sixteen MADMF employees participated in the survey as part of the scientific party, joined by two fisheries professionals from the National Marine Fisheries Service, one coastal scientist from US EPA, one graduate student from the School for Marine Science and Technology, and the Commissioner of the Massachusetts Department of Fish and Game (Table 1).

CRUISE SUMMARY

105 stations were attempted in 18 sampling days (Figs 1 and 2, Table 2). Ninety-nine completed stations are considered acceptable for assessment of all species, SHG ≤ 136 (Table 3). One day was lost for vessel repairs. Four station assignments were not completed with acceptable trawl hauls. A hang at station 102 resulted in an abort and lost station in stratum 11. Increasing tidal current in Muskeget Channel precluded another attempt. Logistics, and interest in returning to port in daylight before navigational conditions degraded, resulted in a dropped station in stratum 25. A rapid deterioration in weather and sea state in Ipswich bay led to the abandonment of one station each in strata 32 and 34. No sub-standard (SHG between 141 and 166) tows were accepted (Table 4). Six attempted tows were aborted due to bottom hangs, abandoned/lost fishing gear, and sea state (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).

The two largest survey catches of sand lance ever were recorded east of Cape Cod, as was the largest catch of longhorn sculpin. Relatively large catches of juvenile haddock and yellowtail flounder were counted in Massachusetts Bay and near Cape Ann. A large catch of spider crabs was recorded in Nantucket Sound West of Monomoy Island and a moderate amount of mud tubes were encountered at one station South of Martha's Vineyard.

Additional sampling goals were achieved (Table 7). To aid cooperative fisheries assessments, over 1,400 scale/otolith/operculum samples, as well as sex and maturity observations, were taken from Atlantic cod, haddock, summer flounder, yellowtail flounder, winter flounder, windowpane flounder, black sea bass, scup, northern searobin, tautog, American lobster and jonah crabs. Additional samples were collected to assist ongoing research by fisheries scientists from MADMF and other labs in the region.

For further information on this survey or others in the time series, contact Matthew Camisa at (508) 990-2860 ext. 139.

Table 1. MADMF SpringCruise 2015 Staffing List**Scientific Party**

Name	Affiliation	Num. Days
Matthew Camisa	MA DMF	11
Jeremy King	MA DMF	10
Vincent Manfredi	MA DMF	10
Mark Szymanski	MA DMF	9
Brad Schondelmeier	MA DMF	7
Ross Kessler	MA DMF	5
Mike Bednarski	MA DMF	5
Collin Farrell	MA DMF	5
Nick Buchan	MA DMF	4
Mark Rousseau	MA DMF	2
Chrissy Petitpas	MA DMF	1
David Chosid	MA DMF	1
Elise Koob	MA DMF	1
Kim Trull	MA DMF	1
Scott Elzey	MA DMF	1
Story Reed	MA DMF	1
Eric Nelson	EPA - Boston	1
George Peterson	MA Fish and Game	1
Eric Robillard	NMFS - WH	1
Paul Nitschke	NMFS - WH	1
Jana delFavero	SMAST	1

R/V Gloria Michelle Crew

Name	Affiliation	Num. Days
<i>Officers</i>		
Doug Pawlishen	NOAA OIC	18
Andrew Reynaga	NOAA JOIC	18
<i>Deck Crew</i>		
George Morton	Contract Fisherman	18
Peter Plantamura	NMFS - Sandy Hook	11
Harvey Walsh	NMFS - Narragansett	7

Table 2. Station Information for the 2015 Massachusetts Spring Inshore Bottom Trawl Survey - Cruise No. 201591.

STATION	STRATUM	DATE	TIME	DEPTH (M)	LATITUDE	LONG.	COURSE	DIST (N MI)	BOT TEMP °C
1	28	5/4/2015	7:03	33	41°54.13	-70°26.05	156	0.81	6.1
2	28	5/4/2015	8:34	35	41°54.17	-70°23.15	324	0.82	5.9
3	29	5/4/2015	10:20	46	41°59.00	-70°25.13	317	0.83	3.4
4	28	5/4/2015	12:24	37	41°58.44	-70°30.76	152	0.82	4.1
5	25	5/4/2015	14:19	10	41°58.19	-70°36.18	196	0.83	7.7
6	27	5/4/2015	16:45	23	41°51.47	-70°27.89	207	0.83	6.2
7	29	5/5/2015	8:00	44	42°03.52	-70°30.04	4	0.82	3.7
8	27	5/5/2015	9:33	25	42°05.93	-70°34.78	114	0.65	4.6
9	32	5/5/2015	11:57	14	42°13.71	-70°44.18	339	0.68	6.6
10	34	5/5/2015	13:25	37	42°18.53	-70°44.17	304	0.01	N/A
11	33	5/5/2015	15:12	23	42°18.77	-70°47.76	331	0.39	5.8
12	33	5/5/2015	16:20	22	42°18.52	-70°48.19	239	0.54	6.1
13	32	5/5/2015	17:13	11	42°17.57	-70°51.54	60	0.82	7.2
14	31	5/6/2015	6:14	8	42°17.40	-70°51.81	139	0.81	7.8
15	34	5/6/2015	7:55	33	42°23.63	-70°49.39	154	0.81	4.5
16	33	5/6/2015	9:15	23	42°23.55	-70°54.47	68	0.83	4.6
17	34	5/6/2015	10:34	30	42°26.43	-70°52.07	91	0.61	4.5
18	35	5/6/2015	12:14	40	42°27.24	-70°49.18	216	0.5	4.4
19	35	5/6/2015	15:05	57	42°29.78	-70°42.43	134	0.54	4.1
20	35	5/6/2015	16:12	55	42°31.18	-70°40.63	182	0.83	4.1
21	35	5/7/2015	6:02	40	42°35.75	-70°35.67	242	0.59	4.1
22	35	5/7/2015	7:47	49	42°36.53	-70°33.63	25	0.84	4.1
23	36	5/7/2015	9:14	71	42°38.02	-70°31.61	46	0.81	4.1
24	34	5/7/2015	11:18	30	42°42.69	-70°41.16	69	0.84	4.5
25	33	5/7/2015	12:28	28	42°43.34	-70°43.00	136	0.85	4.8
26	31	5/7/2015	13:43	11	42°43.03	-70°45.30	120	0.83	5.6
27	31	5/7/2015	14:58	11	42°40.88	-70°42.00	107	0.85	5.9
28	33	5/8/2015	8:08	22	42°46.72	-70°46.10	2	0.65	4.8
29	32	5/8/2015	9:23	14	42°49.57	-70°47.71	355	0.44	7.5
30	36	5/9/2015	7:18	75	42°25.27	-70°39.10	29	0.52	4.0
31	29	5/9/2015	10:42	54	42°06.45	-70°27.38	330	0.81	3.7
32	30	5/9/2015	12:34	58	42°04.37	-70°20.84	118	0.83	3.4
33	29	5/9/2015	13:59	52	42°02.42	-70°25.81	64	0.84	3.6
34	26	5/10/2015	5:47	17	41°46.41	-70°26.21	287	0.83	9.1
35	27	5/10/2015	7:08	22	41°47.57	-70°19.75	242	0.82	6.8
36	27	5/10/2015	8:59	20	41°53.77	-70°10.04	230	0.84	8.5
37	26	5/10/2015	10:00	9	41°53.84	-70°07.58	213	0.84	11.4
38	25	5/10/2015	10:57	8	41°50.66	-70°09.51	29	0.82	10.9
39	26	5/10/2015	12:09	16	41°50.70	-70°11.58	208	0.83	9.2
40	26	5/10/2015	13:57	19	41°46.46	-70°20.17	255	0.81	8.0
41	26	5/10/2015	15:31	21	41°49.21	-70°28.82	178	0.82	8.8
42	30	5/11/2015	6:44	64	42°06.29	-70°18.08	208	0.83	3.8
43	21	5/11/2015	8:03	61	42°07.14	-70°13.12	265	0.56	3.8
44	20	5/11/2015	9:08	31	42°06.08	-70°08.99	273	0.2	5.0
45	20	5/11/2015	9:57	37	42°06.33	-70°09.24	280	0.8	4.6
46	18	5/11/2015	11:35	11	42°04.50	-70°06.06	130	0.52	7.3
47	17	5/11/2015	13:36	10	42°03.97	-70°05.31	124	0.83	8.4
48	29	5/12/2015	5:58	56	42°02.06	-70°15.91	150	0.83	4.3
49	28	5/12/2015	7:29	34	41°58.15	-70°12.11	154	0.83	6.9
50	28	5/12/2015	8:32	31	41°56.59	-70°11.37	170	0.84	6.9
51	27	5/12/2015	9:38	24	41°58.10	-70°08.17	203	0.82	8.1
52	25	5/12/2015	11:12	8	41°57.87	-70°05.58	191	0.83	12.8
53	19	5/13/2015	7:55	26	41°49.34	-69°54.20	329	0.79	7.2
54	21	5/13/2015	9:00	42	41°49.07	-69°52.34	351	0.78	5.9
55	20	5/13/2015	10:13	33	41°45.91	-69°52.03	357	0.81	6.9
56	18	5/13/2015	12:10	15	41°38.70	-69°53.78	201	0.78	8.9
57	17	5/13/2015	14:12	8	41°36.18	-69°56.22	221	0.8	9.1
58	16	5/14/2015	6:22	14	41°26.81	-70°03.55	265	0.86	9.9
59	18	5/14/2015	7:32	18	41°26.42	-70°01.62	148	0.54	9.7

Table 2 continued.

STATION	STRATUM	DATE	TIME	DEPTH (M)	LATITUDE	LONG.	COURSE	DIST (N MI)	BOT TEMP °C
60	17	5/14/2015	8:38	10	41°27.75	-70°00.57	359	0.83	9.3
61	17	5/14/2015	10:06	9	41°23.81	-69°59.19	50	0.83	10.4
62	17	5/14/2015	11:00	9	41°21.99	-69°59.12	342	0.85	10.4
63	16	5/14/2015	12:57	11	41°28.18	-70°08.17	105	0.83	9.7
64	16	5/15/2015	7:04	12	41°29.50	-70°24.27	320	0.6	13.1
65	15	5/15/2015	7:59	8	41°28.59	-70°22.75	347	0.76	13.0
66	15	5/15/2015	9:36	10	41°34.81	-70°22.33	345	0.81	14.4
67	15	5/15/2015	11:52	10	41°31.88	-70°17.61	25	0.84	12.8
68	15	5/15/2015	12:56	7	41°31.76	-70°20.67	121	0.82	13.1
69	15	5/15/2015	14:40	8	41°36.44	-70°12.62	229	0.53	13.5
70	15	5/15/2015	16:17	7	41°36.76	-70°01.79	260	0.81	14.2
71	16	5/16/2015	5:59	14	41°21.96	-70°05.87	200	0.81	12.1
72	16	5/16/2015	7:00	14	41°22.38	-70°03.48	204	0.83	11.8
73	16	5/16/2015	8:02	17	41°23.95	-70°03.85	211	0.84	11.6
74	15	5/16/2015	10:02	9	41°32.96	-70°04.42	208	0.82	12.9
75	16	5/16/2015	11:14	11	41°33.61	-70°06.23	195	0.82	12.7
76	16	5/16/2015	12:47	11	41°27.36	-70°10.22	125	0.82	11.0
77	15	5/16/2015	13:46	10	41°24.73	-70°09.95	101	0.85	10.8
78	15	5/16/2015	14:51	9	41°23.19	-70°13.55	84	0.86	12.8
79	16	5/16/2015	15:52	14	41°22.56	-70°11.35	188	0.84	12.7
80	18	5/17/2015	9:03	13	41°16.27	-70°19.14	289	0.78	10.7
81	19	5/17/2015	10:08	20	41°14.40	-70°15.93	305	0.81	10.5
82	18	5/17/2015	11:37	14	41°14.18	-70°10.01	82	0.76	11.8
83	11	5/17/2015	14:34	9	41°18.78	-70°30.02	51	0.81	12.4
84	12	5/17/2015	15:40	12	41°19.35	-70°29.69	63	0.82	12.7
85	12	5/17/2015	16:46	17	41°19.11	-70°33.67	69	0.81	12.2
86	13	5/17/2015	18:02	23	41°18.30	-70°39.03	78	0.79	10.3
87	13	5/18/2015	5:21	22	41°17.33	-70°44.38	36	0.82	10.4
88	13	5/18/2015	6:34	22	41°17.12	-70°44.45	34	0.81	10.4
89	12	5/20/2015	5:39	14	41°33.16	-70°42.64	148	0.82	12.4
90	12	5/20/2015	6:54	13	41°34.81	-70°42.09	341	0.57	12.6
91	11	5/20/2015	7:54	9	41°38.71	-70°44.10	215	0.83	13.9
92	11	5/20/2015	9:25	9	41°40.92	-70°41.69	203	0.57	15.5
93	12	5/20/2015	11:14	17	41°31.24	-70°49.30	48	0.83	11.6
94	13	5/20/2015	12:27	23	41°29.50	-70°54.31	70	0.83	11.4
95	12	5/20/2015	13:46	13	41°29.03	-70°48.94	34	0.83	11.9
96	12	5/20/2015	14:56	14	41°31.05	-70°46.42	64	0.81	11.9
97	13	5/21/2015	6:37	26	41°22.06	-70°50.30	73	0.84	11.8
98	13	5/21/2015	7:57	27	41°21.80	-70°52.48	231	0.82	10.3
99	14	5/21/2015	9:10	32	41°20.10	-70°54.70	127	0.53	9.2
100	14	5/21/2015	10:41	32	41°24.49	-70°59.94	192	0.54	10.9
101	11	5/21/2015	12:11	8	41°30.08	-71°03.81	158	0.79	11.8
102	11	5/22/2015	7:46	9	41°23.77	-70°25.73	194	0.52	14.0
103	16	5/22/2015	9:37	18	41°27.08	-70°26.35	240	0.56	13.9
104	15	5/22/2015	11:29	11	41°32.36	-70°30.18	253	0.73	15.6
105	16	5/22/2015	12:30	14	41°32.35	-70°31.30	241	0.63	15.4

Table 3. Sampling Effort Assigned and Accomplished by Stratum, Cruise 201591.

Stratum	Region	Assigned Stations	Number of Stations Completed			Aborted Tows
			All Accepted Tows	Sub-Standard	Standard	
11	1	5	4		4	1
12	1	7	7		7	
13	1	5	5		5	1
14	1	2	2		2	
15	2	10	10		10	
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	1
21	3	2	2		2	
25	4	4	3		3	
26	4	5	5		5	
27	4	5	5		5	
28	4	5	5		5	
29	4	5	5		5	
30	4	2	2		2	
31	5	3	3		3	
32	5	3	2		2	1
33	5	4	4		4	1
34	5	4	3		3	1
35	5	5	5		5	
36	5	2	2		2	
TOTALS		103	99	0	99	6

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 201591.
 Not Advised for Indices of Abundance other than Spiny Dogfish.

Station	Stratum	SHG Location	Description
No sub-standard tows on cruise 201591.			

Table 5. Attempted Tows Aborted During Cruise 201591.

Station	Stratum	SHG Location	Description
10	34	179	Hung down. Hauled back early.
11	33	176	Old heavy line and gear hung on bridle. Slowed. H
29	32	177	Hauled back early. Sea state impacts fishing oper:
44	20	176	Lobster trawl intercepted. Hauled back early.
87	13	176	Pile of ghost lobster gear intercepted.
102	11	179	Hung down. Net damaged

Table 6a. Total Catch Numbers and Weights Observed on the 2015
 Massachusetts Spring Inshore Bottom Trawl Survey - Cruise 201591- Sorted by Number

SPP CODE	COMMON NAME	COUNT	WEIGHT(kg)
181	NORTHERN SAND LANCE	200,563	1,510.169
163	LONGHORN SCULPIN	6,661	1,149.672
106	WINTER FLOUNDER	4,804	610.314
143	SCUP	3,948	1,044.361
105	YELLOWTAIL FLOUNDER	3,206	713.584
503	LONGFIN SQUID	2,307	63.100
317	SPIDER CRAB UNCL	2,234	255.117
72	SILVER HAKE	2,054	208.022
102	AMERICAN PLAICE	1,702	194.137
313	ATLANTIC ROCK CRAB	1,552	198.442
171	NORTHERN SEAROBIN	1,513	322.865
141	BLACK SEA BASS	844	509.567
301	AMERICAN LOBSTER	808	251.906
26	LITTLE SKATE	741	431.459
33	ALEWIFE	642	21.314
77	RED HAKE	562	50.782
193	OCEAN POUT	547	101.100
73	ATLANTIC COD	513	60.903
74	HADDOCK	499	128.977
322	LADY CRAB	403	32.643
32	ATLANTIC HERRING	336	10.833
108	WINDOWPANE	194	37.753
15	SPINY DOGFISH	139	348.951
131	BUTTERFISH	137	10.083
75	POLLOCK	123	0.161
23	WINTER SKATE	121	94.400
312	JONAH CRAB	115	18.481
103	SUMMER FLOUNDER	107	64.601
104	FOURSPOT FLOUNDER	92	19.218
155	ACADIAN REDFISH	86	10.582
34	BLUEBACK HERRING	78	1.728
348	NORTHERN MOONSNAIL	74	5.933
177	TAUTOG	73	57.137
78	SPOTTED HAKE	65	1.164
35	AMERICAN SHAD	65	1.750
401	SEA SCALLOP	54	17.889
172	STRIPED SEAROBIN	34	17.994
164	SEA RAVEN	31	21.174
318	HORSESHOE CRAB	30	14.499
121	ATLANTIC MACKEREL	27	7.162
176	CUNNER	24	1.413
76	WHITE HAKE	23	1.561
183	DAUBED SHANNY	20	0.127

Table 6a continued.

SPP CODE	COMMON NAME	COUNT	WEIGHT(kg)
182	SNAKEBLenny	15	0.453
45	RAINBOW SMELT	14	0.134
13	SMOOTH DOGFISH	14	40.550
116	NORTHERN PIPEFISH	13	0.021
336	CHANNELED WHELK	9	1.074
180	ROCK GUNNEL	6	0.048
117	SMALLMOUTH FLOUNDER	5	0.056
107	WITCH FLOUNDER	4	0.189
166	GRUBBY	4	0.055
337	KNOBBED WHELK	2	0.862
113	ATLANTIC SILVERSIDE	2	0.015
197	GOOSEFISH	2	0.239
28	THORNY SKATE	1	0.121
185	OYSTER TOADFISH	1	0.299
83	FOURBEARD ROCKLING	1	0.006
192	ATLANTIC WOLFFISH	1	10.440
139	STRIPED BASS	1	0.361
409	OCEAN QUAHOG	1	0.328
165	ALLIGATORFISH	1	0.004
168	LUMPFISH	1	0.006
323	MANTIS SHRIMP UNCL	1	0.048
520	LONGFIN SQUID EGG MOPS		6.513
Totals		238,250	8,684.850

Table 6b. Total Catch Numbers and Weights Observed on the 2015
 Massachusetts Spring Inshore Bottom Trawl Survey - Cruise 201591- Sorted byWeight

SPP CODE	COMMON NAME	COUNT	WEIGHT(kg)
181	NORTHERN SAND LANCE	200,563	1,510.169
163	LONGHORN SCULPIN	6,661	1,149.672
143	SCUP	3,948	1,044.361
105	YELLOWTAIL FLOUNDER	3,206	713.584
106	WINTER FLOUNDER	4,804	610.314
141	BLACK SEA BASS	844	509.567
26	LITTLE SKATE	741	431.459
15	SPINY DOGFISH	139	348.951
171	NORTHERN SEAROBIN	1,513	322.865
317	SPIDER CRAB UNCL	2,234	255.117
301	AMERICAN LOBSTER	808	251.906
72	SILVER HAKE	2,054	208.022
313	ATLANTIC ROCK CRAB	1,552	198.442
102	AMERICAN PLAICE	1,702	194.137
74	HADDOCK	499	128.977
193	OCEAN POUT	547	101.100
23	WINTER SKATE	121	94.400
103	SUMMER FLOUNDER	107	64.601
503	LONGFIN SQUID	2,307	63.100
73	ATLANTIC COD	513	60.903
177	TAUTOG	73	57.137
77	RED HAKE	562	50.782
13	SMOOTH DOGFISH	14	40.550
108	WINDOWPANE	194	37.753
322	LADY CRAB	403	32.643
33	ALEWIFE	642	21.314
164	SEA RAVEN	31	21.174
104	FOURSPOT FLOUNDER	92	19.218
312	JONAH CRAB	115	18.481
172	STRIPED SEAROBIN	34	17.994
401	SEA SCALLOP	54	17.889
318	HORSESHOE CRAB	30	14.499
32	ATLANTIC HERRING	336	10.833
155	ACADIAN REDFISH	86	10.582
192	ATLANTIC WOLFFISH	1	10.440
131	BUTTERFISH	137	10.083
121	ATLANTIC MACKEREL	27	7.162
520	LONGFIN SQUID EGG MOPS	0	6.513
348	NORTHERN MOONSNAIL	74	5.933
35	AMERICAN SHAD	65	1.750
34	BLUEBACK HERRING	78	1.728
76	WHITE HAKE	23	1.561
176	CUNNER	24	1.413

Table 6b continued.

SPP CODE	COMMON NAME	COUNT	WEIGHT(kg)
78	SPOTTED HAKE	65	1.164
336	CHANNELED WHELK	9	1.074
337	KNOBBED WHELK	2	0.862
182	SNAKEBLenny	15	0.453
139	STRIPED BASS	1	0.361
409	OCEAN QUAHOG	1	0.328
185	OYSTER TOADFISH	1	0.299
197	GOOSEFISH	2	0.239
107	WITCH FLOUNDER	4	0.189
75	POLLOCK	123	0.161
45	RAINBOW SMELT	14	0.134
183	DAUBED SHANNY	20	0.127
28	THORNY SKATE	1	0.121
117	SMALLMOUTH FLOUNDER	5	0.056
166	GRUBBY	4	0.055
323	MANTIS SHRIMP UNCL	1	0.048
180	ROCK GUNNEL	6	0.048
116	NORTHERN PIPEFISH	13	0.021
113	ATLANTIC SILVERSIDE	2	0.015
168	LUMPFISH	1	0.006
83	FOURBEARD ROCKLING	1	0.006
165	ALLIGATORFISH	1	0.004
Totals		238,250	8,684.850

Table 7. Number of individuals obtained for age, growth, maturity and special studies during Massachusetts DMF Cruise 201591.

Species	Maturity Observation	Age and Growth Collection			YOY
		Scales	Otoliths	Opercula	
Atlantic Cod	54		54		
Haddock	77		77		
American Plaice	15				
Summer Flounder	75	75			
Yellowtail Flounder	249	249			
Winter Flounder	548		548		
Windowpane Flounder	105	105	105		
Black Sea Bass	121	121			
Scup	159	159			
Northern Searobin	15	15			
Tautog	34			34	
American Lobster	14				
Jonah crab (Female)	16				
TOTAL	1,482	724	784	34	0

OTHER COLLECTIONS:

Both summer flounder and yellowtail flounder were separated by sex at all stations.

Livers and hearts of winter flounder (437) and yellowtail flounder (203) were examined for ichthyophonous (Correia).

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

641 river herring for age and growth study (Armstrong).

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

162 YOY and age-1 Atlantic cod for a climate change study (Golet).

Otolith and fin-ray samples of Atlantic cod for genetics and morphometrics study (Kerr).

Various species saved for outreach and training programs (DMF).

1 fish saved for ID (Manfredi).

Figure 1.

Massachusetts Division of Marine Fisheries Inshore Bottom Trawl Survey

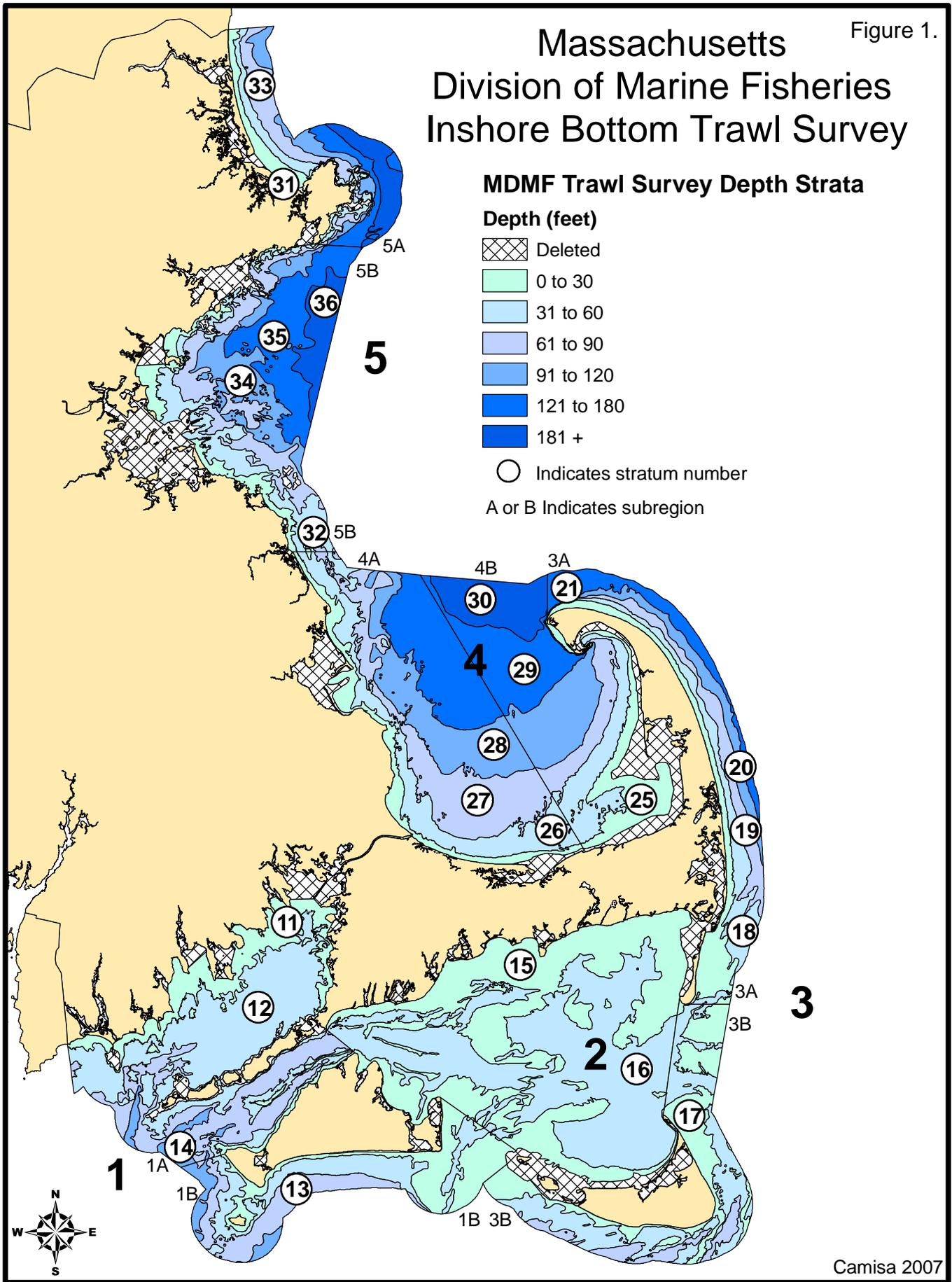


Figure 2.

Spring 2015 Mass Division of Marine Fisheries Bottom Trawl Survey Tow Locations

- 201591 Proposed Tow Circles (1.5nm)
 - 201591 Completed Tow Tracks
 - ✖ 201591 Aborted Tows
- Data label indicates day of month (May)

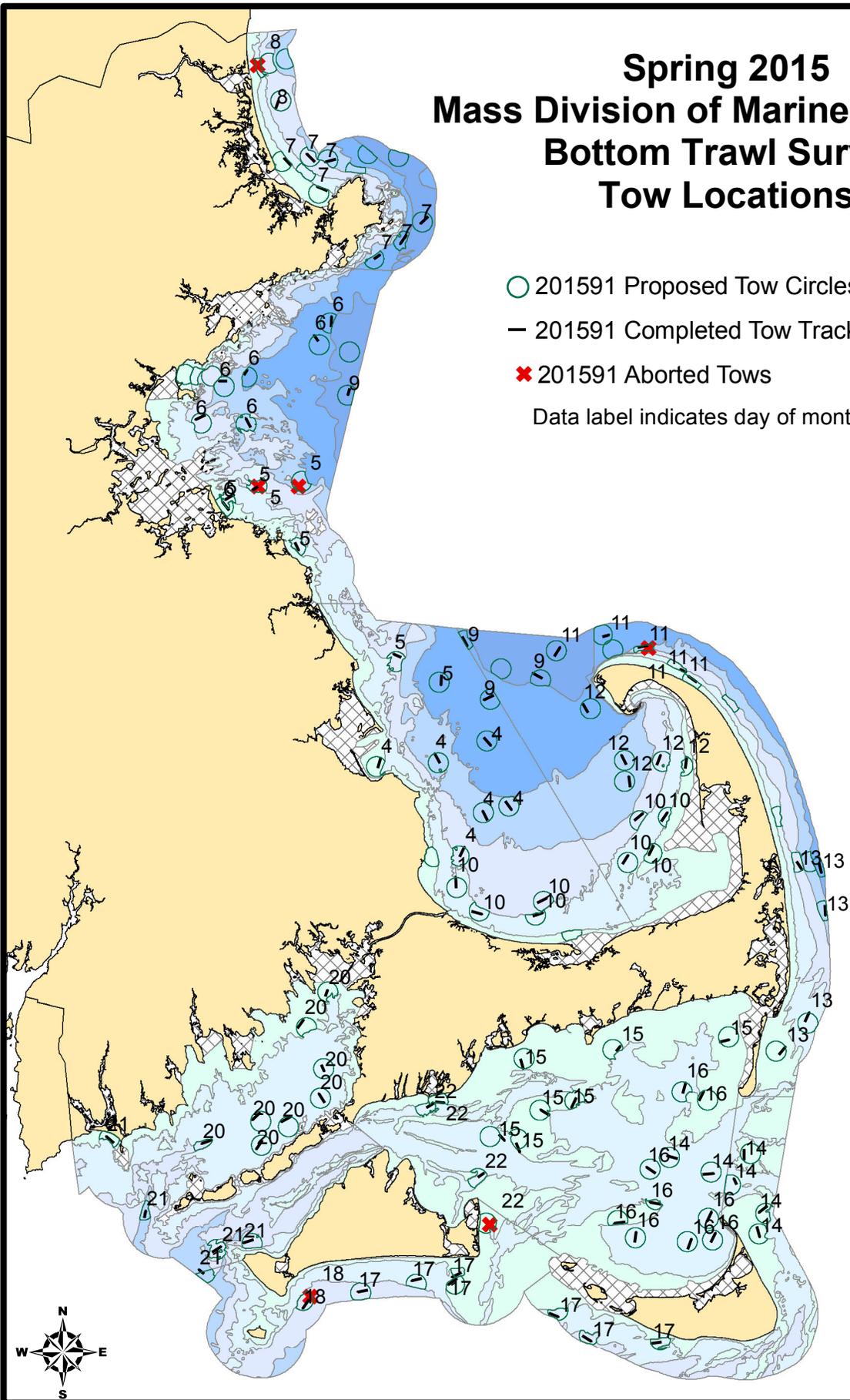


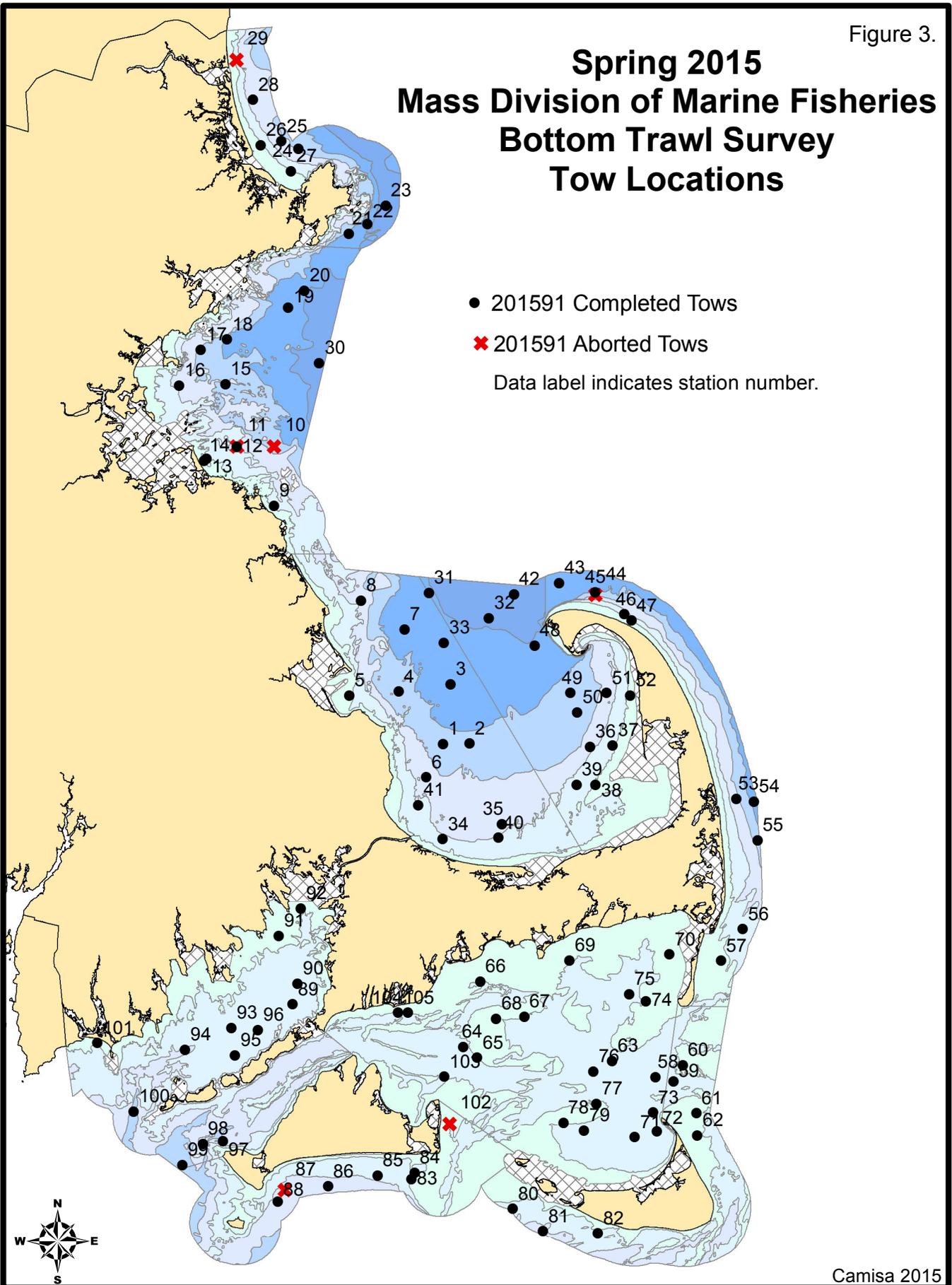
Figure 3.

Spring 2015 Mass Division of Marine Fisheries Bottom Trawl Survey Tow Locations

● 201591 Completed Tows

✖ 201591 Aborted Tows

Data label indicates station number.



CRUISE RESULTS

R/V GLORIA MICHELLE

2015 Massachusetts Inshore Fall
Bottom Trawl Survey
Cruise No. 201592

CRUISE PERIOD AND AREA

From September 8 through September 24, 2015 the Massachusetts Division of Marine Fisheries conducted its 38th 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 Computer Tidbit™ attached to the net's headrope.

Twenty-four MADMF employees participated in the survey as part of the scientific party, joined by two fisheries professionals from the National Marine Fisheries Service, and one coastal scientist from US EPA (Table 1).

CRUISE SUMMARY

103 stations were attempted in 16 sampling days (Figs 1 and 2, Table 2). Ninety-four completed stations are considered acceptable for assessment of all species, SHG ≤ 136 (Table 3). One day was lost due to weather. Nine station assignments were not completed with acceptable trawl hauls. Fixed gear at station 17 resulted in an abort and lost station in stratum 32. One station in stratum 34 was lost due to time constraints from the weather day. A hang at station 23 resulted in an abort and lost station in stratum 35. Two additional stations were lost in stratum 35 due to an abundance of fixed gear in our proposed circles. A large catch of weed at station 44 resulted in an abort and lost station in stratum 25 and the alternate could not be completed due to fixed gear. A hang at station 62 resulted in an abort and lost station in stratum 18. Two stations were lost in stratum 16 due to sand waves and inconsistencies between navigational charts and actual sounder observations. One sub-standard (SHG between 141 and 166) tow was accepted (Table 4). Eight attempted tows were aborted due to bottom hangs, fixed gear, weed, and sea state (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). The largest survey catch of YOY black sea bass ever was recorded west of Monomoy and the largest fall survey catches of red hake and American shad were recorded at the same station north of Provincetown. Small monkfish were counted at several stations north and east of Cape Cod and relatively large catches of winter and little skate were taken East of Cape Cod and Nantucket. Inshore lizardfish and snakefish were counted at several stations south of the Cape. Blotched swimming crabs were recorded for the first time on the survey at two stations in Nantucket Sound.

Additional sampling goals were achieved (Table 7). To aid cooperative fisheries assessments, over 1,450 scale/otolith/operculum samples, as well as sex and maturity observations, were taken from Atlantic cod, haddock, summer flounder, yellowtail flounder, winter flounder, windowpane flounder, black sea bass, scup, weakfish, tautog, American lobster and Jonah crabs. Additional samples were collected to assist ongoing research by fisheries scientists from MADMF and other labs in the region.

For further information on this survey or others in the time series, contact Matthew Camisa at (508) 990-2860 ext. 139.

Table 1. MADMF Fall Cruise 2015 Staffing List**Scientific Party**

Name	Affiliation	Num. Days
Vincent Manfredi	MA DMF	10
Matthew Camisa	MA DMF	9
Mark Szymanski	MA DMF	8
Nick Buchan	MA DMF	8
Steve Voss	MA DMF	6
Brad Schondelmeier	MA DMF	5
Collin Farrell	MA DMF	5
Elise Koob	MA DMF	4
John Logan	MA DMF	4
Mark Rousseau	MA DMF	4
Ross Kessler	MA DMF	4
Bob Glenn	MA DMF	2
Kim Trull	MA DMF	2
Matt Best	MA DMF	2
Chrissy Petitpas	MA DMF	1
Gabe Lundgren	MA DMF	1
Jared Silva	MA DMF	1
Jill Carr	MA DMF	1
Julia Livemore	MA DMF	1
Kate Ostrikis	MA DMF	1
Melissa Campbell	MA DMF	1
Scott Elzey	MA DMF	1
Theresa Burnham	MA DMF	1
Wendy Mainardi	MA DMF	1
Eric Nelson	EPA - Boston	1
Eric Robillard	NMFS - WH	1
Rob Johnston	NMFS - WH	1

R/V Gloria Michelle Crew

Name	Affiliation	Num. Days
<i>Officers</i>		
Doug Pawlishen	NOAA OIC	17
Andrew Reynaga	NOAA JOIC	17
<i>Deck Crew</i>		
George Morton	Contract Fisherman	17
Ryan Belcher	NOAA Officer	17

Table 2. Station Information for the 2015 Massachusetts Fall Inshore Bottom Trawl Survey - Cruise No. 201592.

STATION	STRATUM	DATE	TIME	DEPTH (M)	LATITUDE	LONG.	COURSE	DIST (N MI)	BOT TEMP °C
1	25	9/8/2015	6:27	11	41°50.44	-70°30.51	194	0.82	12.9
2	26	9/8/2015	7:54	17	41°51.30	-70°29.54	172	0.74	10.9
3	27	9/8/2015	9:44	28	41°55.38	-70°29.64	155	0.80	10.2
4	29	9/8/2015	11:31	42	41°59.60	-70°27.51	8	0.81	8.5
5	29	9/8/2015	13:32	42	41°58.37	-70°26.03	254	0.80	8.3
6	29	9/8/2015	15:11	42	41°57.64	-70°24.32	255	0.81	8.2
7	28	9/8/2015	16:37	32	41°53.35	-70°23.72	263	0.82	8.7
8	27	9/9/2015	6:24	23	41°47.57	-70°22.84	257	0.81	10.3
9	26	9/9/2015	8:01	17	41°45.44	-70°21.37	278	0.81	11.6
10	26	9/9/2015	9:36	15	41°45.30	-70°19.09	249	0.82	12.4
11	25	9/9/2015	12:04	8	41°48.93	-70°03.03	232	0.61	20.9
12	27	9/9/2015	14:09	22	41°50.81	-70°13.90	247	0.82	10.0
13	27	9/9/2015	15:55	23	41°49.73	-70°22.60	213	0.76	9.8
14	25	9/10/2015	8:22	12	42°08.90	-70°41.28	159	0.83	13.2
15	34	9/10/2015	11:40	38	42°18.48	-70°43.28	306	0.52	8.8
16	32	9/10/2015	13:47	17	42°17.92	-70°49.32	304	0.53	11.1
17	32	9/10/2015	14:45	11	42°17.49	-70°51.63	56	0.46	13.1
18	33	9/12/2015	6:45	22	42°23.76	-70°54.72	108	0.83	11.8
19	34	9/12/2015	8:43	34	42°23.53	-70°49.30	105	0.83	10.4
20	31	9/12/2015	10:32	8	42°27.16	-70°55.34	118	0.67	18.2
21	33	9/12/2015	12:12	24	42°27.00	-70°53.30	104	0.82	12.1
22	35	9/12/2015	14:58	55	42°27.27	-70°42.73	312	0.60	8.6
23	35	9/12/2015	16:08	59	42°28.94	-70°41.83	323	0.20	N/A
24	36	9/13/2015	7:27	63	42°37.46	-70°32.17	196	0.30	N/A
25	36	9/13/2015	8:57	83	42°39.67	-70°31.24	162	0.57	8.2
26	34	9/13/2015	11:48	36	42°43.47	-70°40.29	99	0.64	9.9
27	33	9/13/2015	12:57	27	42°43.29	-70°42.95	136	0.81	11.0
28	32	9/13/2015	14:30	16	42°42.27	-70°43.41	134	0.82	13.9
29	31	9/13/2015	15:18	9	42°41.40	-70°43.24	144	0.78	15.0
30	31	9/13/2015	16:34	8	42°42.70	-70°45.08	297	0.52	17.4
31	33	9/13/2015	17:31	23	42°45.12	-70°44.51	146	0.52	11.7
32	35	9/14/2015	6:22	54	42°31.23	-70°40.41	187	0.82	8.1
33	35	9/14/2015	7:08	57	42°30.59	-70°40.61	21	0.82	8.1
34	36	9/14/2015	8:26	75	42°29.38	-70°37.39	341	0.51	7.5
35	36	9/14/2015	10:25	77	42°29.06	-70°37.52	2	0.49	7.2
36	30	9/14/2015	14:51	60	42°05.78	-70°23.27	204	0.80	7.7
37	28	9/15/2015	7:21	33	41°54.64	-70°20.50	341	0.58	9.5
38	28	9/15/2015	8:29	28	41°52.23	-70°17.91	340	0.81	10.0
39	28	9/15/2015	9:49	30	41°53.48	-70°13.44	336	0.81	10.1
40	27	9/15/2015	11:07	24	41°51.45	-70°13.17	37	0.52	11.4
41	26	9/15/2015	12:15	14	41°51.72	-70°09.71	29	0.81	18.4
42	28	9/15/2015	13:40	31	41°54.83	-70°11.54	231	0.83	10.4
43	26	9/15/2015	15:53	12	41°54.63	-70°07.45	204	0.50	19.2
44	25	9/15/2015	17:35	8	41°57.93	-70°05.55	347	0.35	N/A
45	29	9/16/2015	6:19	41	41°58.46	-70°17.74	69	0.81	9.4
46	29	9/16/2015	7:41	48	42°01.06	-70°18.01	160	0.82	9.1
47	30	9/16/2015	9:36	61	42°06.08	-70°18.23	39	0.82	7.8
48	21	9/16/2015	11:31	62	42°05.50	-70°14.53	56	0.82	8.3
49	21	9/16/2015	12:48	40	42°06.54	-70°09.19	270	0.81	10.0
50	20	9/16/2015	14:18	37	42°05.90	-70°06.89	272	0.52	9.6
51	20	9/16/2015	15:32	34	42°03.64	-70°01.45	328	0.09	N/A
52	17	9/17/2015	6:15	9	41°53.65	-69°57.20	342	0.83	17.5
53	19	9/17/2015	7:17	22	41°52.52	-69°55.65	347	0.47	12.4
54	20	9/17/2015	8:43	31	41°47.67	-69°52.74	356	0.82	10.3
55	18	9/17/2015	10:30	14	41°42.72	-69°53.89	186	0.53	13.7
56	19	9/17/2015	11:30	23	41°41.62	-69°51.85	10	0.56	12.6
57	18	9/17/2015	12:25	19	41°39.91	-69°53.09	35	0.60	13.9
58	17	9/17/2015	13:40	9	41°35.21	-69°56.92	24	0.76	17.2

Table 2 continued.

STATION	STRATUM	DATE	TIME	DEPTH (M)	LATITUDE	LONG.	COURSE	DIST (N MI)	BOT TEMP
									°C
59	17	9/17/2015	16:54	8	41°23.37	-70°00.59	87	0.52	19.4
60	17	9/18/2015	5:39	9	41°21.70	-69°59.86	69	0.54	19.4
61	18	9/18/2015	6:48	11	41°23.28	-69°57.86	154	0.82	16.3
62	18	9/18/2015	8:26	17	41°26.35	-70°01.57	77	0.42	17.8
63	16	9/18/2015	9:27	15	41°27.54	-70°02.95	272	0.75	16.9
64	16	9/18/2015	10:55	17	41°24.03	-70°03.77	198	0.81	20.5
65	16	9/18/2015	13:44	19	41°26.47	-70°22.47	291	0.83	21.8
66	15	9/19/2015	7:42	7	41°25.36	-70°25.78	14	0.83	22.2
67	11	9/19/2015	8:47	8	41°24.57	-70°25.48	166	0.51	22.0
68	17	9/19/2015	11:15	10	41°17.01	-70°20.96	75	0.83	19.8
69	19	9/19/2015	12:40	19	41°13.46	-70°13.34	305	0.84	19.2
70	18	9/19/2015	13:52	12	41°14.30	-70°08.54	276	0.81	20.7
71	13	9/19/2015	17:08	20	41°18.17	-70°32.96	101	0.81	18.9
72	12	9/20/2015	5:31	12	41°20.10	-70°39.85	88	0.83	20.3
73	11	9/20/2015	6:25	9	41°20.51	-70°39.45	90	0.82	20.7
74	13	9/20/2015	7:56	21	41°17.12	-70°44.44	37	0.83	18.8
75	14	9/20/2015	9:28	30	41°12.29	-70°46.86	60	0.78	16.6
76	12	9/20/2015	10:59	15	41°18.80	-70°49.54	144	0.81	20.0
77	14	9/20/2015	12:21	32	41°20.74	-70°55.50	116	0.80	15.7
78	12	9/20/2015	14:07	17	41°25.78	-71°02.65	132	0.81	19.3
79	13	9/20/2015	15:32	23	41°24.00	-70°54.17	235	0.85	18.7
80	11	9/20/2015	17:14	8	41°21.45	-70°46.35	22	0.53	20.5
81	12	9/21/2015	6:15	12	41°35.38	-70°43.62	22	0.82	22.4
82	11	9/21/2015	7:28	8	41°38.28	-70°43.49	355	0.75	22.1
83	12	9/21/2015	8:44	10	41°39.44	-70°41.56	289	0.74	21.9
84	11	9/21/2015	10:30	9	41°35.63	-70°48.48	334	0.52	22.0
85	12	9/21/2015	11:45	15	41°32.29	-70°46.17	232	0.83	21.0
86	12	9/21/2015	13:04	17	41°30.05	-70°50.59	230	0.82	20.2
87	13	9/21/2015	14:54	26	41°23.06	-70°52.41	236	0.83	16.8
88	16	9/22/2015	8:11	15	41°33.67	-70°22.00	99	0.79	22.2
89	15	9/22/2015	9:27	10	41°33.23	-70°25.19	15	0.80	21.9
90	15	9/22/2015	11:38	9	41°32.03	-70°17.53	18	0.80	21.5
91	16	9/22/2015	12:40	16	41°31.00	-70°14.72	315	0.79	20.8
92	16	9/22/2015	13:53	15	41°29.50	-70°14.51	241	0.79	20.9
93	16	9/23/2015	8:04	12	41°28.48	-70°13.25	22	0.83	20.7
94	16	9/23/2015	9:12	12	41°30.37	-70°10.10	80	0.82	17.9
95	15	9/23/2015	10:32	8	41°32.66	-70°04.48	357	0.82	17.2
96	16	9/23/2015	11:30	10	41°34.19	-70°05.39	22	0.84	19.0
97	15	9/23/2015	12:39	8	41°37.73	-70°05.77	51	0.81	20.6
98	15	9/23/2015	13:55	7	41°36.86	-70°08.79	284	0.80	20.9
99	15	9/23/2015	14:50	7	41°37.24	-70°10.49	244	0.83	21.3
100	15	9/23/2015	16:01	8	41°34.18	-70°13.09	231	0.82	21.5
101	15	9/24/2015	7:29	9	41°25.02	-70°31.07	339	0.58	20.7
102	15	9/24/2015	8:28	9	41°26.18	-70°30.34	96	0.51	20.7
103	13	9/24/2015	11:21	19	41°27.74	-70°43.42	34	0.57	21.2

Table 3. Sampling Effort Assigned and Accomplished by Stratum, Cruise 201592.

Stratum	Region	Assigned Stations	Number of Stations Completed			Aborted Tows
			All Accepted Tows	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	9		9	
17	3	5	5		5	
18	3	5	4		4	1
19	3	2	2		2	1
20	3	2	3	1	2	
21	3	2	2		2	
25	4	4	3		3	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	
32	5	3	2		2	1
33	5	4	4		4	
34	5	4	3		3	
35	5	5	2		2	2
36	5	2	2		2	2
TOTALS		103	95	1	94	8

Note:

Standard Tows. SHG <=136. Recommended for use in all indices of abundance.

Sub-Standard Tows. SHG 141 - 166. Not recommended for use in indices other than spiny dogfish.

Aborted Tows. Catch data not recommended for use.

Table 4. Sub-Standard Tows (SHG 141 - 166) Completed on Cruise 201592.
 Not Advised for Indices of Abundance other than Spiny Dogfish.

Station	Stratum	SHG	Location	Description
51	9200	141	East of Race Point	2 minute dogfish tow.

Table 5. Attempted Tows Aborted During Cruise 201592.

Station	Stratum	SHG	Location	Description
17	9320	176	East of Nantasket	Lobster Trawl Intercepted.
23	9350	176	Southeast of Salem Sound	Hung down.
24	9360	176	East of Gloucester	Lobster Trawl Intercepted.
32	9350	177	South of Gloucester	Water tow. Net not on bottom.
34	9360	177	Southeast of Gloucester	Doors crossed.
44	9250	174	Southwest of the Pamet River	Hauled early due to slowing from weed.
53	9190	173	East of Wellfleet	Hung down.

Table 6a. Total Catch Numbers and Weights Observed on the 2015
 Massachusetts Fall Inshore Bottom Trawl Survey - Cruise 201592- Sorted by Number

SPP CODE	COMMON NAME	COUNT	WEIGHT(kg)
143	SCUP	325,987	2,391.849
141	BLACK SEA BASS	41,205	197.501
181	NORTHERN SAND LANCE	21,456	134.852
43	BAY ANCHOVY	20,512	15.939
503	LONGFIN SQUID	17,148	206.080
131	BUTTERFISH	13,830	239.110
313	ATLANTIC ROCK CRAB	7,071	731.015
106	WINTER FLOUNDER	5,474	793.938
77	RED HAKE	4,269	534.017
72	SILVER HAKE	4,085	544.003
26	LITTLE SKATE	3,763	2,037.557
301	AMERICAN LOBSTER	3,231	792.938
322	LADY CRAB	3,078	213.240
171	NORTHERN SEAROBIN	2,038	19.949
15	SPINY DOGFISH	1,901	3,270.630
105	YELLOWTAIL FLOUNDER	1,838	349.449
163	LONGHORN SCULPIN	1,565	131.704
176	CUNNER	1,388	6.463
102	AMERICAN PLAICE	1,249	136.108
23	WINTER SKATE	1,082	906.174
312	JONAH CRAB	870	151.753
108	WINDOWPANE	724	116.740
74	HADDOCK	658	35.469
117	SMALLMOUTH FLOUNDER	611	1.458
103	SUMMER FLOUNDER	578	382.998
193	OCEAN POUT	493	44.215
317	SPIDER CRAB UNCL	480	59.897
116	NORTHERN PIPEFISH	442	0.835
104	FOURSPOT FLOUNDER	363	56.009
337	KNOBBED WHELK	221	69.118
177	TAUTOG	219	16.990
45	RAINBOW SMELT	187	7.672
32	ATLANTIC HERRING	186	22.544
33	ALEWIFE	130	6.671
401	SEA SCALLOP	108	34.218
180	ROCK GUNNEL	104	0.456
76	WHITE HAKE	99	15.353
348	NORTHERN MOONSNAIL	97	9.949
35	AMERICAN SHAD	93	9.643
409	OCEAN QUAHOG	80	7.052
78	SPOTTED HAKE	72	7.356
13	SMOOTH DOGFISH	72	120.527
336	CHANNELED WHELK	72	14.412
172	STRIPED SEAROBIN	69	25.258
132	ATLANTIC MOONFISH	58	0.419
197	GOOSEFISH	56	16.670
73	ATLANTIC COD	51	23.860
435	INSHORE LIZARDFISH	43	3.457
107	WITCH FLOUNDER	43	12.876
36	ATLANTIC MENHADEN	38	0.123
318	HORSESHOE CRAB	35	44.589
402	BAY SCALLOP	30	2.010
135	BLUEFISH	28	13.631
164	SEA RAVEN	28	7.761
121	ATLANTIC MACKEREL	24	1.991
146	NORTHERN KINGFISH	22	2.229
196	NORTHERN PUFFER	21	0.622
155	ACADIAN REDFISH	21	5.932

Table 6a continued.

SPP CODE	COMMON NAME	COUNT	WEIGHT(kg)
439	SNAKEFISH	18	0.220
83	FOURBEARD ROCKLING	15	0.907
109	GULF STREAM FLOUNDER	11	0.141
211	ROUND SCAD	11	0.066
34	BLUEBACK HERRING	10	0.400
343	BLUE MUSSEL	10	1.290
403	ATLANTIC SURFCLAM	9	5.760
342	NORTHERN HORSEMUSSEL	9	0.259
28	THORNY SKATE	9	6.800
201	PLANEHEAD FILEFISH	9	0.332
314	BLUE CRAB	7	0.138
212	ROUGH SCAD	6	0.190
516	BLOTCHED SWIMMING CRAB	5	0.011
182	SNAKEBLenny	5	0.312
145	WEAKFISH	4	0.326
120	BLUESPOTTED CORNETFISH	4	0.066
24	CLEARNOSE SKATE	3	5.890
185	OYSTER TOADFISH	3	1.035
502	NORTHERN SHORTFIN SQUID	3	0.189
118	HOGCHOKER	2	0.257
213	SILVER RAG	2	0.090
4	ROUGHTAIL STINGRAY	2	151.527
338	MOON SNAIL, SHARK EYE, AND BABY-EAR	2	0.181
149	SPOT	1	0.075
249	LUMPFISH SNAILFISH UNCL	1	0.002
413	NORTHERN QUAHOG	1	0.600
641	RED PORGY	1	0.032
27	SMOOTH SKATE	1	0.630
166	GRUBBY	1	0.023
99	GREENLAND HALIBUT	1	0.086
191	WRYMOUTH	1	0.126
331	SEA URCHIN AND SAND DOLLAR UNCL	1	0.001
165	ALLIGATORFISH	1	0.006
63	CONGER EEL	1	0.012
323	MANTIS SHRIMP UNCL	1	0.009
520	LONGFIN SQUID EGG MOPS		26.248
Totals		489,867	15,209.516

Table 6b. Total Catch Numbers and Weights Observed on the 2015

Massachusetts Fall Inshore Bottom Trawl Survey - Cruise 201592- Sorted by Weight

SPP CODE	COMMON NAME	COUNT	WEIGHT(kg)
15	SPINY DOGFISH	1,901	3,270.630
143	SCUP	325,987	2,391.849
26	LITTLE SKATE	3,763	2,037.557
23	WINTER SKATE	1,082	906.174
106	WINTER FLOUNDER	5,474	793.938
301	AMERICAN LOBSTER	3,231	792.938
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72	SILVER HAKE	4,085	544.003
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503	LONGFIN SQUID	17,148	206.080
141	BLACK SEA BASS	41,205	197.501
312	JONAH CRAB	870	151.753
4	ROUGHTAIL STINGRAY	2	151.527
102	AMERICAN PLAICE	1,249	136.108
181	NORTHERN SAND LANCE	21,456	134.852
163	LONGHORN SCULPIN	1,565	131.704
13	SMOOTH DOGFISH	72	120.527
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337	KNOBBED WHELK	221	69.118
317	SPIDER CRAB UNCL	480	59.897
104	FOURSPOT FLOUNDER	363	56.009
318	HORSESHOE CRAB	35	44.589
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401	SEA SCALLOP	108	34.218
520	LONGFIN SQUID EGG MOPS		26.248
172	STRIPED SEAROBIN	69	25.258
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32	ATLANTIC HERRING	186	22.544
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43	BAY ANCHOVY	20,512	15.939
76	WHITE HAKE	99	15.353
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164	SEA RAVEN	28	7.761
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78	SPOTTED HAKE	72	7.356
409	OCEAN QUAHOG	80	7.052
28	THORNY SKATE	9	6.800
33	ALEWIFE	130	6.671
176	CUNNER	1,388	6.463
155	ACADIAN REDFISH	21	5.932
24	CLEARNOSE SKATE	3	5.890
403	ATLANTIC SURFLAM	9	5.760
435	INSHORE LIZARDFISH	43	3.457
146	NORTHERN KINGFISH	22	2.229
402	BAY SCALLOP	30	2.010
121	ATLANTIC MACKEREL	24	1.991
117	SMALLMOUTH FLOUNDER	611	1.458

Table 6b continued.

SPP CODE	COMMON NAME	COUNT	WEIGHT(kg)
343	BLUE MUSSEL	10	1.290
185	OYSTER TOADFISH	3	1.035
83	FOURBEARD ROCKLING	15	0.907
116	NORTHERN PIPEFISH	442	0.835
27	SMOOTH SKATE	1	0.630
196	NORTHERN PUFFER	21	0.622
413	NORTHERN QUAHOG	1	0.600
180	ROCK GUNNEL	104	0.456
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165	ALLIGATORFISH	1	0.006
249	LUMPFISH SNAILFISH UNCL	1	0.002
331	SEA URCHIN AND SAND DOLLAR UNCL	1	0.001
Totals		489,867	15,209.516

Table 7. Number of individuals obtained for age, growth, maturity and special studies during Massachusetts DMF Cruise 201592.

Species	Maturity Observation	Age and Growth Collection			YOY
		Scales	Otoliths	Opercula	
Atlantic Cod	19		19		12
Haddock	25		25		
Summer Flounder	293	293			
Yellowtail Flounder	251	251			
Winter Flounder	415		415		
Windowpane Flounder	94	94	94		
Black Sea Bass	121	121			
Scup	126	126			
Weakfish	2	2			
Tautog	48			48	
American Lobster	26				
Jonah crab (Female)	31				
TOTAL	1,451	887	553	48	12

OTHER COLLECTIONS:

Both summer flounder and yellowtail flounder were separated by sex at all stations.

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

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

48 tautog saved for age and growth study (Elzey).

54 knobbed whelk saved for maturity study (Wilcox).

2 winter flounder saved for EPA National Coastal Assessment Program (Logan).

2 ocean pout saved for the Ocean Genome Project (Seid).

3 fish saved for ID (Manfredi).

Figure 1.

Massachusetts Division of Marine Fisheries Inshore Bottom Trawl Survey

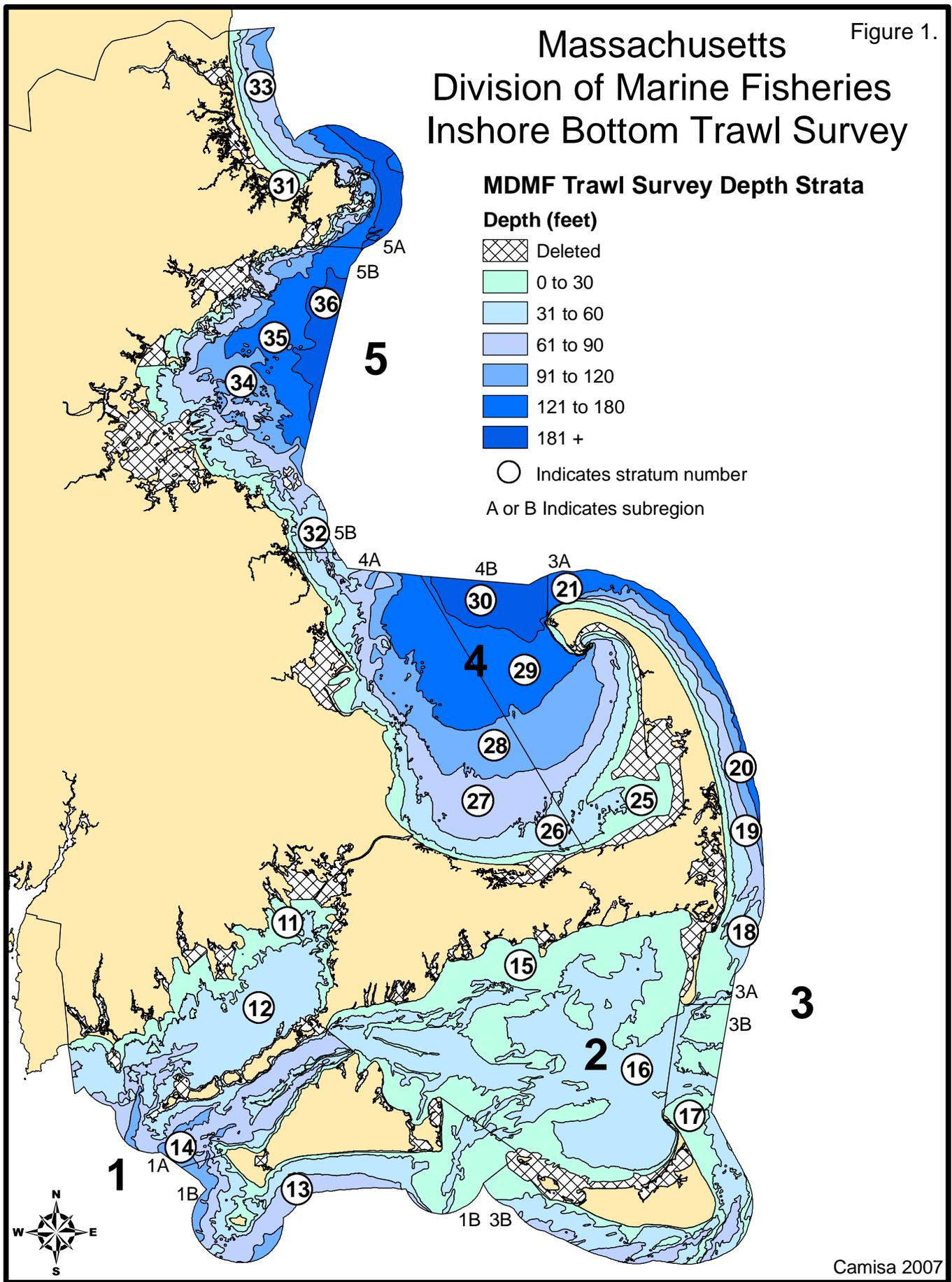


Figure 2.

Fall 2015 Mass Division of Marine Fisheries Bottom Trawl Survey Tow Locations

- 201592 Proposed Tow Circles (1.5nm)
- 201592 Completed Tow Tracks
- ✖ 201592 Aborted Tows

Data label indicates day of month (Sept.)

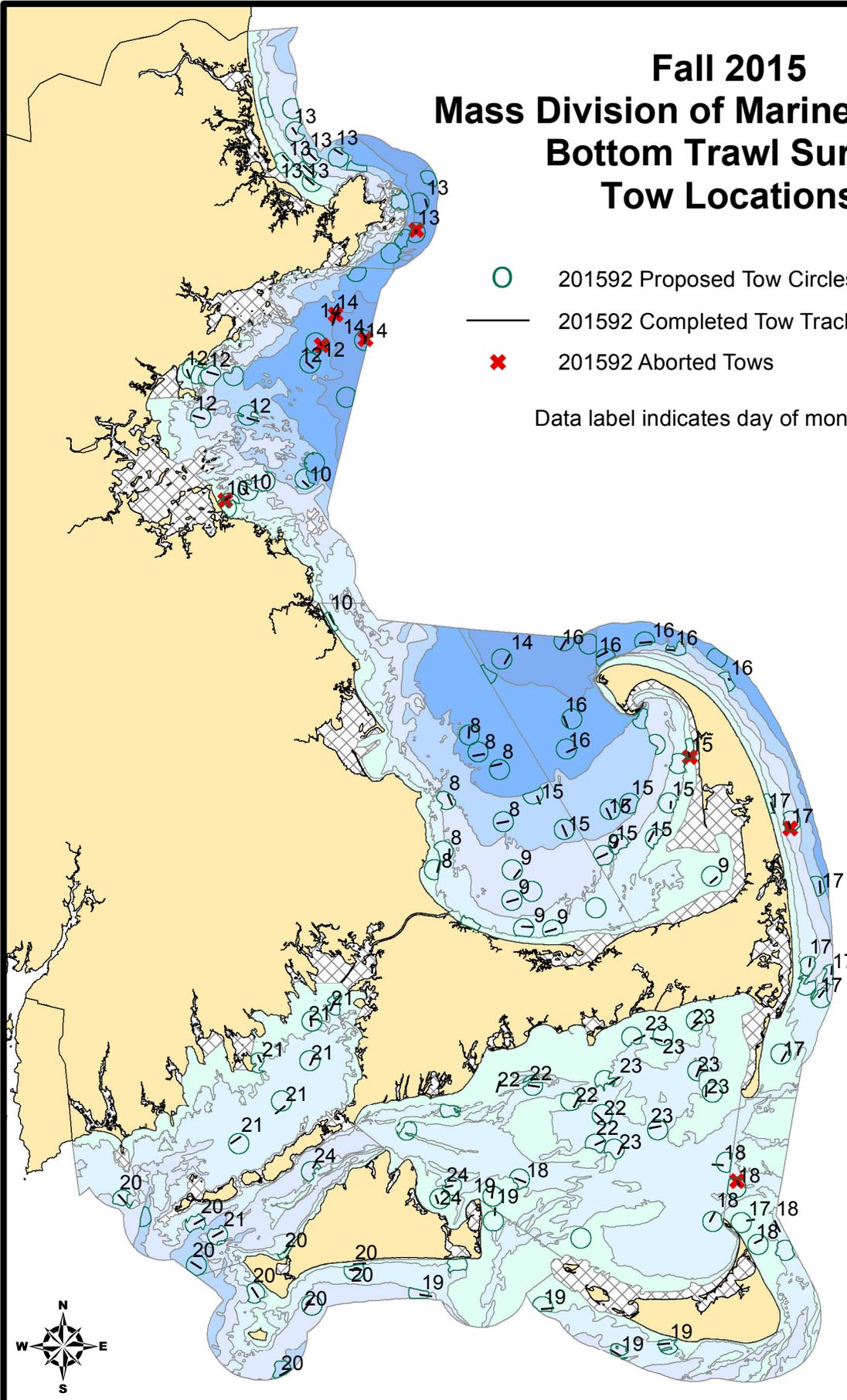
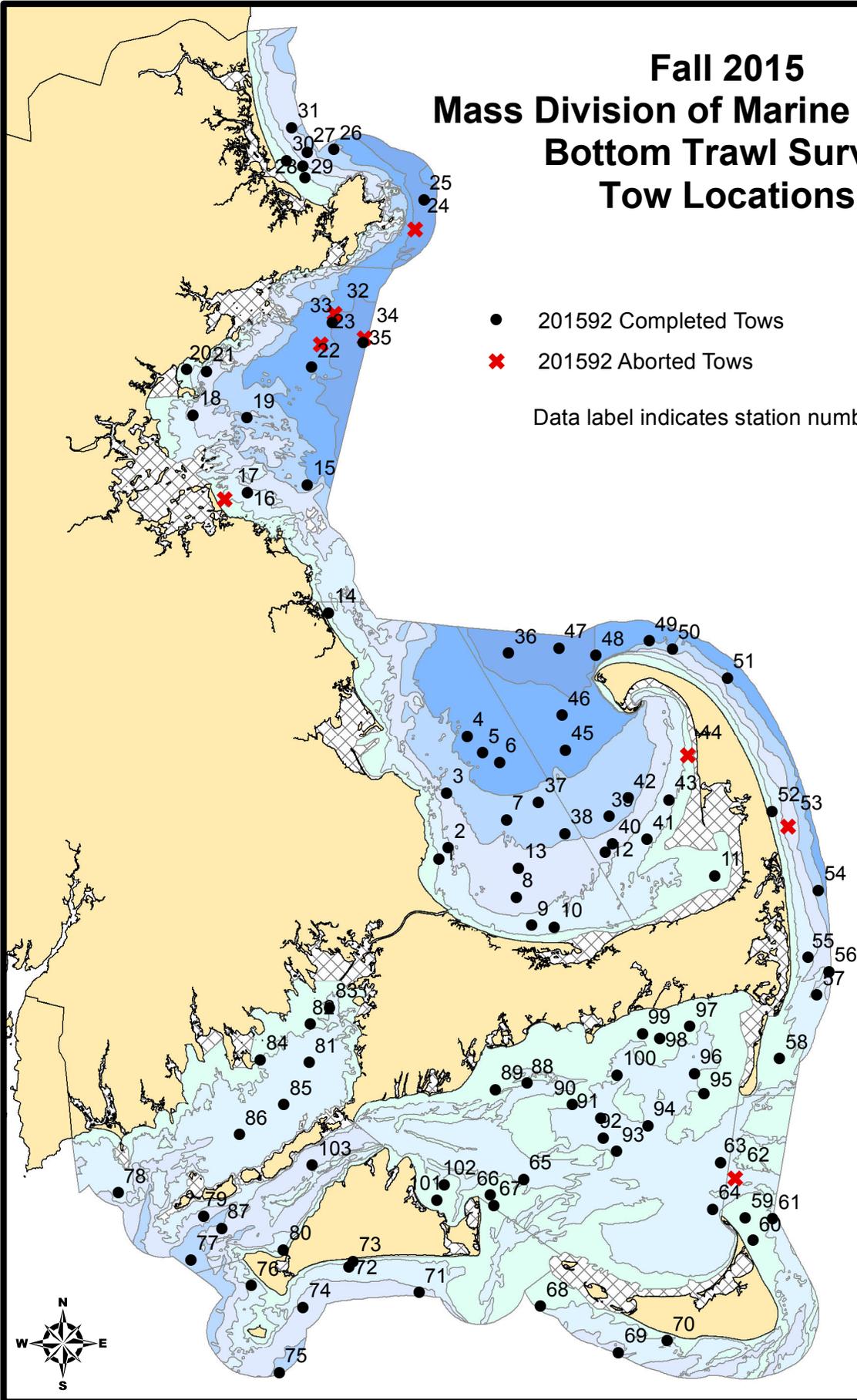


Figure 3.

Fall 2015 Mass Division of Marine Fisheries Bottom Trawl Survey Tow Locations

- 201592 Completed Tows
- ✖ 201592 Aborted Tows

Data label indicates station number.



SURVEY REPORT

2015 Nantucket Sound Estuarine Winter Flounder

Young of the Year (YOY)

Seine Survey

SURVEY PERIOD, AREA, AND PARTICIPANTS

From June 15 – June 30, 2015 the Massachusetts Division of Marine Fisheries (MDMF) conducted the 40th 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). The survey, led by Vincent M. Manfredi, was completed with assistance from MDMF colleague Mark Szymanski.

OBJECTIVES

The primary objective of this survey is to provide a winter flounder YOY abundance index for the Southern New England Stock. All commercially and recreationally important finfish and invertebrates are counted. 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) is determined by aggregating catch from three replicate hauls at each station. Consistent area swept is maintained using a fixed-length spreader rope. Haul distance is 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 is 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 employs stratification techniques; each estuary is considered a stratum and each station's three replicate hauls are

treated as one individual sample. Stratified mean density and confidence limits were derived from standard and modified formulae for mean and variance.

SURVEY RESULTS

The 2015 pooled (all estuaries combined) winter flounder YOY index (0.127 YOY / m²) is below the timeseries median for the 13th time since 2000 (Figure 2, Table 1). All estuary specific indices for YOY winter flounder decreased in 2015 (Figure 3). The Age 1+ winter flounder index remains below the timeseries median for the 6th consecutive year (Figure 4). The YOY Fluke index was 0, one of five years in the timeseries when no YOY were captured (Figure 5). The blue crab index dropped further in 2015, below the timeseries median for the second time since 2009 (Figure 6). Forty species were encountered in seine hauls in 2015 including one new species occurrence, a Northern Sennet (Table 2). All bottom temperature monitors were collected and successfully downloaded (Figure 7). For further information on this survey or others in the time series, please contact Vincent M. Manfredi (508)-990-2860 ext. 110.

Table 1. YOY Winter Flounder Index, All Estuaries.
MDMF Seine Survey: 1976-2015

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	0.027	0.130	0.241
2015	0.127	0.018	0.090	0.163

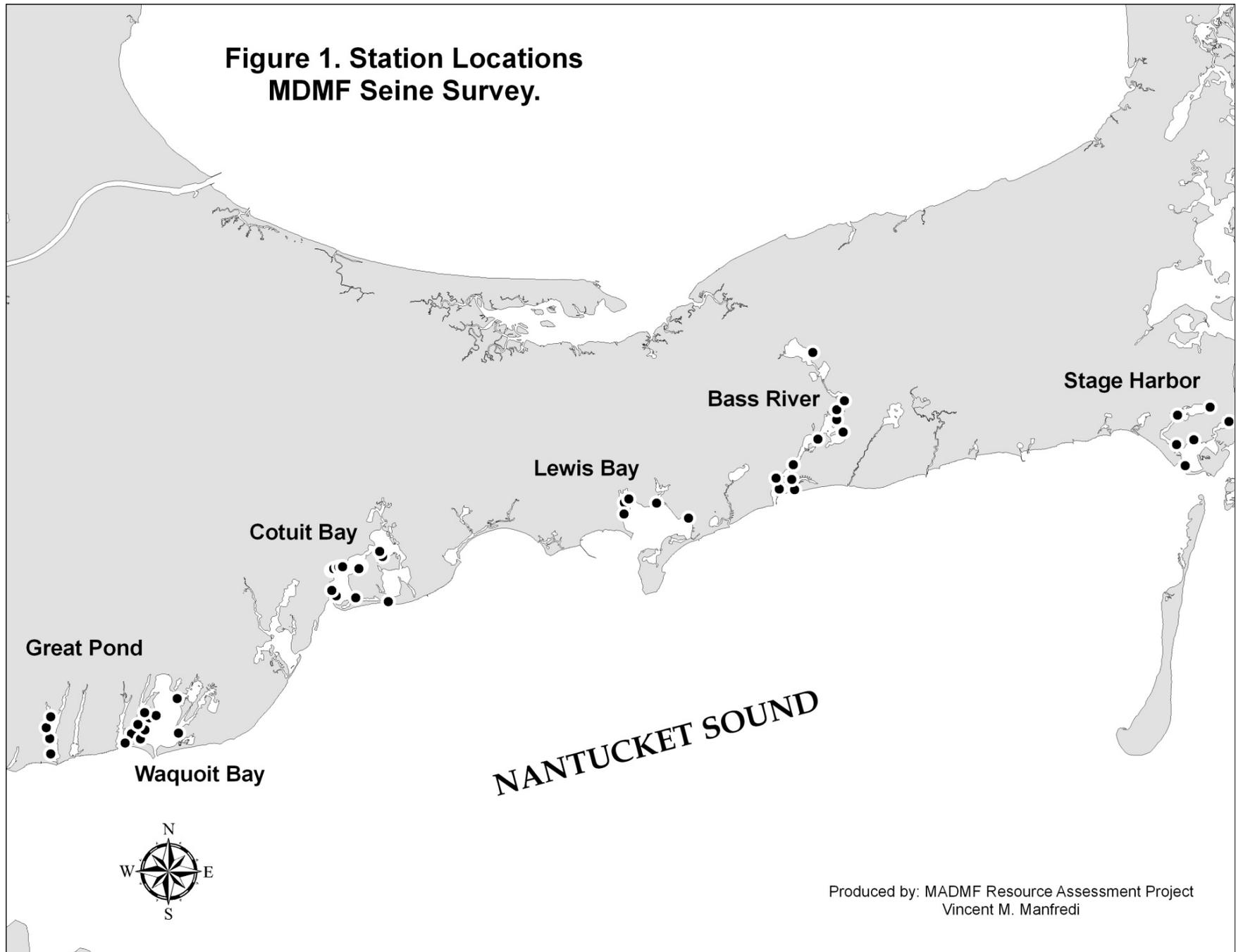
Timeseries Median

0.226

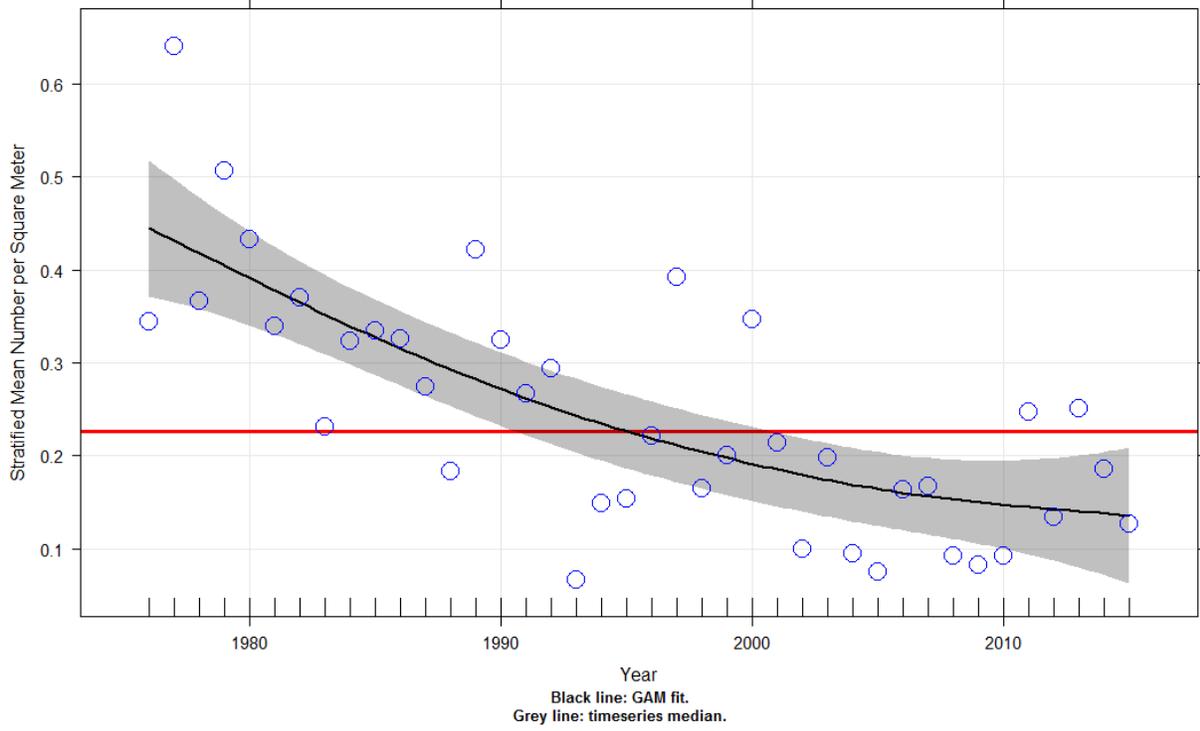
Table 2. Catch Observations of all Species Recorded, 2015 MDMF Seine Survey.
 (for species marked "Present" counts are not taken and presence is noted at each haul)

COMMON NAME	TAXONOMIC NAME	TOTAL NUMBER	PERCENT OCCURRENCE
YOY Winter Flounder	<i>Pseudopleuronectes americanus</i>	1108	89.9
Atlantic Silverside	<i>Menidia menidia</i>	Present	87.7
Sand Shrimp	<i>Crangon septemspinosa</i>	Present	84.8
Mud Snail	<i>Nassarius obsoletus</i>	Present	66.7
Striped Killifish	<i>Fundulus majalis</i>	Present	58.7
Grass Shrimp	<i>Paelmonetes pugio</i>	Present	47.1
Northern Pipefish	<i>Sygnathus fuscus</i>	Present	33.3
Fourspine Stickleback	<i>Apeltes quadracus</i>	Present	31.2
Mummichog	<i>Fundulus heteroclitus</i>	Present	24.6
Spider Crab Uncl.	<i>Majidae</i>	86	22.5
Blue Crab	<i>Callinectes sapidus</i>	58	21.0
Lady Crab	<i>Ovalipes ocellatus</i>	125	16.7
Green Crab	<i>Carcinus maenus</i>	24	13.8
Atlantic Needlefish	<i>Strongylura marina</i>	42	13.8
Alewife / Blueback Herring	<i>Alosa spp.</i>	252	13.8
Northern Kingfish	<i>Menticirrhitis saxatilis</i>	26	13.0
Ribbed Mussel	<i>Guekensia demissus</i>	33	8.7
Threespine Stickleback	<i>Gasterosteus aculeatus</i>	Present	7.2
Rainwater Killifish	<i>Lucania parva</i>	7	5.8
Spot	<i>Leiostomus xanthurus</i>	11	5.1
Horseshoe Crab	<i>Limulus polyphemus</i>	7	4.3
Windowpane Flounder	<i>Scophthalmus aquosus</i>	9	3.6
Striped Searobin	<i>Prionotus evolans</i>	8	3.6
Atlantic Rock Crab	<i>Cancer irroratus</i>	13	3.6
White Mullet	<i>Mugil curema</i>	13	3.6
Atlantic Herring	<i>Clupea harengus</i>	4	2.9
American Eel	<i>Anguilla rostrata</i>	3	2.2
Age 1+ Winter Flounder	<i>Pseudopleuronectes americanus</i>	2	1.4
Asian Shore Crab	<i>Hemigrapsus sanguineus</i>	2	1.4
Channeled Whelk	<i>Busycon canniculata</i>	3	1.4
Bay Scallop	<i>Argopecten irradians</i>	2	1.4
Northern Quahog	<i>Mercenaria mercenaria</i>	2	1.4
Sheepshead Minnow	<i>Cyprinodon variegatus</i>	2	1.4
Grubby	<i>Myoxocephalus aeneus</i>	1	0.7
Tautog	<i>Tautoga onitis</i>	1	0.7
Northern Sand Lance	<i>Ammodytes dubius</i>	1	0.7
Knobbed Whelk	<i>Busycon carica</i>	1	0.7
Soft Shell Clam	<i>Mya arenaria</i>	2	0.7
Pinfish	<i>Lagodon rhomboides</i>	1	0.7
Northern Sennet	<i>Sphyræna borealis</i>	1	0.7

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



**Figure 2A. YOY Winter Flounder Abundance, All Estuaries
MDMF Seine Survey: 1976-2015**



**Figure 2B. YOY Winter Flounder Abundance, All Estuaries
MDMF Seine Survey: 1976-2015**

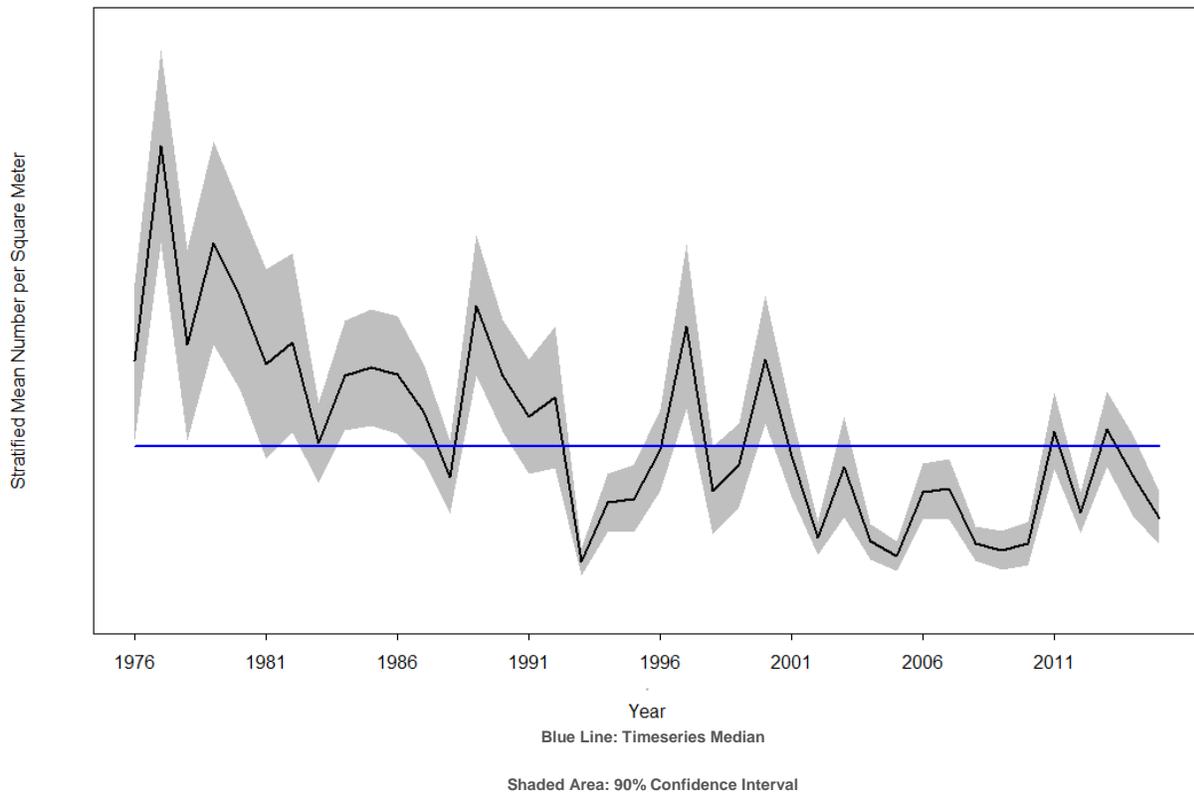
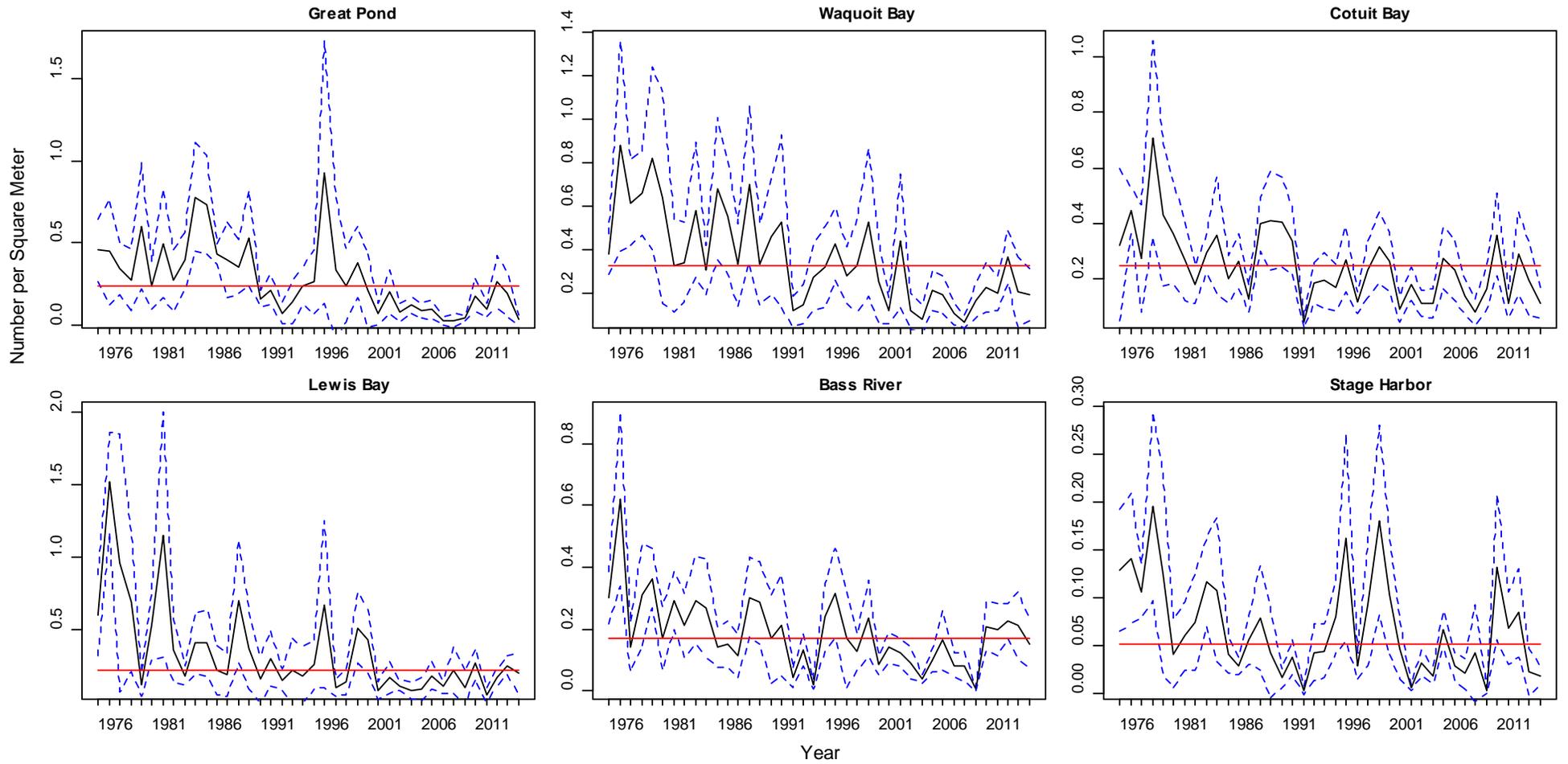


Figure 3. Abundance of YOY winter flounder by estuary, MDMF Seine Survey 1976 – 2015.

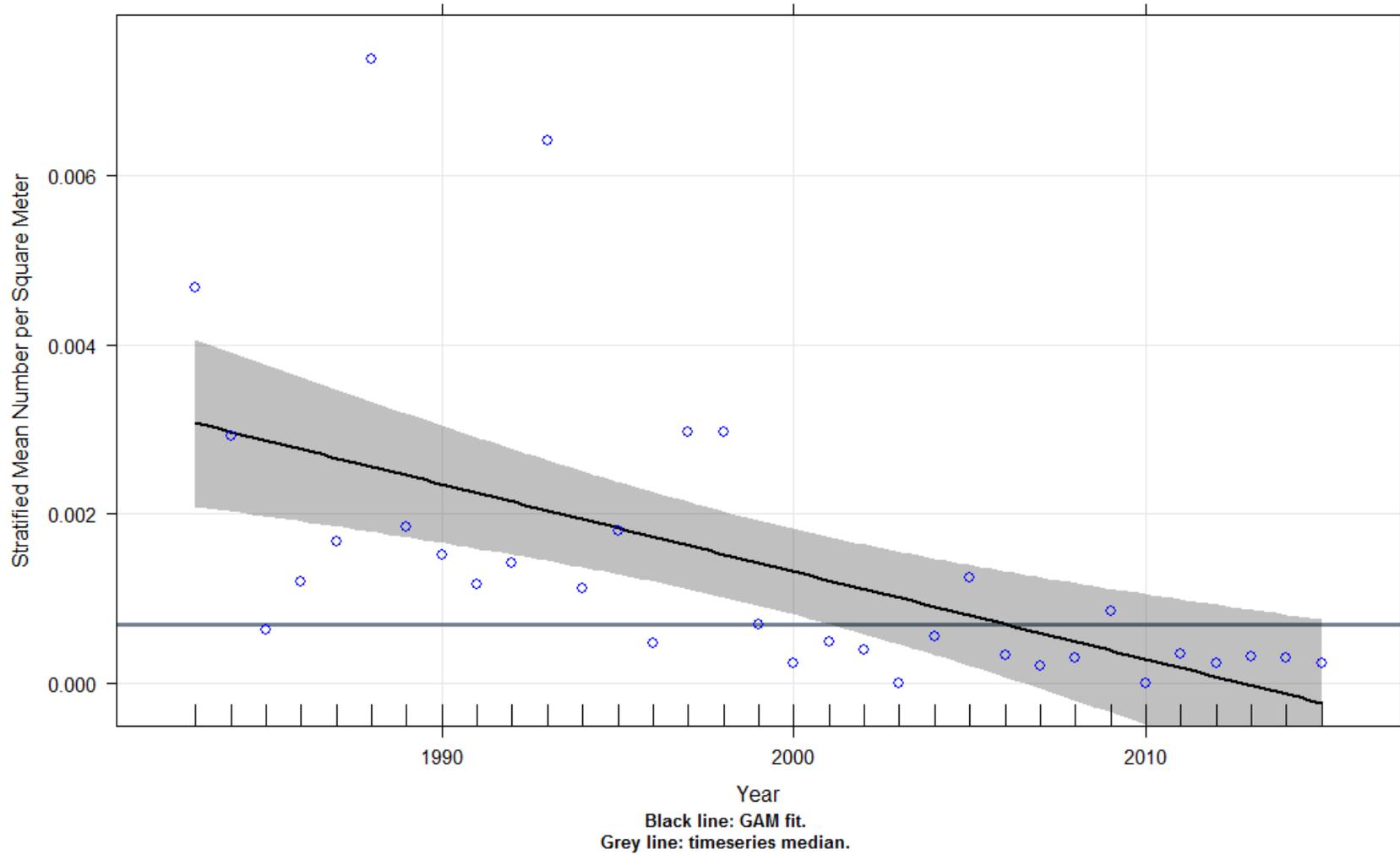


Dashed Lines = 95% Confidence Intervals

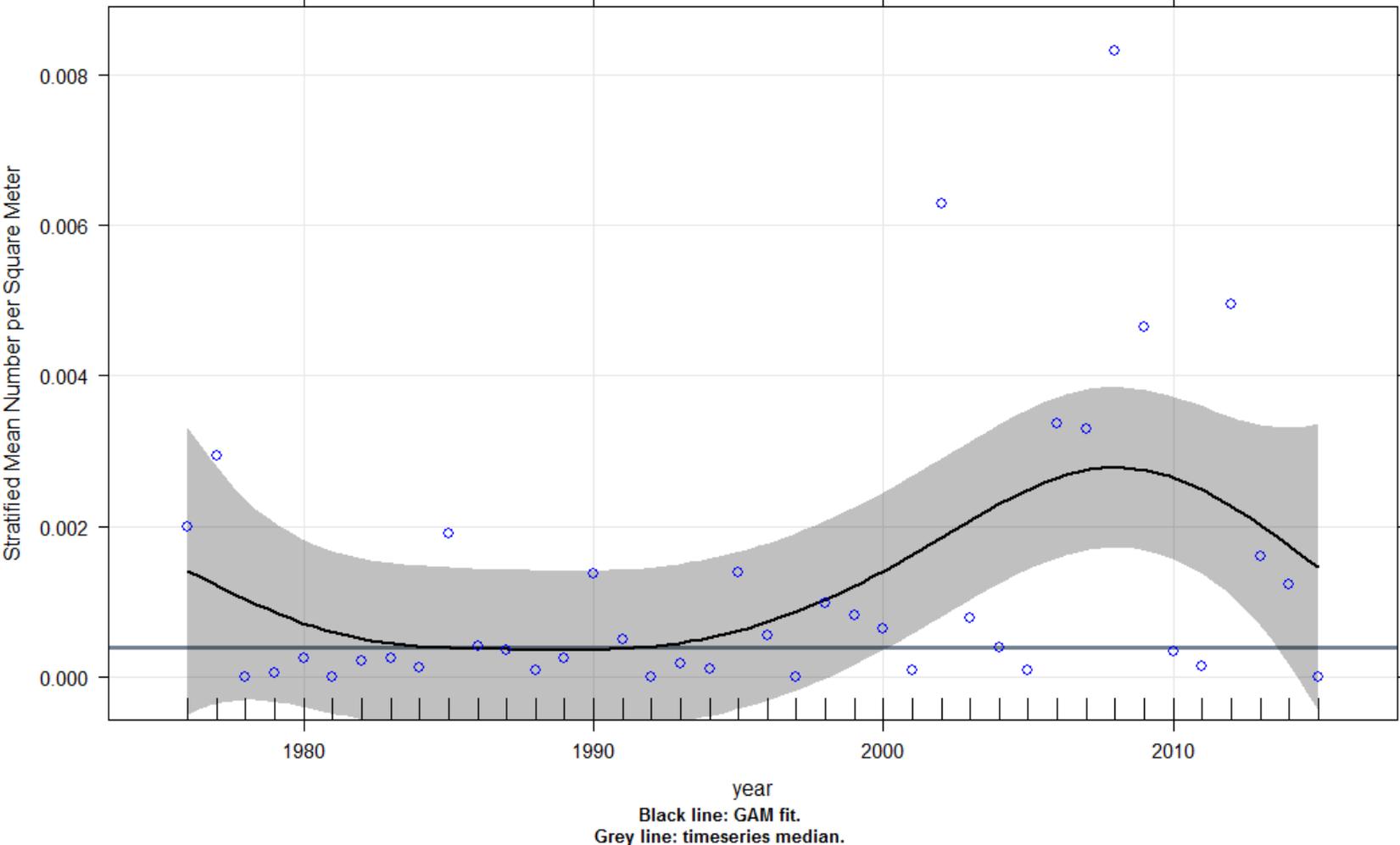
Horizontal Line = Timeseries Median for each Estuary

Note: y-axis scales differ in magnitude.

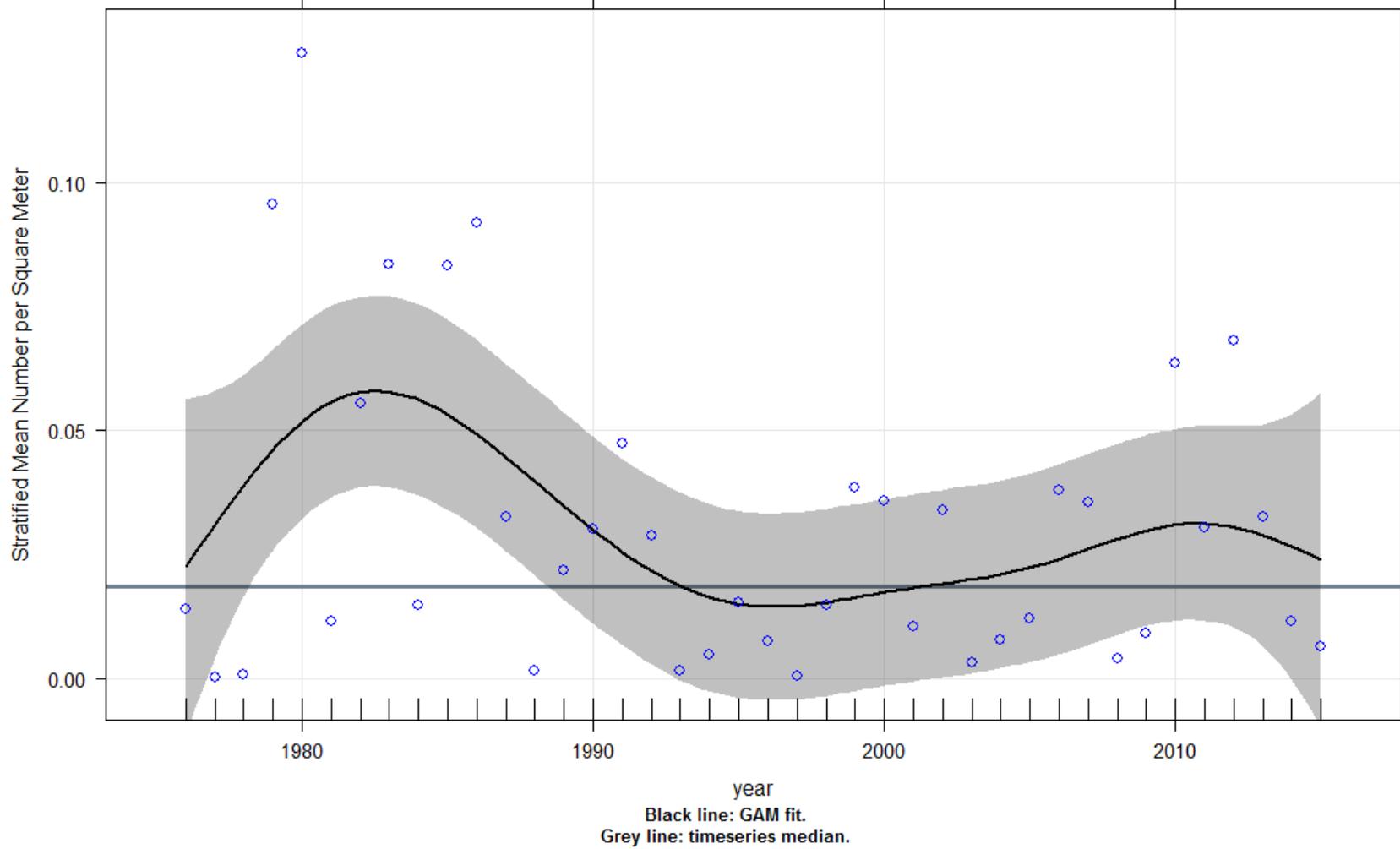
**Figure 4. Age 1+ Winter Flounder Abundance, All Estuaries
MDMF Seine Survey: 1983-2015**



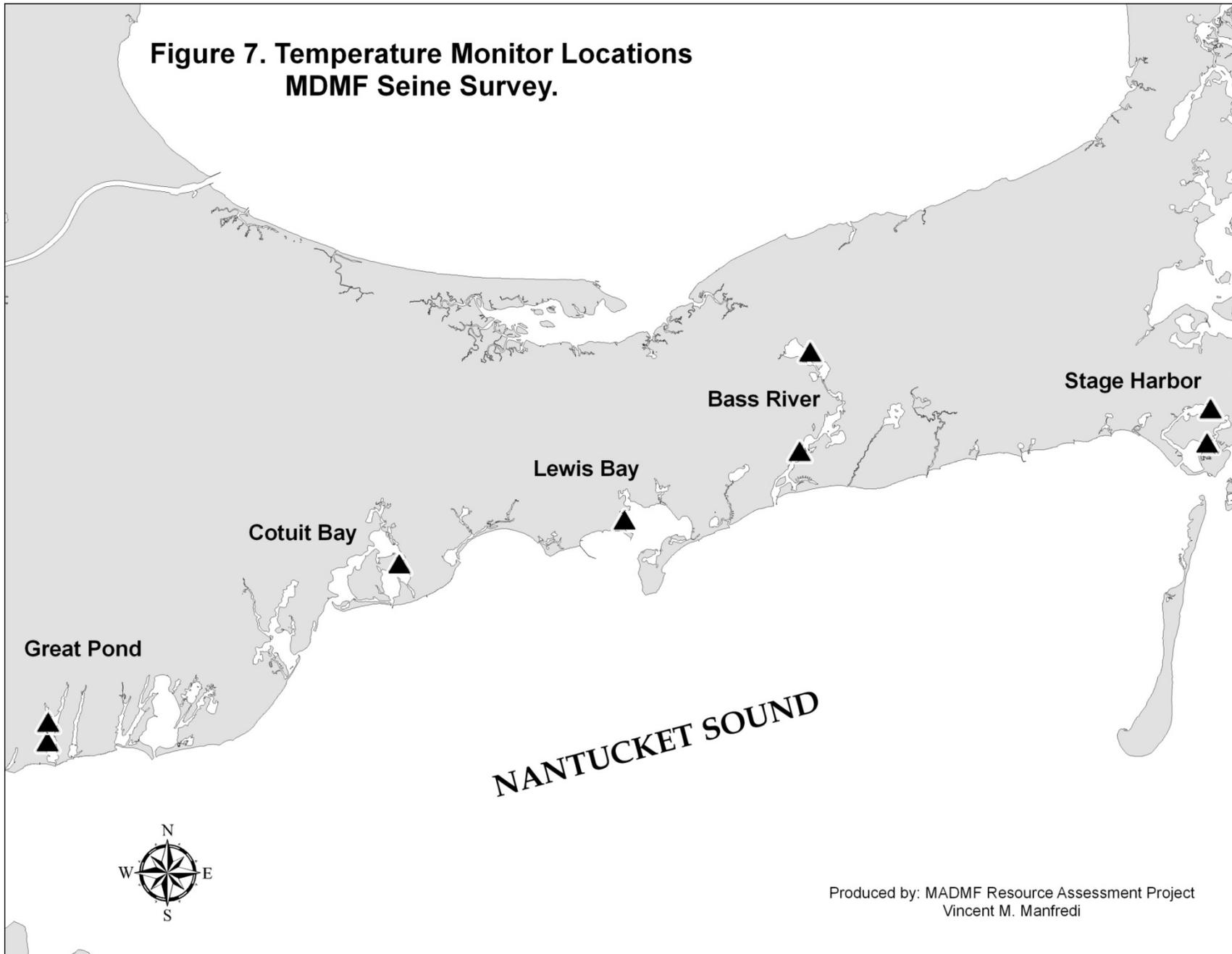
**Figure 5. YOY Fluke Abundance, All Estuaries
MDMF Seine Survey: 1976-2015**



**Figure 6. Blue Crab Abundance, All Estuaries
MDMF Seine Survey: 1976-2015**



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



Appendix A.

Massachusetts Inshore Bottom Trawl Survey Results 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 508-990-2860 ext. 139.

Contents:

Figure 1.

Massachusetts trawl survey regions.

Figure 2.

Paired figures of stratified mean weight per tow (kg) with (top) GAM smoothed trend line and (bottom) 95% confidence interval on bootstrapped mean. 1978 – 2015 Massachusetts DMF trawl survey.

Spring **Winter Flounder** Regions 1 - 3
Spring **Winter Flounder** Regions 4 - 5
Fall **Winter Flounder** Regions 4 - 5
Spring **Yellowtail Flounder** Regions 3 - 5
Spring **Summer Flounder** Regions 1 - 5
Fall **Summer Flounder** Regions 1 - 5
Spring **Windowpane** Regions 1 - 3
Fall **Windowpane** Regions 1 - 3
Spring **Windowpane** Regions 4 - 5
Fall **Windowpane** Regions 4 - 5
Spring **Little Skate** Regions 1 - 3
Fall **Little Skate** Regions 1 - 3
Spring **Little Skate** Regions 4 - 5
Fall **Little Skate** Regions 4 - 5
Spring **Winter Skate** Regions 1 - 3
Fall **Winter Skate** Regions 1 - 3
Spring **Winter Skate** Regions 4 - 5
Fall **Winter Skate** Regions 4 - 5
Spring **Atlantic Cod** Regions 4 - 5
Fall **Red Hake** Regions 4 - 5
Spring **Ocean Pout** Regions 1 - 5
Spring **Longhorn Sculpin** Regions 3 - 5
Fall **Longhorn Sculpin** Regions 3 - 5
Spring **Northern Sea Robin** Regions 1 - 5
Spring **Scup** Regions 1 - 3
Spring **Tautog** Regions 1 - 3
Fall **Tautog** Regions 1 - 3
Spring **Black Sea Bass** Regions 1 - 3
Fall **Butterfish** Regions 1 - 2
Fall **Lady Crab** Regions 4 - 5
Fall **Lobster** Regions 4 - 5

Figure 3.

Paired figures of stratified mean number per tow with (top) GAM smoothed trend line and (bottom) 95% confidence interval on bootstrapped mean. 1978 – 2015 Massachusetts DMF trawl survey.

Spring **Channeled Whelk** Regions 1 - 2
Fall **Channeled Whelk** Regions 1 - 2
Fall **Knobbed Whelk** Regions 1 - 2
Spring **Atlantic Wolffish** Regions 3 - 5

Figure 4.

Paired figures of pre-recruit stratified mean number per tow with (top) GAM smoothed trend line and (bottom) 95% confidence interval on bootstrapped mean. 1978 – 2015 Massachusetts DMF trawl survey.

Fall **Age-0 Scup** (<13 cm) Regions 1 – 3

Fall **Age-0 Black Sea Bass** (<12 cm) Regions 1 - 3

Figure 5

Abundance-at-age. Timeseries range varies dependent on age sample availability. Massachusetts DMF trawl survey.

Spring **Summer Flounder** (ages 1-5+) Regions 1 – 5

Spring **Yellowtail Flounder** (ages 1-5+) Regions 4 - 5

Figure 1. Massachusetts trawl survey regions

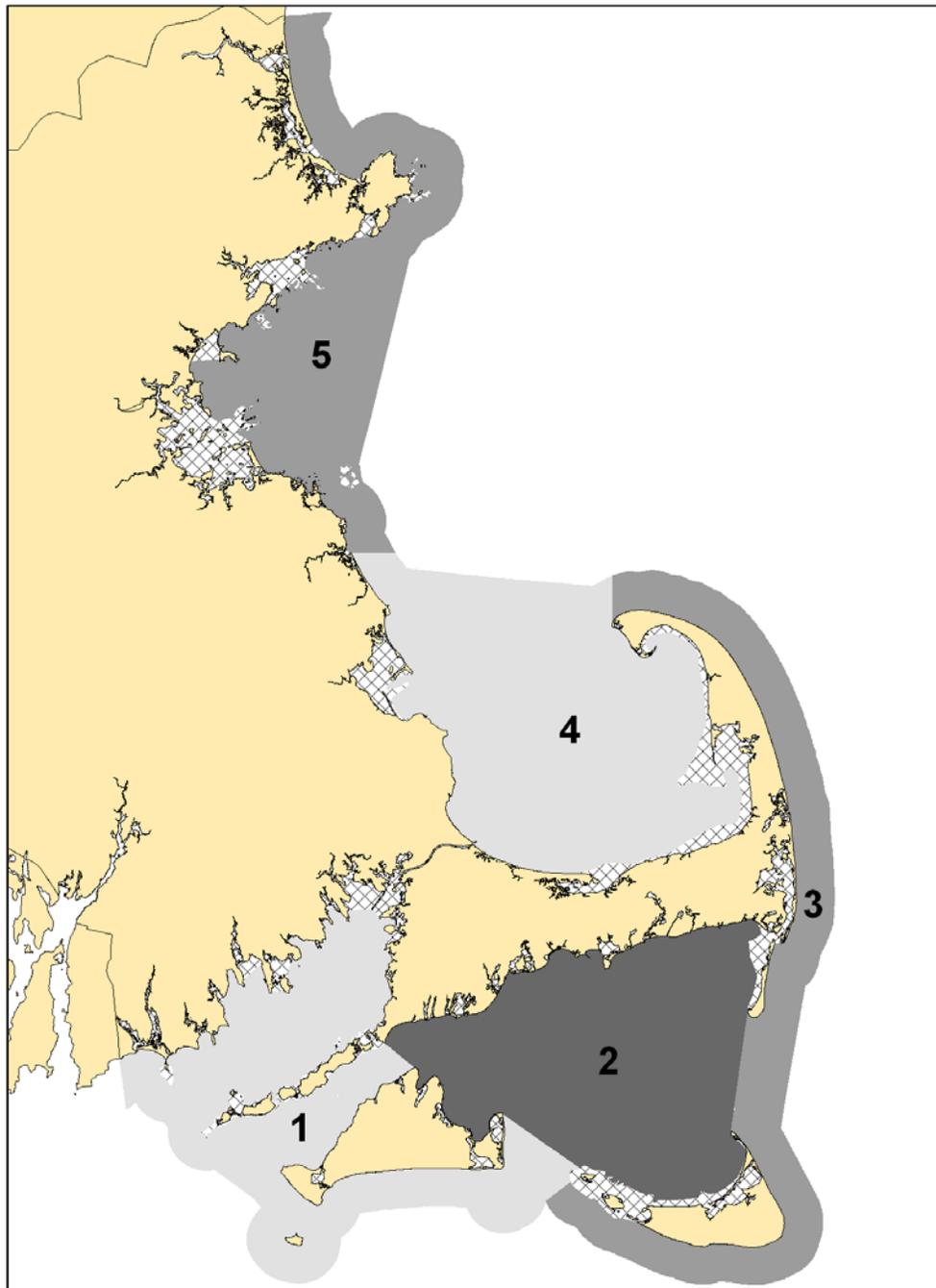


Figure 2. Paired figures of stratified mean weight per tow (kg) with (top) GAM smoothed trend line and (bottom) 95% confidence interval on bootstrapped mean. 1978 – 2015 Massachusetts DMF Trawl survey.

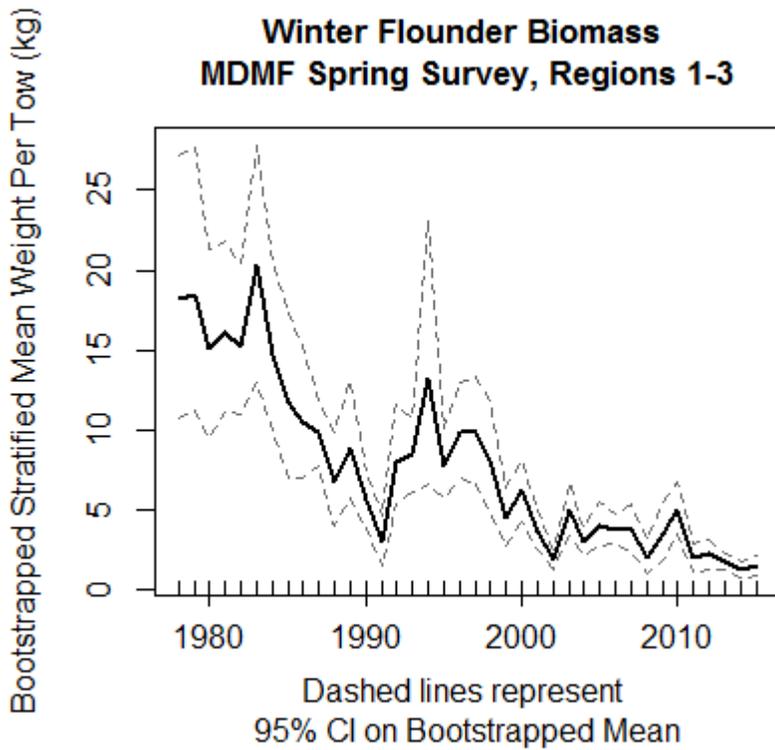
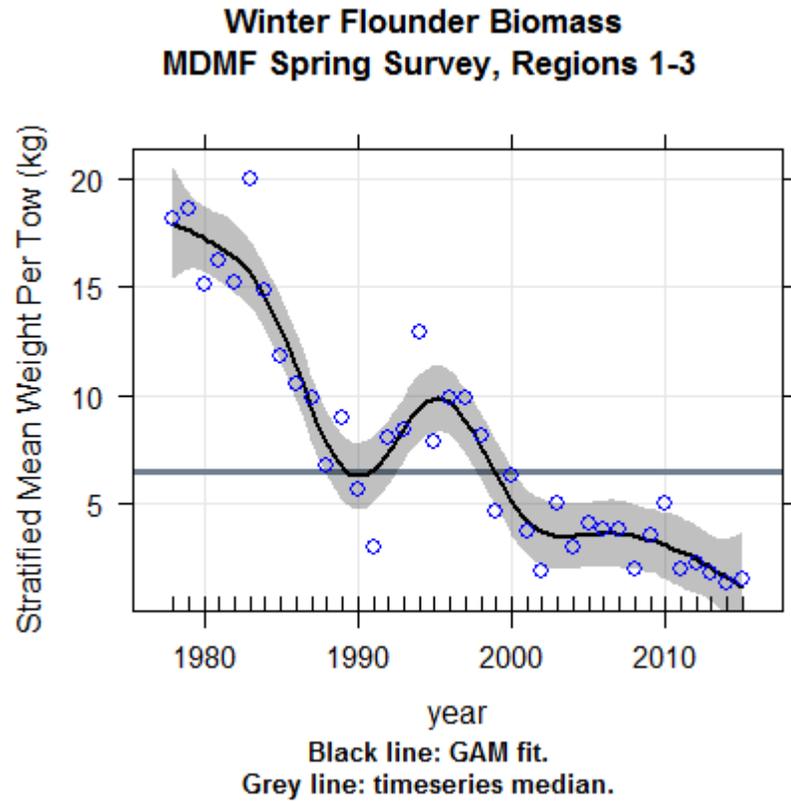
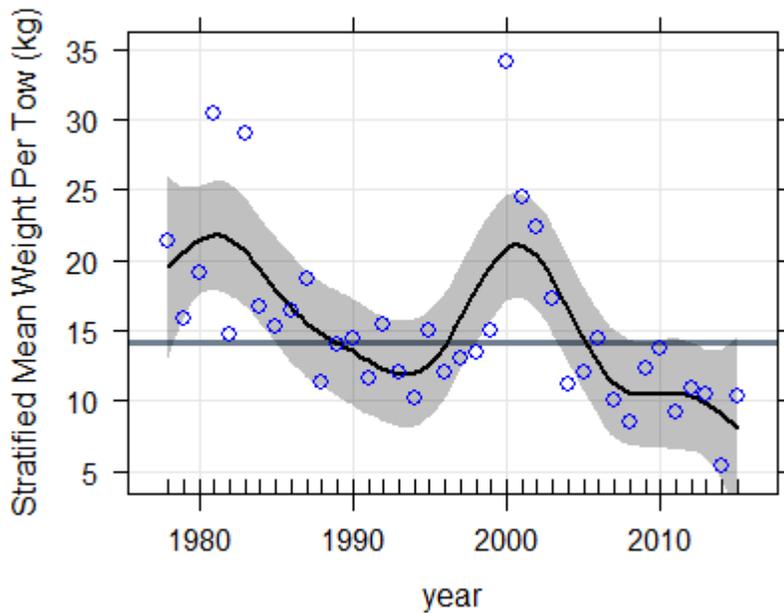


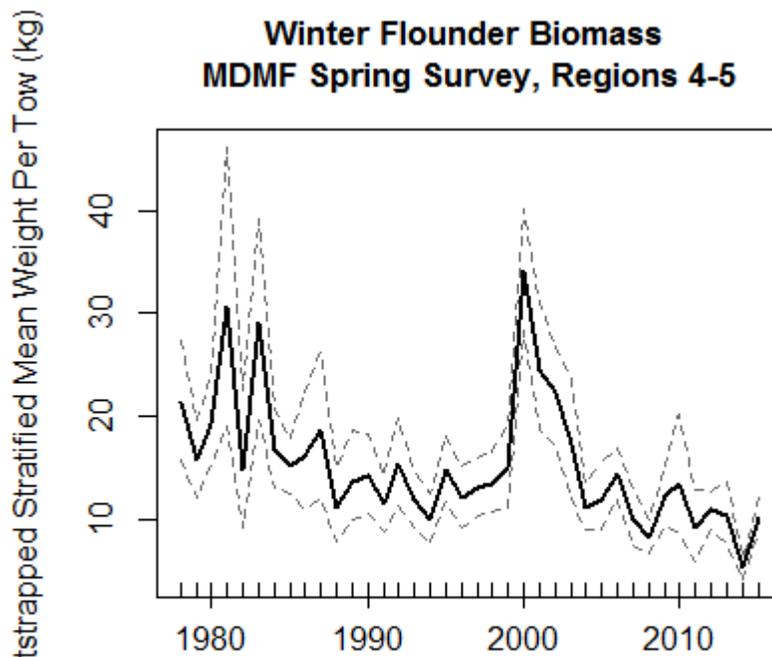
Figure 2 *continued*. Paired figures of stratified mean weight per tow (kg) with (top) GAM smoothed trend line and (bottom) 95% confidence interval on bootstrapped mean. 1978 – 2015 Massachusetts DMF Trawl survey.

Winter Flounder Biomass MDMF Spring Survey, Regions 4-5



Black line: GAM fit.
Grey line: timeseries median.

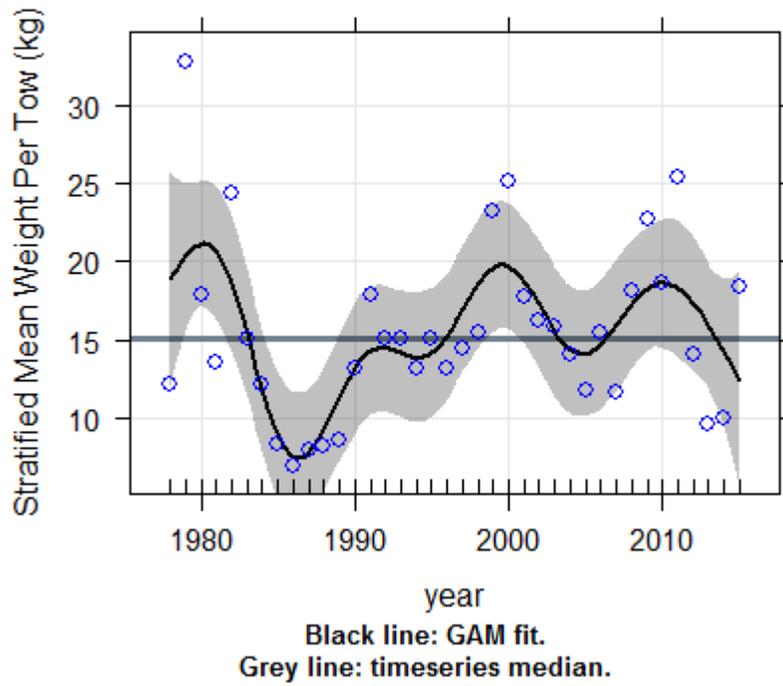
Winter Flounder Biomass MDMF Spring Survey, Regions 4-5



Dashed lines represent
95% CI on Bootstrapped Mean

Figure 2 *continued*. Paired figures of stratified mean weight per tow (kg) with (top) GAM smoothed trend line and (bottom) 95% confidence interval on bootstrapped mean. 1978 – 2015 Massachusetts DMF Trawl survey.

Winter Flounder Biomass MDMF Fall Survey, Regions 4-5



Winter Flounder Biomass MDMF Fall Survey, Regions 4-5

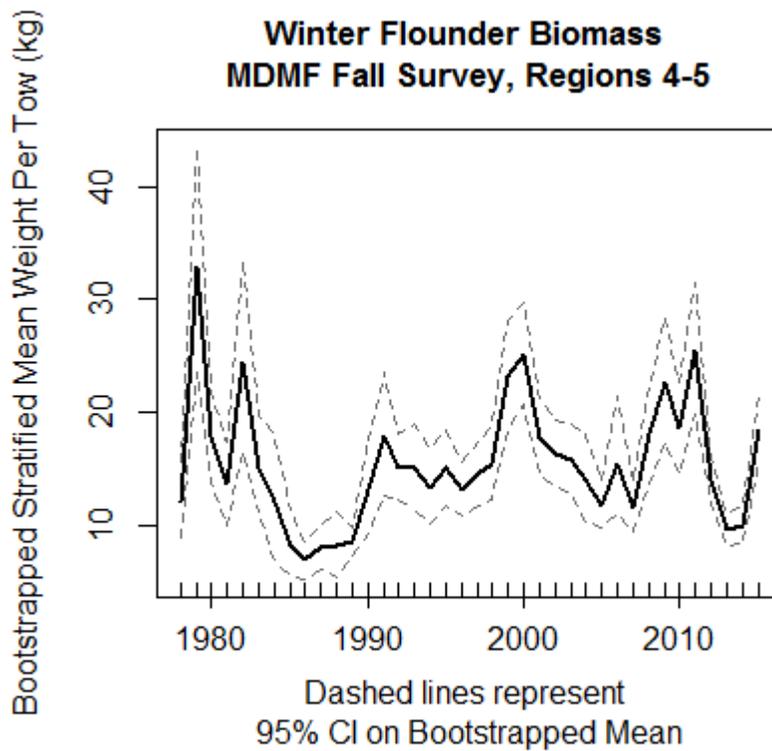
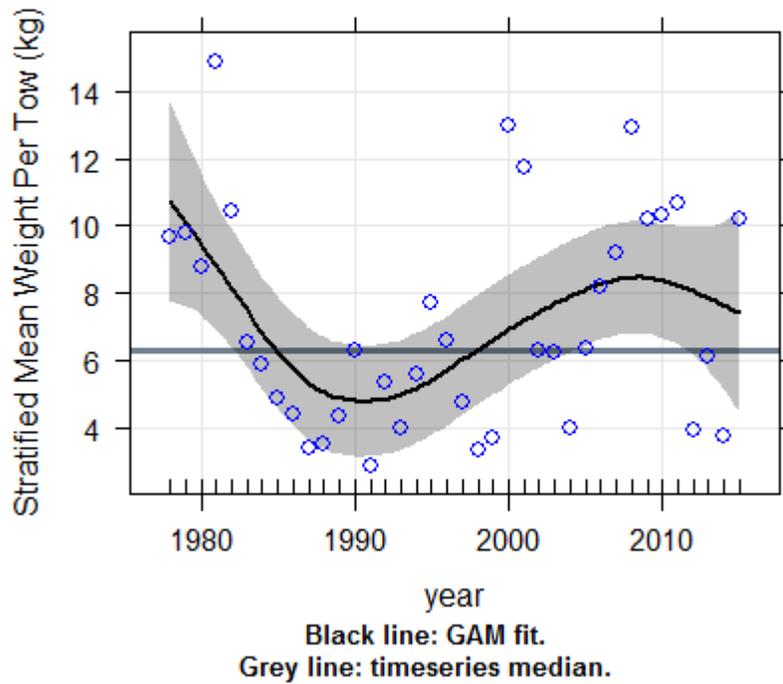


Figure 2 *continued*. Paired figures of stratified mean weight per tow (kg) with (top) GAM smoothed trend line and (bottom) 95% confidence interval on bootstrapped mean. 1978 – 2015 Massachusetts DMF Trawl survey.

Yellowtail Flounder Biomass MDMF Spring Survey, Regions 3-5



Yellowtail Flounder Biomass MDMF Spring Survey, Regions 3-5

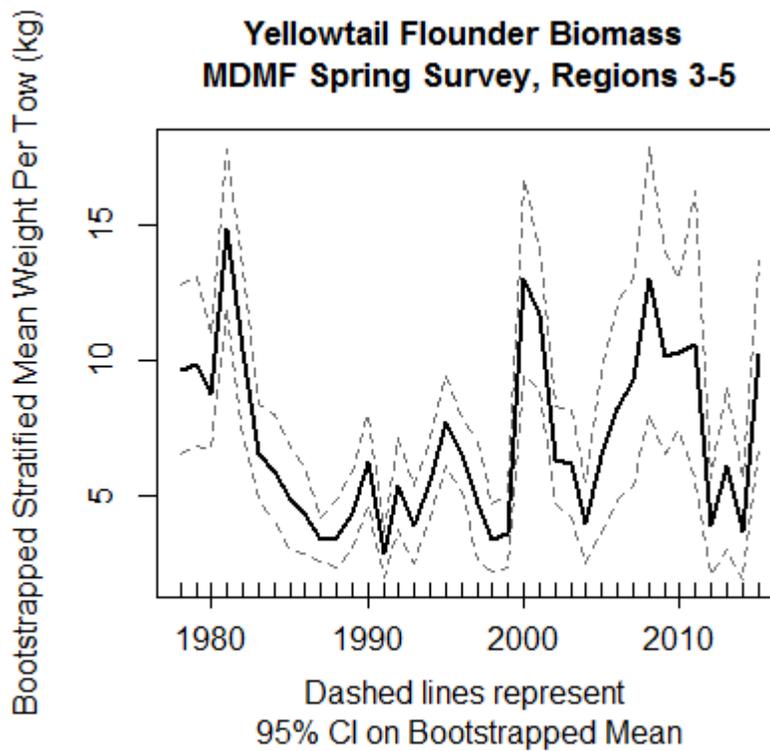
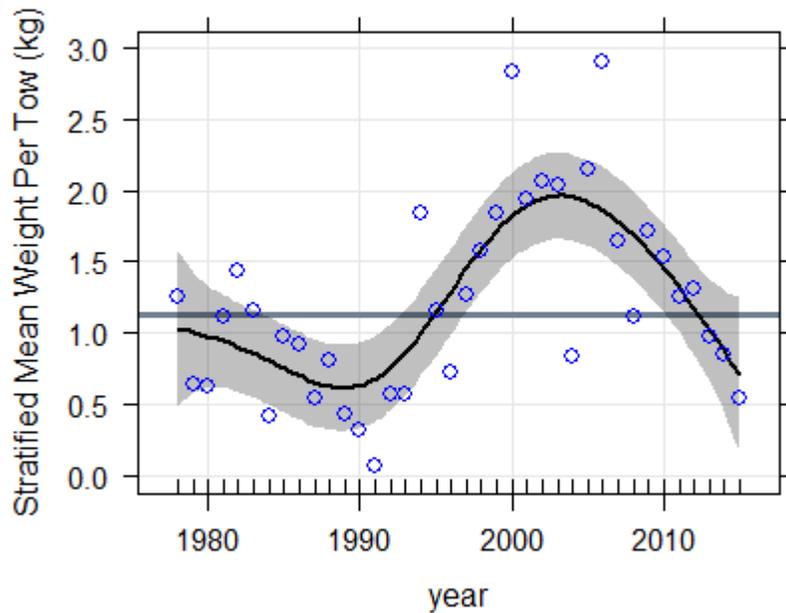


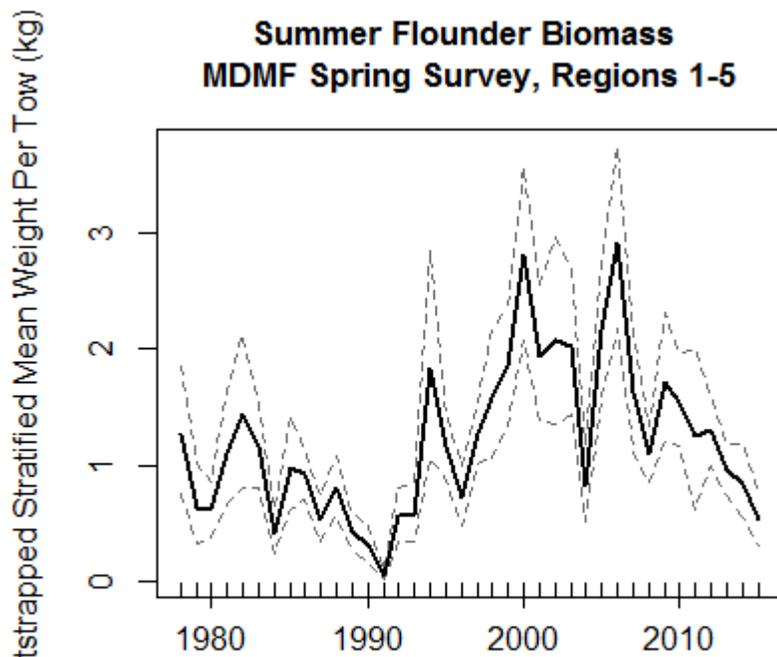
Figure 2 *continued*. Paired figures of stratified mean weight per tow (kg) with (top) GAM smoothed trend line and (bottom) 95% confidence interval on bootstrapped mean. 1978 – 2015 Massachusetts DMF Trawl survey.

Summer Flounder Biomass MDMF Spring Survey, Regions 1-5



Black line: GAM fit.
Grey line: timeseries median.

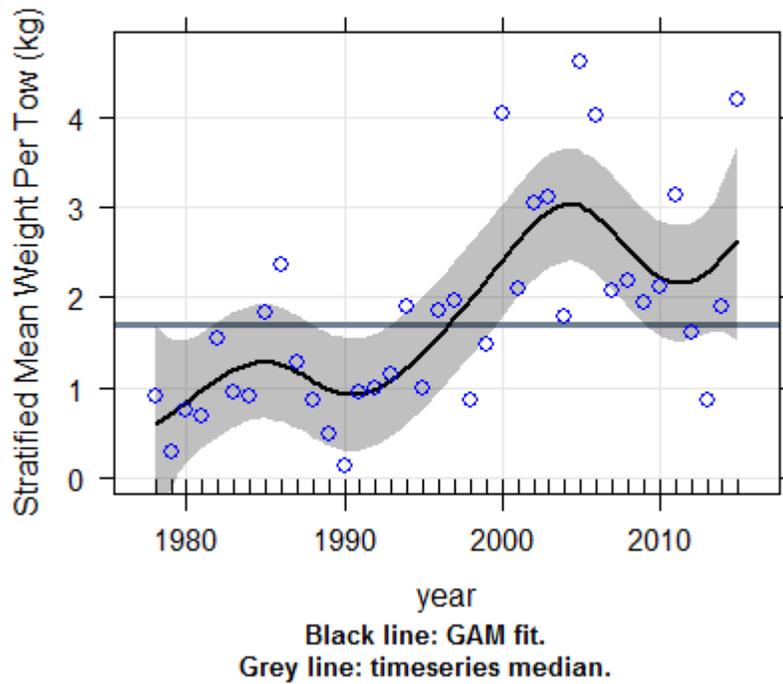
Summer Flounder Biomass MDMF Spring Survey, Regions 1-5



Dashed lines represent
95% CI on Bootstrapped Mean

Figure 2 *continued*. Paired figures of stratified mean weight per tow (kg) with (top) GAM smoothed trend line and (bottom) 95% confidence interval on bootstrapped mean. 1978 – 2015 Massachusetts DMF Trawl survey.

Summer Flounder Biomass MDMF Fall Survey, Regions 1-5



Summer Flounder Biomass MDMF Fall Survey, Regions 1-5

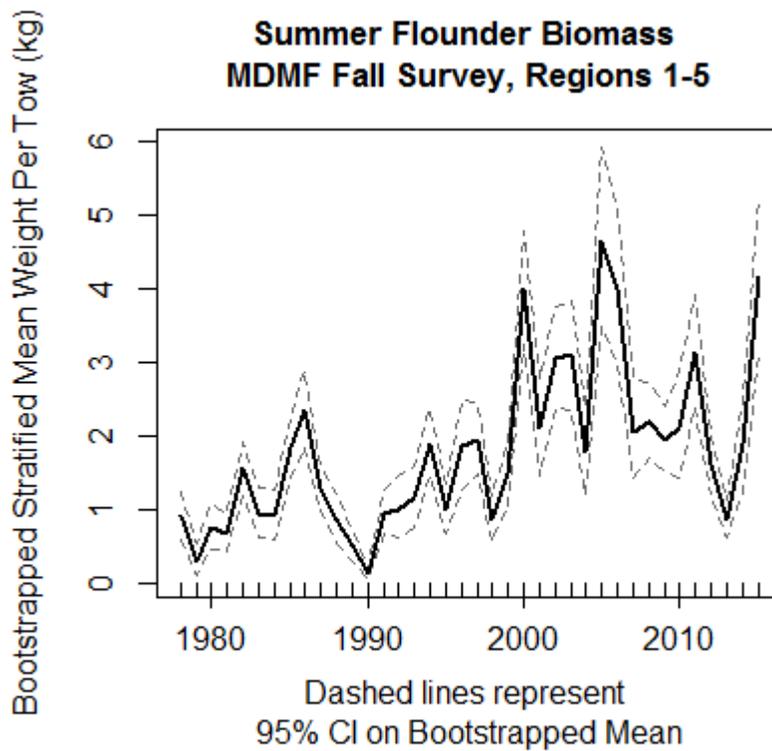
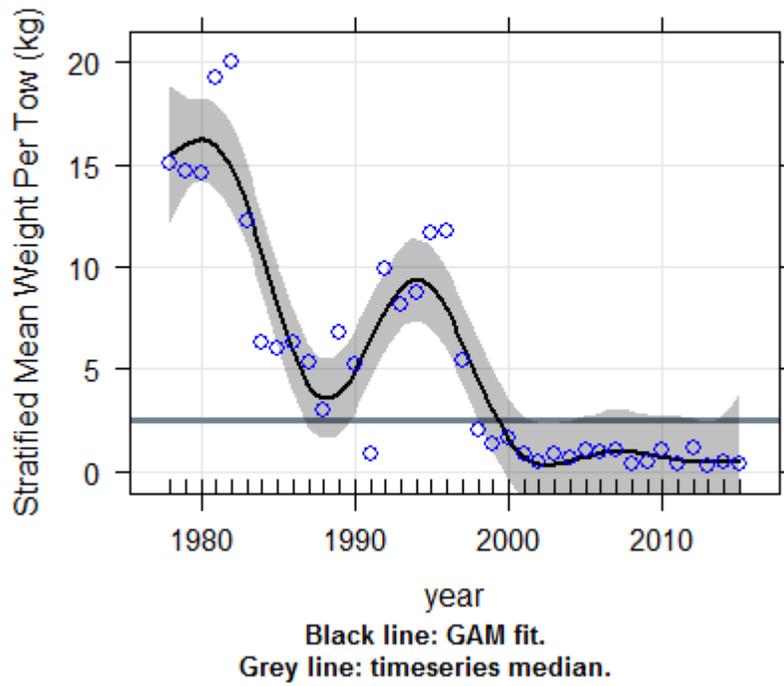


Figure 2 *continued*. Paired figures of stratified mean weight per tow (kg) with (top) GAM smoothed trend line and (bottom) 95% confidence interval on bootstrapped mean. 1978 – 2015 Massachusetts DMF Trawl survey.

Windowpane Flounder Biomass MDMF Spring Survey, Regions 1-3



Windowpane Flounder Biomass MDMF Spring Survey, Regions 1-3

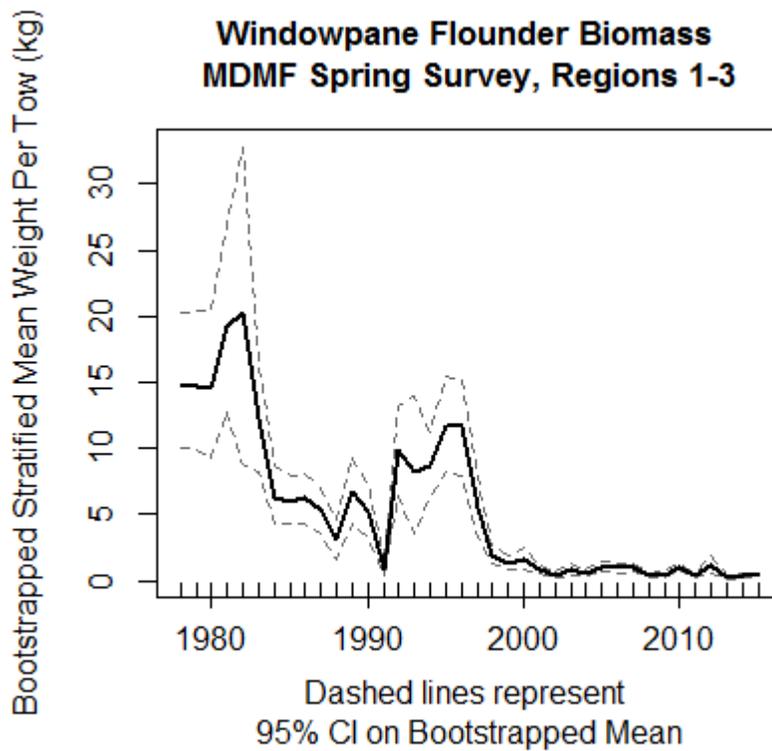


Figure 2 *continued*. Paired figures of stratified mean weight per tow (kg) with (top) GAM smoothed trend line and (bottom) 95% confidence interval on bootstrapped mean. 1978 – 2015 Massachusetts DMF Trawl survey.

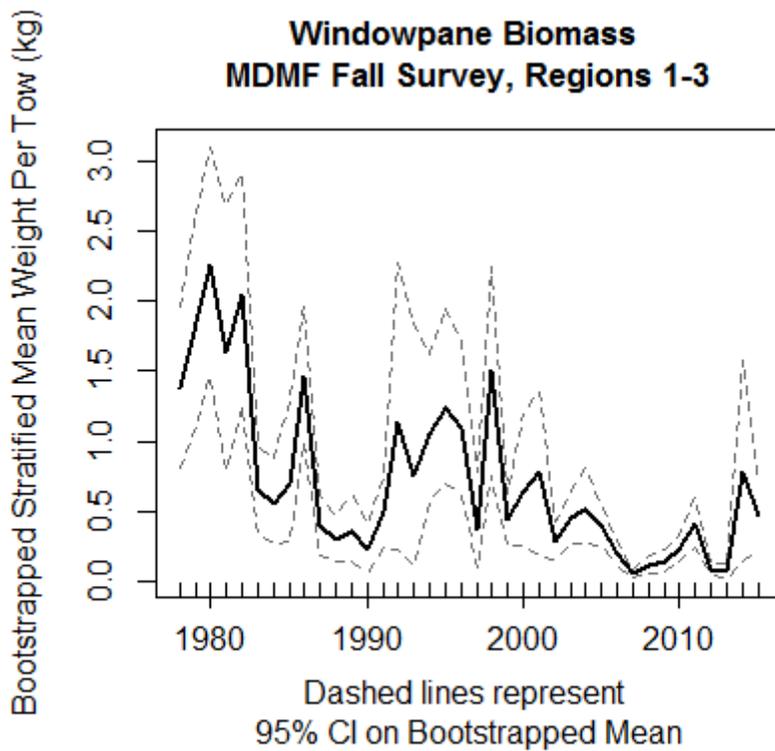
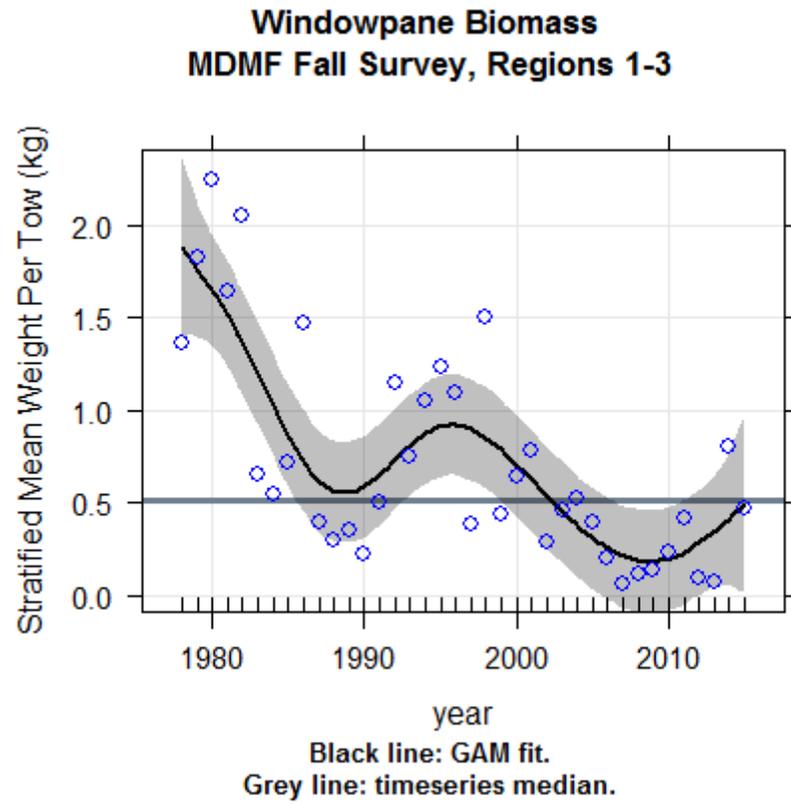
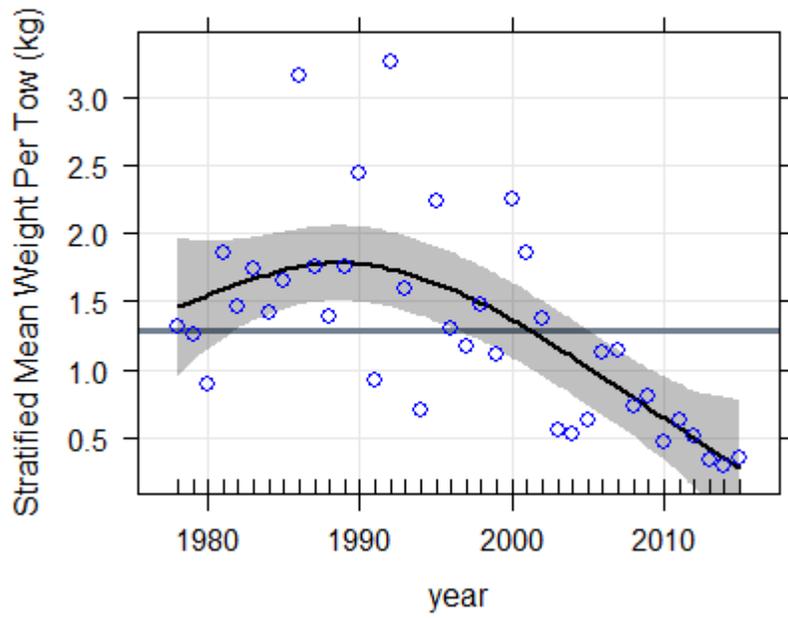


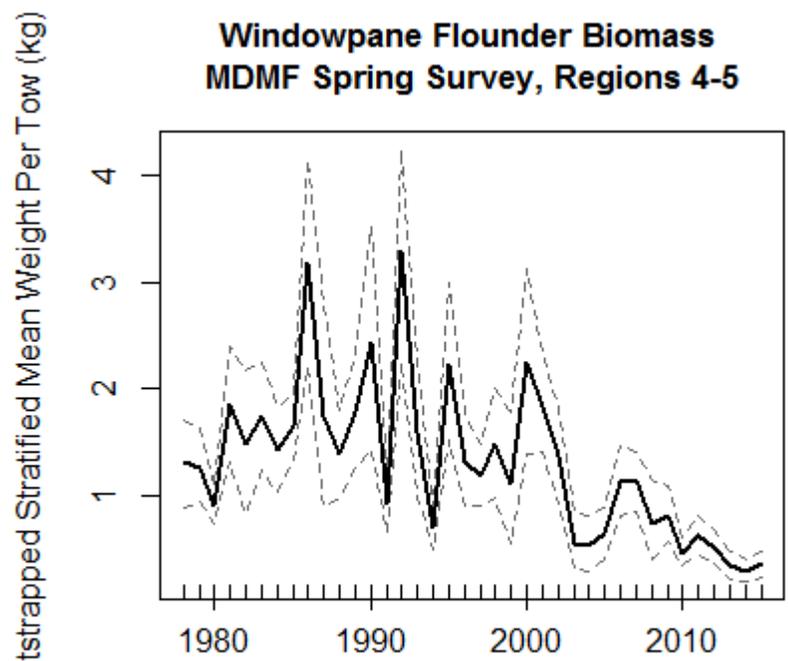
Figure 2 *continued*. Paired figures of stratified mean weight per tow (kg) with (top) GAM smoothed trend line and (bottom) 95% confidence interval on bootstrapped mean. 1978 – 2015 Massachusetts DMF Trawl survey.

Windowpane Flounder Biomass MDMF Spring Survey, Regions 4-5



Black line: GAM fit.
Grey line: timeseries median.

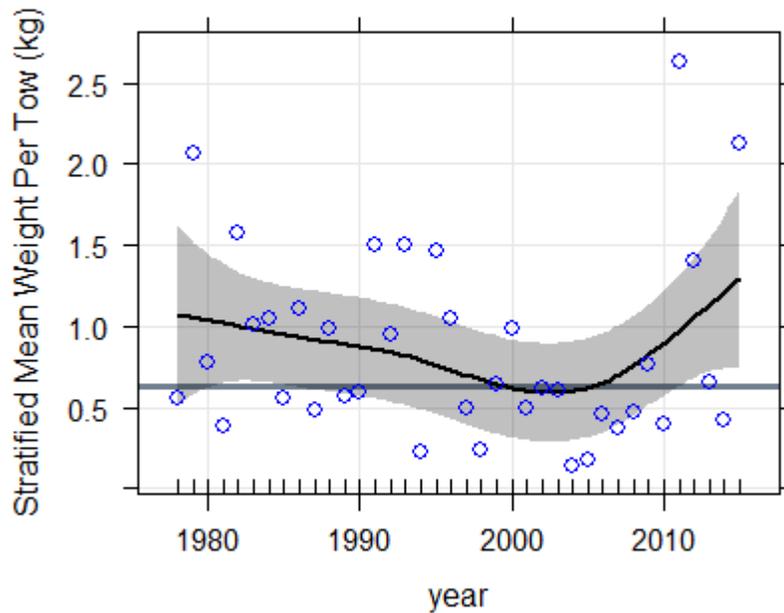
Windowpane Flounder Biomass MDMF Spring Survey, Regions 4-5



Dashed lines represent
95% CI on Bootstrapped Mean

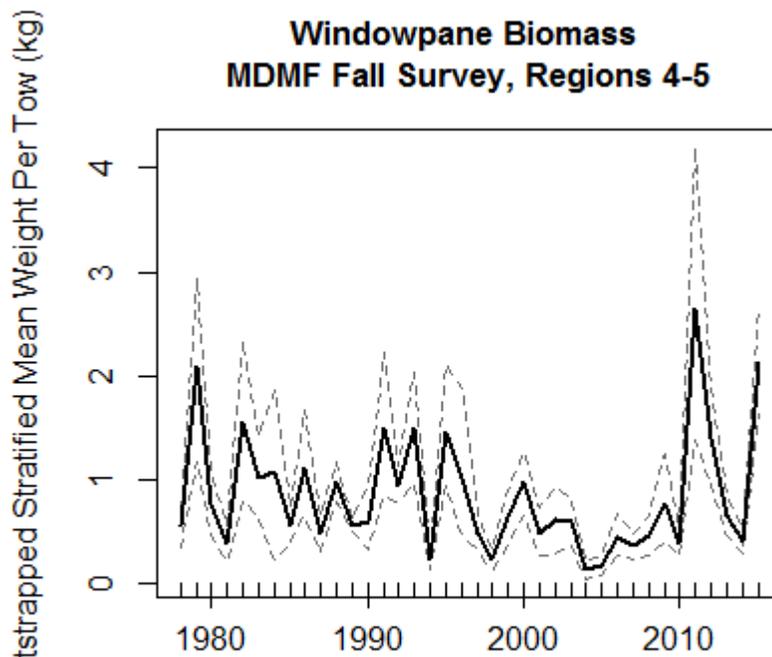
Figure 2 *continued*. Paired figures of stratified mean weight per tow (kg) with (top) GAM smoothed trend line and (bottom) 95% confidence interval on bootstrapped mean. 1978 – 2015 Massachusetts DMF Trawl survey.

Windowpane Biomass MDMF Fall Survey, Regions 4-5



Black line: GAM fit.
Grey line: timeseries median.

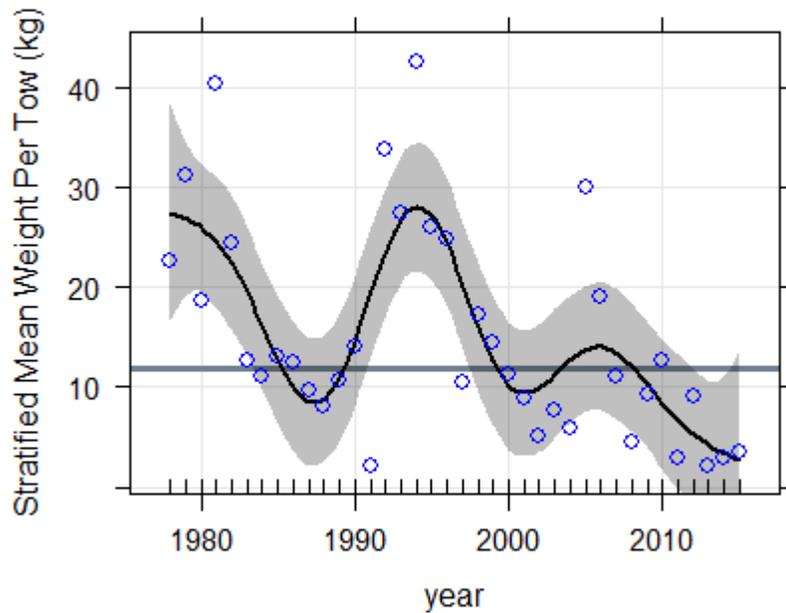
Windowpane Biomass MDMF Fall Survey, Regions 4-5



Dashed lines represent
95% CI on Bootstrapped Mean

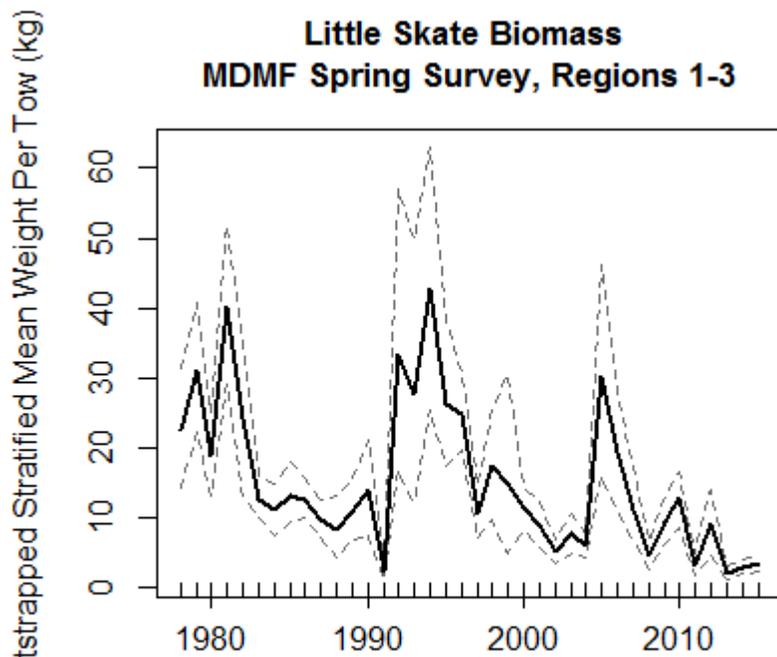
Figure 2 *continued*. Paired figures of stratified mean weight per tow (kg) with (top) GAM smoothed trend line and (bottom) 95% confidence interval on bootstrapped mean. 1978 – 2015 Massachusetts DMF Trawl survey.

Little Skate Biomass MDMF Spring Survey, Regions 1-3



Black line: GAM fit.
Grey line: timeseries median.

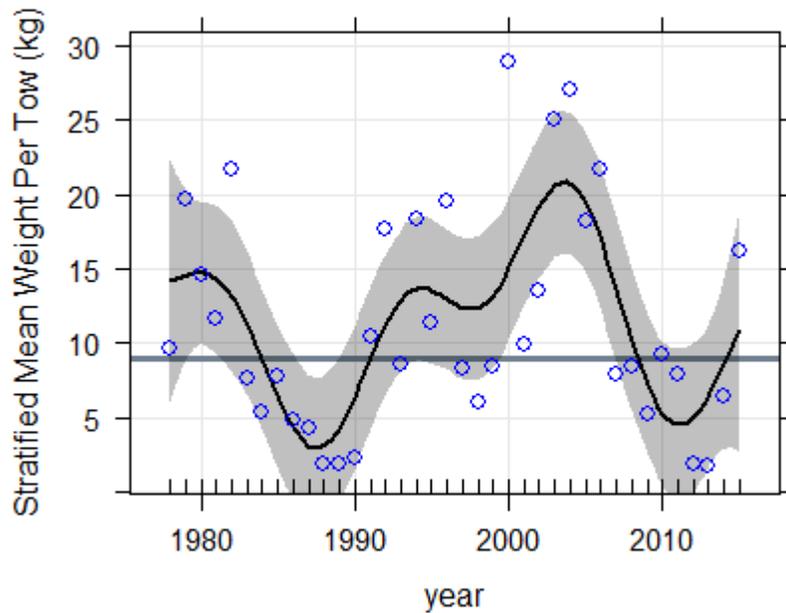
Little Skate Biomass MDMF Spring Survey, Regions 1-3



Dashed lines represent
95% CI on Bootstrapped Mean

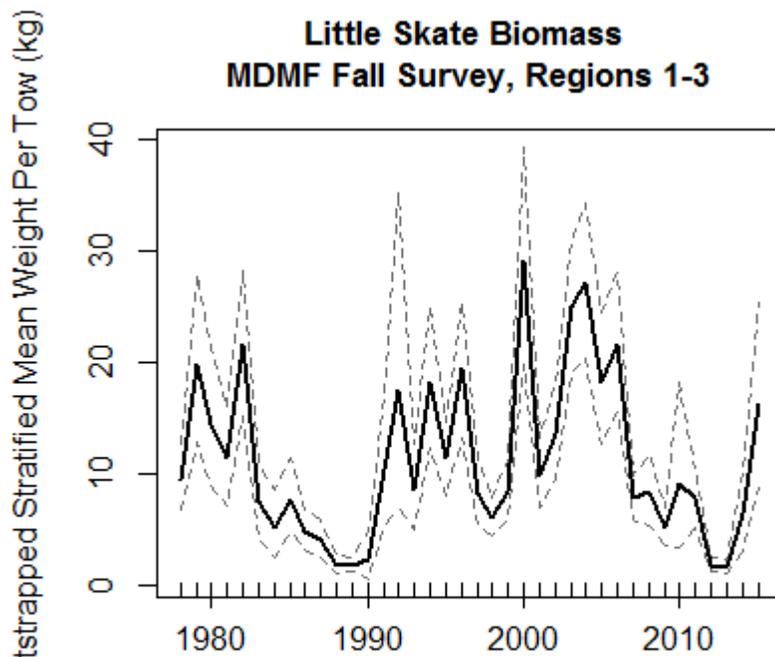
Figure 2 *continued*. Paired figures of stratified mean weight per tow (kg) with (top) GAM smoothed trend line and (bottom) 95% confidence interval on bootstrapped mean. 1978 – 2015 Massachusetts DMF Trawl survey.

Little Skate Biomass MDMF Fall Survey, Regions 1-3



Black line: GAM fit.
Grey line: timeseries median.

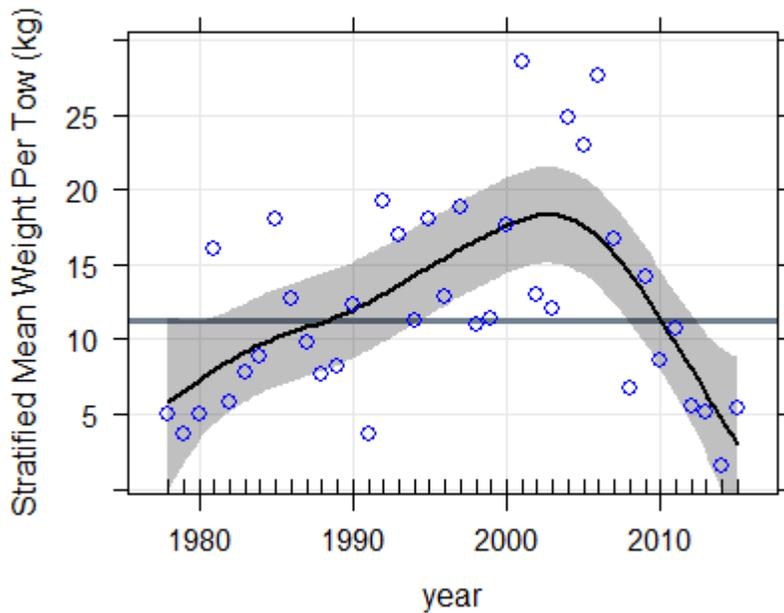
Little Skate Biomass MDMF Fall Survey, Regions 1-3



Dashed lines represent
95% CI on Bootstrapped Mean

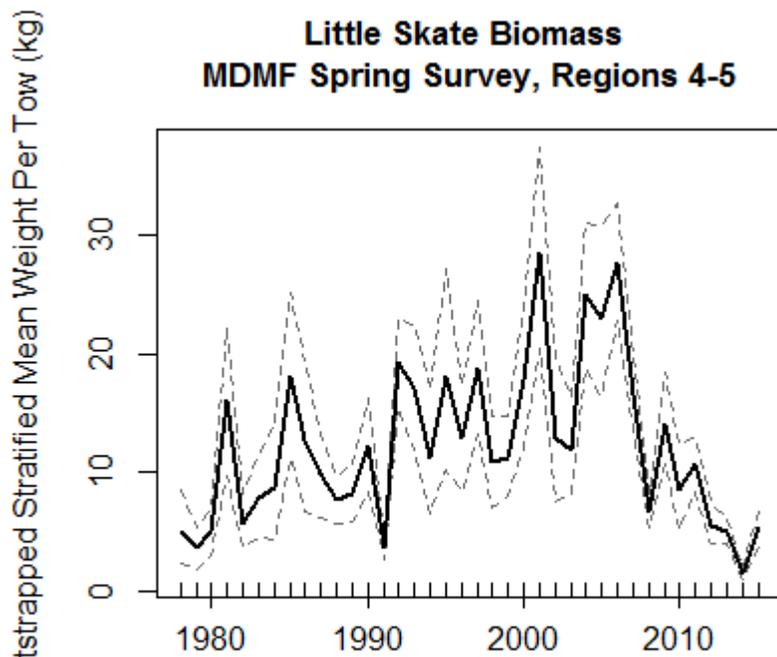
Figure 2 *continued*. Paired figures of stratified mean weight per tow (kg) with (top) GAM smoothed trend line and (bottom) 95% confidence interval on bootstrapped mean. 1978 – 2015 Massachusetts DMF Trawl survey.

Little Skate Biomass MDMF Spring Survey, Regions 4-5



Black line: GAM fit.
Grey line: timeseries median.

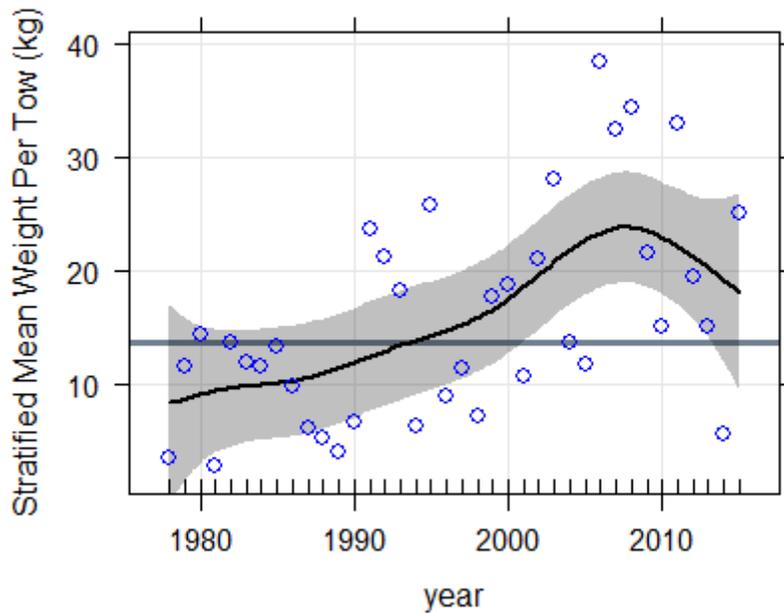
Little Skate Biomass MDMF Spring Survey, Regions 4-5



Dashed lines represent
95% CI on Bootstrapped Mean

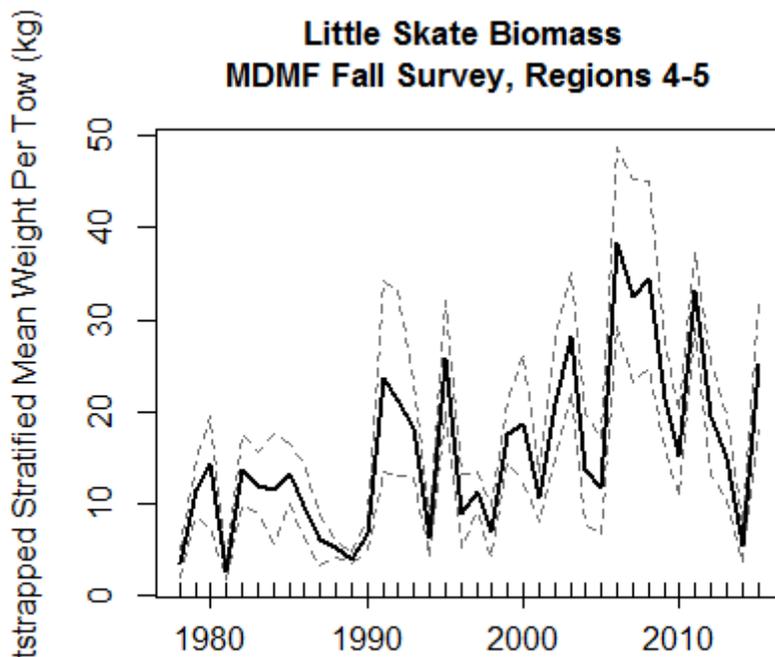
Figure 2 *continued*. Paired figures of stratified mean weight per tow (kg) with (top) GAM smoothed trend line and (bottom) 95% confidence interval on bootstrapped mean. 1978 – 2015 Massachusetts DMF Trawl survey.

Little Skate Biomass MDMF Fall Survey, Regions 4-5



Black line: GAM fit.
Grey line: timeseries median.

Little Skate Biomass MDMF Fall Survey, Regions 4-5



Dashed lines represent
95% CI on Bootstrapped Mean

Figure 2 *continued*. Paired figures of stratified mean weight per tow (kg) with (top) GAM smoothed trend line and (bottom) 95% confidence interval on bootstrapped mean. 1978 – 2015 Massachusetts DMF Trawl survey.

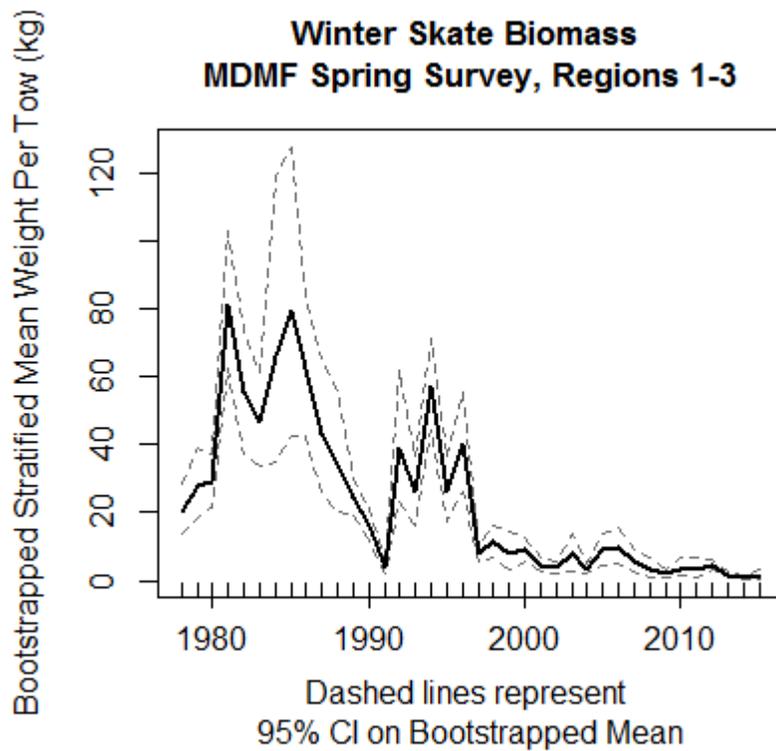
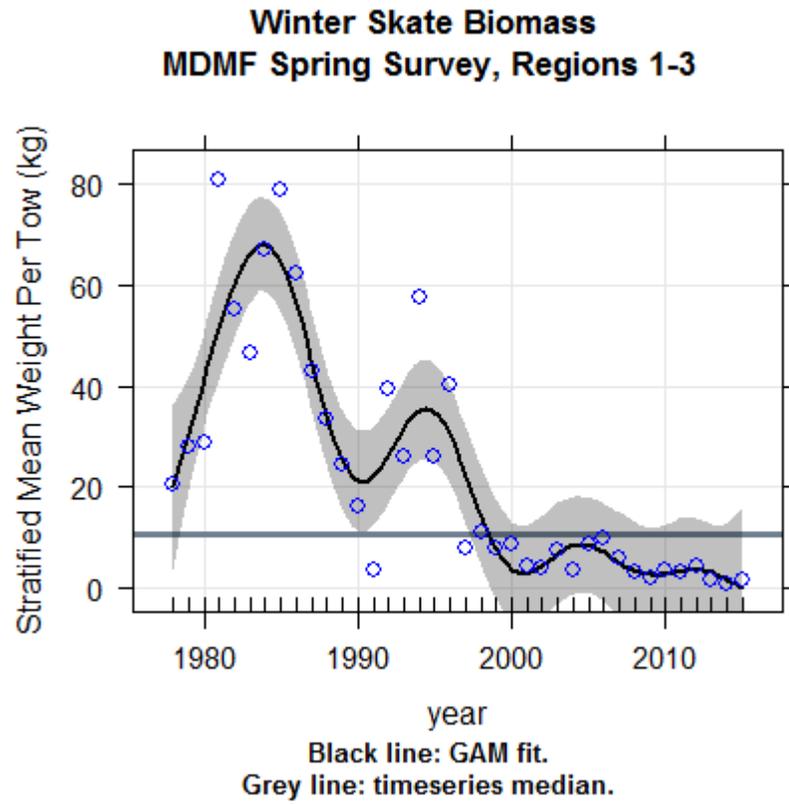
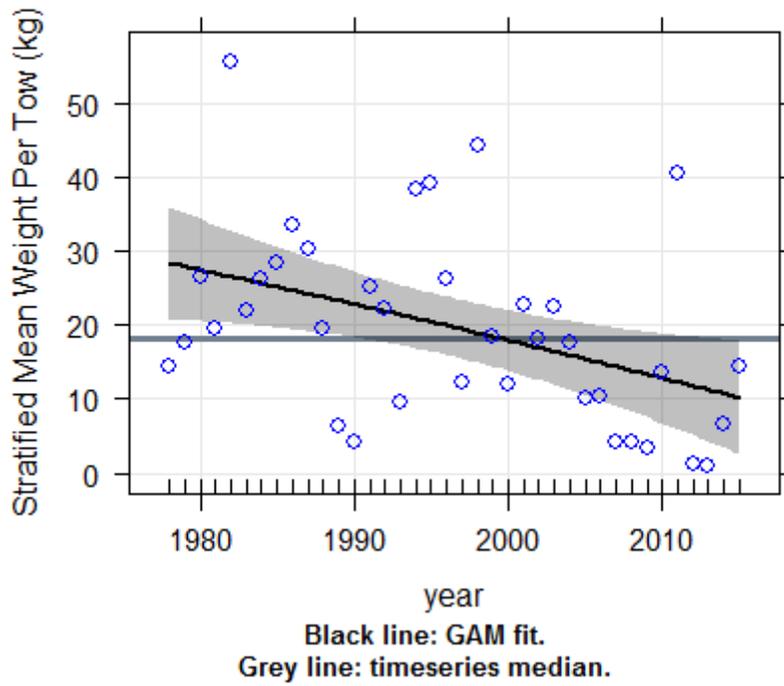


Figure 2 *continued*. Paired figures of stratified mean weight per tow (kg) with (top) GAM smoothed trend line and (bottom) 95% confidence interval on bootstrapped mean. 1978 – 2015 Massachusetts DMF Trawl survey.

Winter Skate Biomass MDMF Fall Survey, Regions 1-3



Winter Skate Biomass MDMF Fall Survey, Regions 1-3

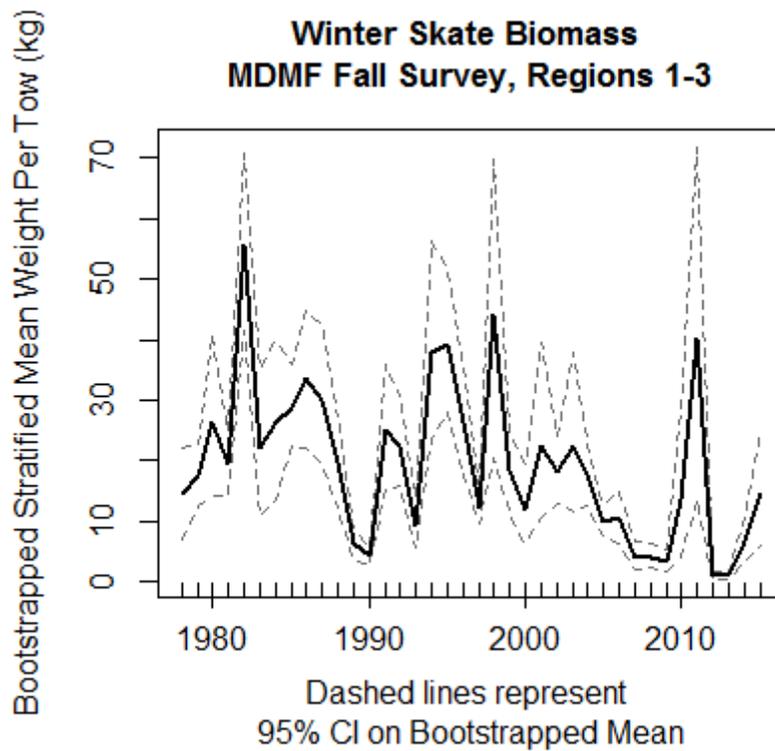
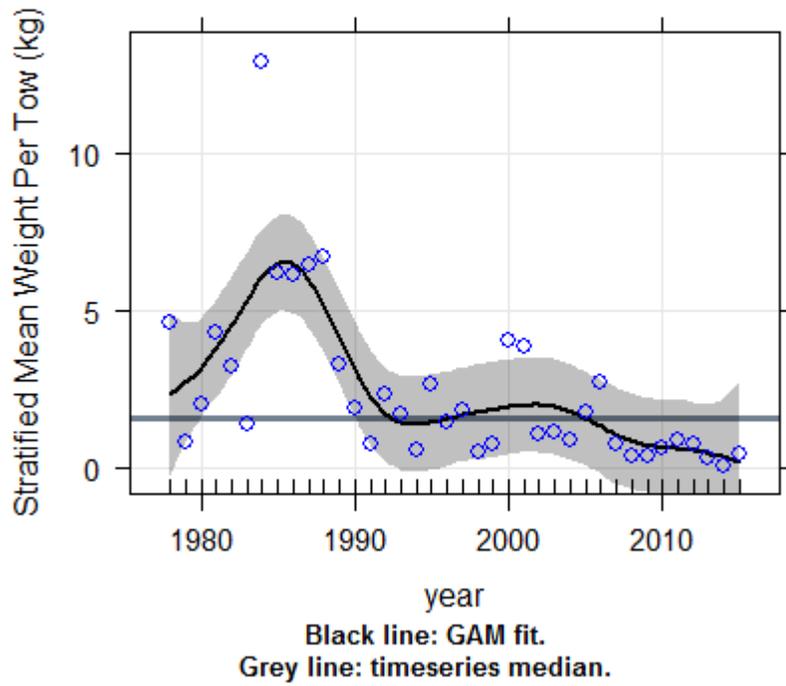


Figure 2 *continued*. Paired figures of stratified mean weight per tow (kg) with (top) GAM smoothed trend line and (bottom) 95% confidence interval on bootstrapped mean. 1978 – 2015 Massachusetts DMF Trawl survey.

Winter Skate Biomass MDMF Spring Survey, Regions 4-5



Winter Skate Biomass MDMF Spring Survey, Regions 4-5

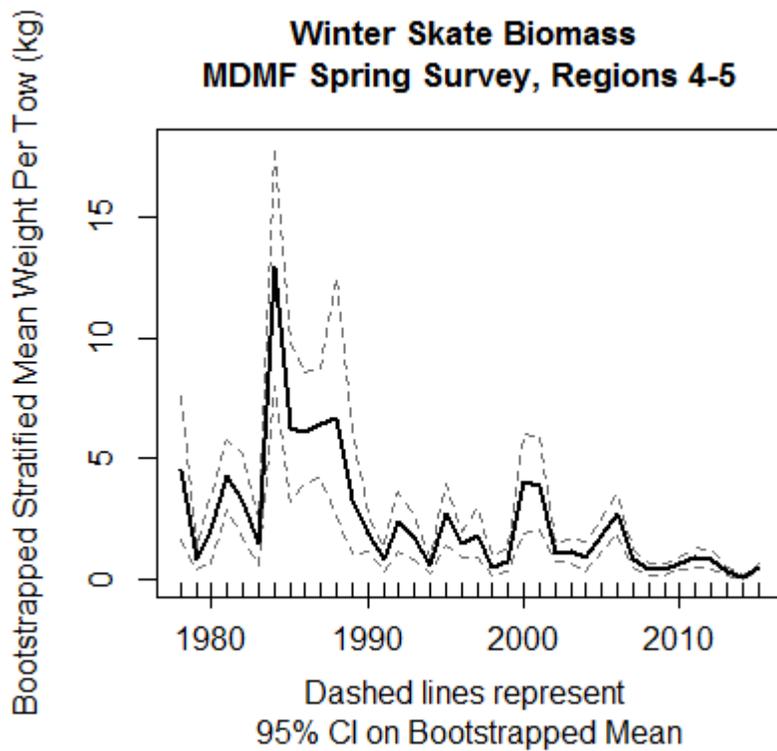
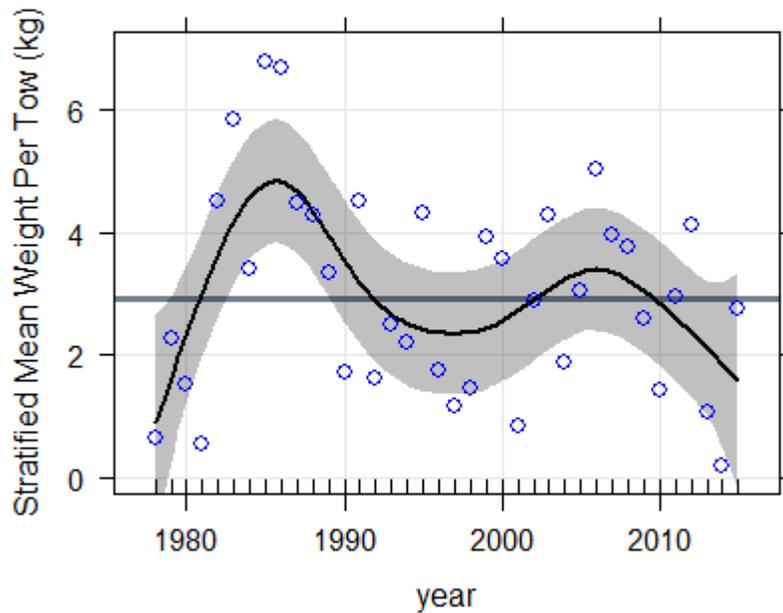


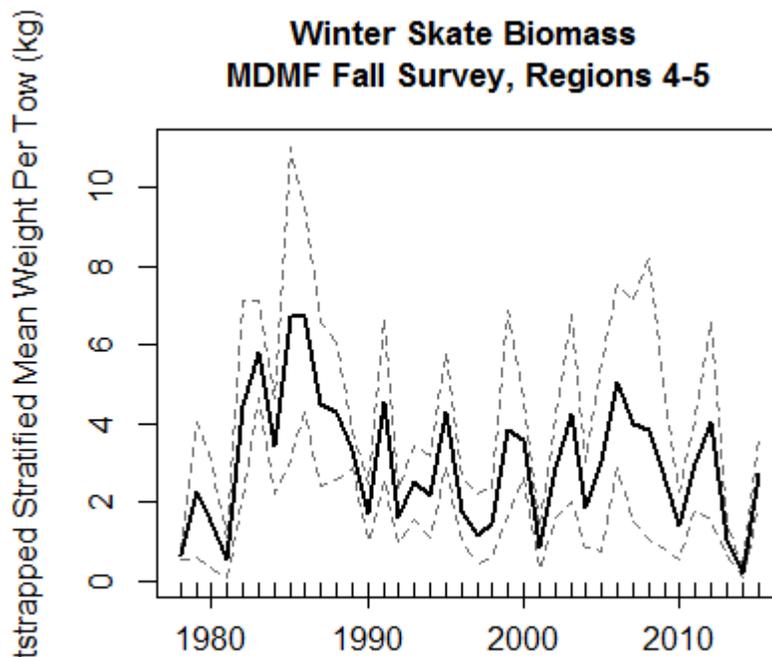
Figure 2 *continued*. Paired figures of stratified mean weight per tow (kg) with (top) GAM smoothed trend line and (bottom) 95% confidence interval on bootstrapped mean. 1978 – 2015 Massachusetts DMF Trawl survey.

Winter Skate Biomass MDMF Fall Survey, Regions 4-5



Black line: GAM fit.
Grey line: timeseries median.

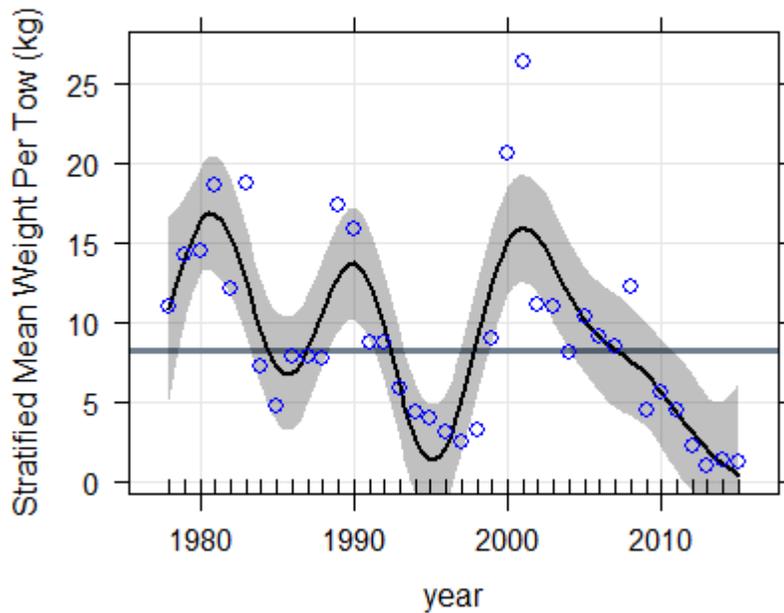
Winter Skate Biomass MDMF Fall Survey, Regions 4-5



Dashed lines represent
95% CI on Bootstrapped Mean

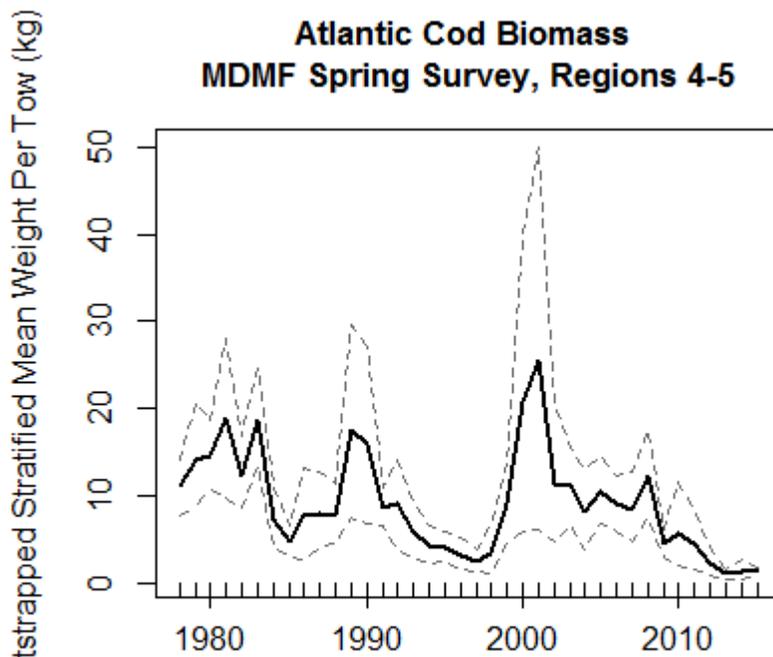
Figure 2 *continued*. Paired figures of stratified mean weight per tow (kg) with (top) GAM smoothed trend line and (bottom) 95% confidence interval on bootstrapped mean. 1978 – 2015 Massachusetts DMF Trawl survey.

Atlantic Cod Biomass MDMF Spring Survey, Regions 4-5



Black line: GAM fit.
Grey line: timeseries median.

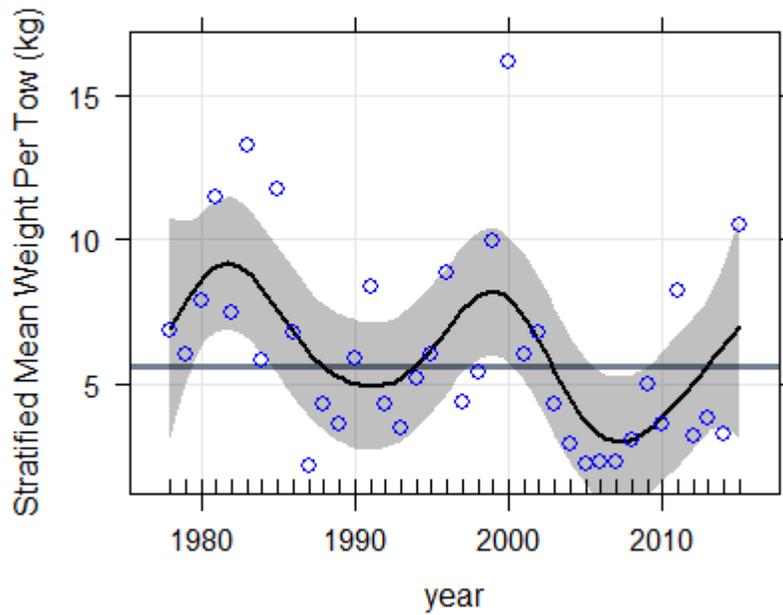
Atlantic Cod Biomass MDMF Spring Survey, Regions 4-5



Dashed lines represent
95% CI on Bootstrapped Mean

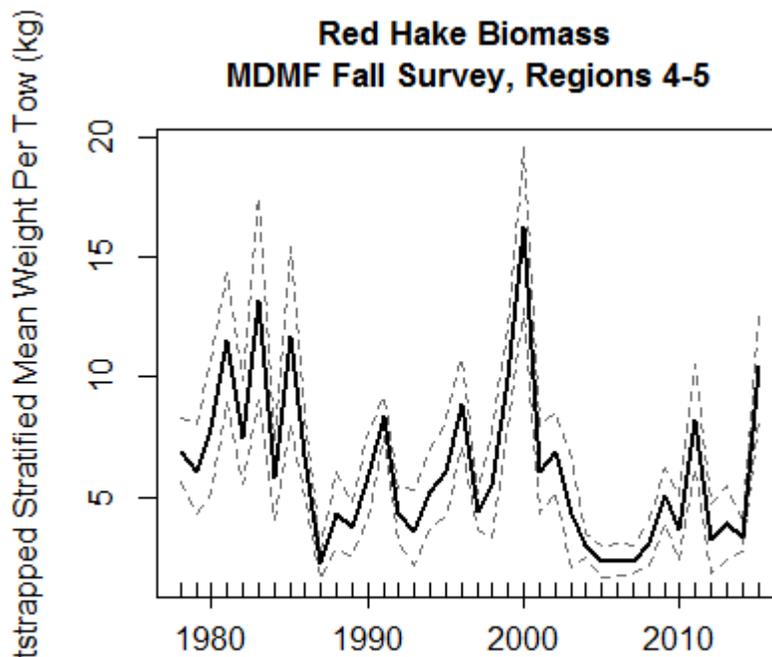
Figure 2 *continued*. Paired figures of stratified mean weight per tow (kg) with (top) GAM smoothed trend line and (bottom) 95% confidence interval on bootstrapped mean. 1978 – 2015 Massachusetts DMF Trawl survey.

Red Hake Biomass MDMF Fall Survey, Regions 4-5



Black line: GAM fit.
Grey line: timeseries median.

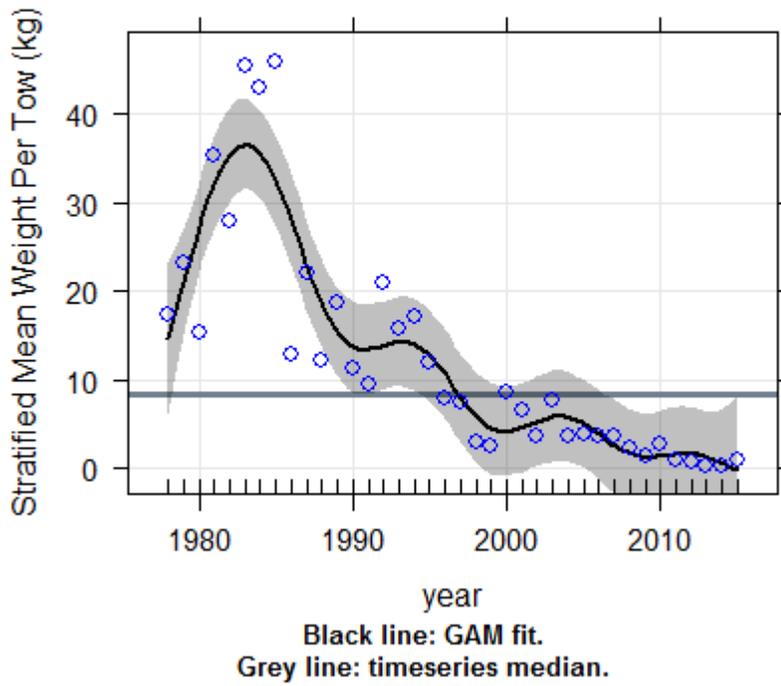
Red Hake Biomass MDMF Fall Survey, Regions 4-5



Dashed lines represent
95% CI on Bootstrapped Mean

Figure 2 *continued*. Paired figures of stratified mean weight per tow (kg) with (top) GAM smoothed trend line and (bottom) 95% confidence interval on bootstrapped mean. 1978 – 2015 Massachusetts DMF Trawl survey.

Ocean Pout Biomass MDMF Spring Survey, Regions 1-5



Ocean Pout Biomass MDMF Spring Survey, Regions 1-5

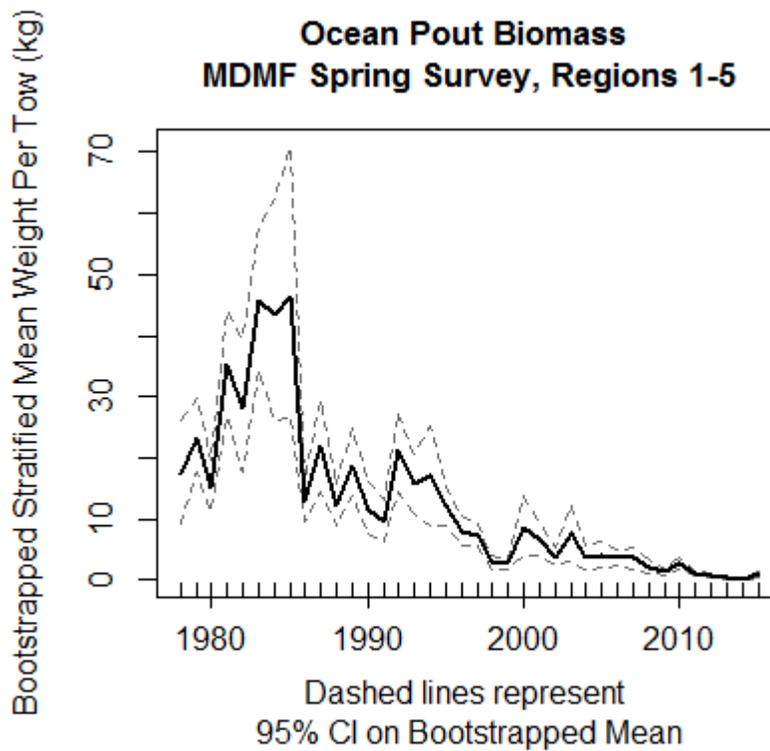
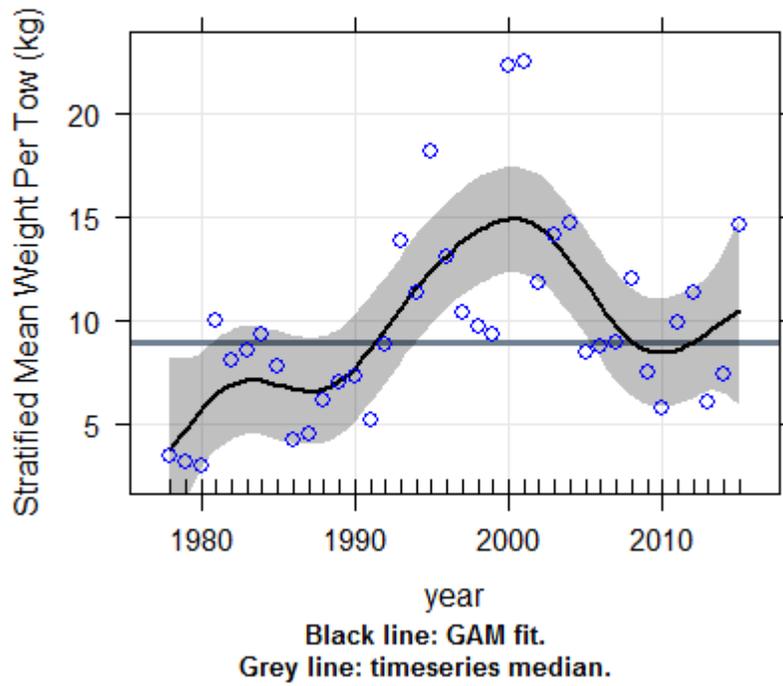


Figure 2 *continued*. Paired figures of stratified mean weight per tow (kg) with (top) GAM smoothed trend line and (bottom) 95% confidence interval on bootstrapped mean. 1978 – 2015 Massachusetts DMF Trawl survey.

Longhorn Sculpin Biomass MDMF Spring Survey, Regions 3-5



Longhorn Sculpin Biomass MDMF Spring Survey, Regions 3-5

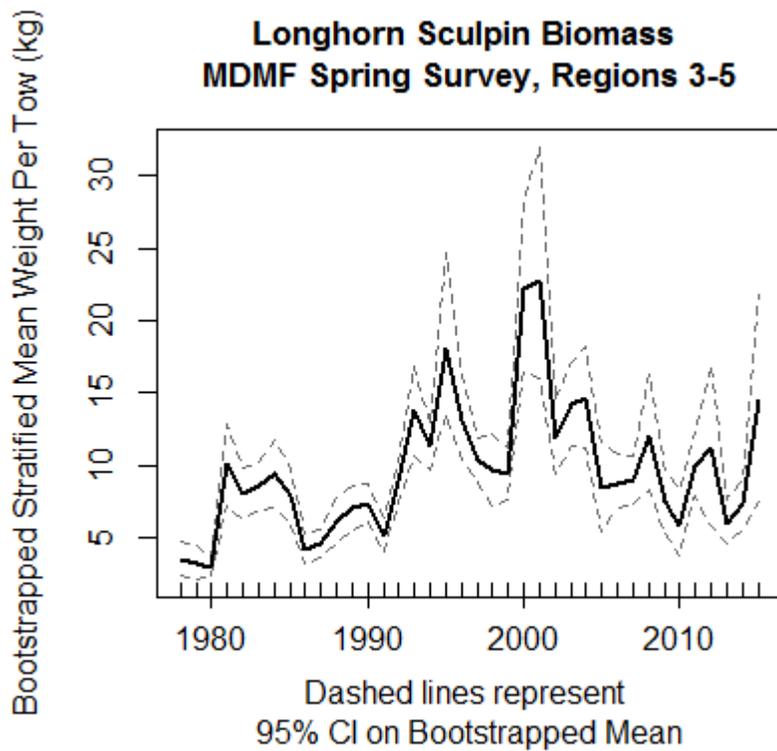


Figure 2 *continued*. Paired figures of stratified mean weight per tow (kg) with (top) GAM smoothed trend line and (bottom) 95% confidence interval on bootstrapped mean. 1978 – 2015 Massachusetts DMF Trawl survey.

Longhorn Sculpin Biomass MDMF Fall Survey, Regions 3-5

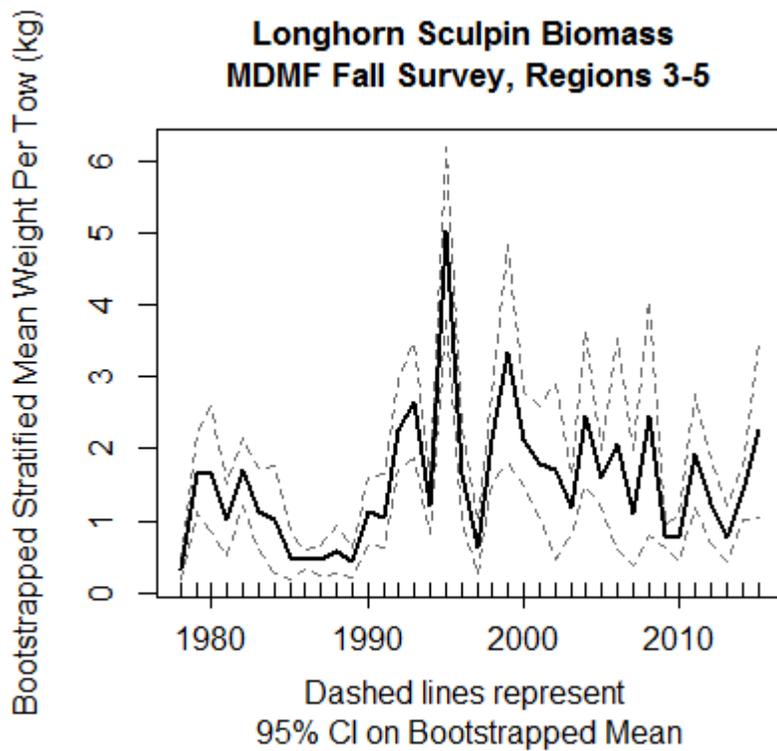
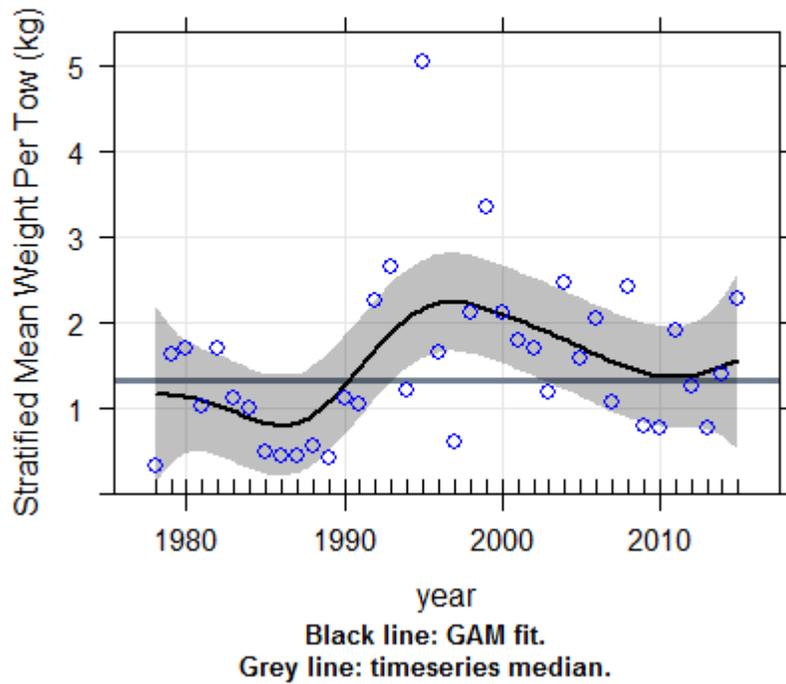
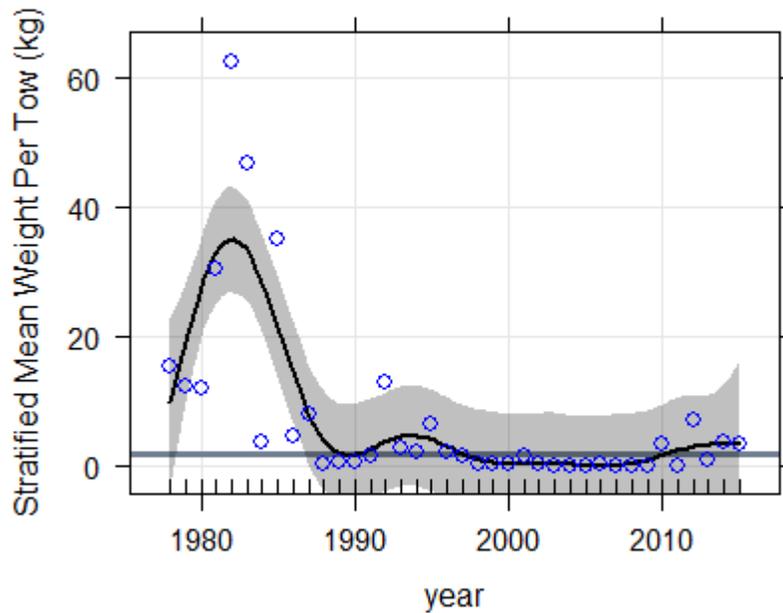


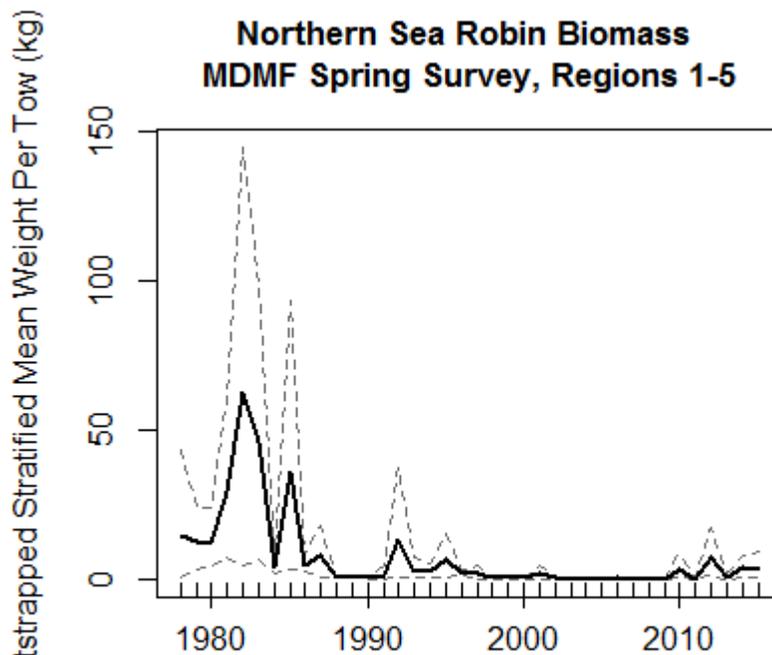
Figure 2 *continued*. Paired figures of stratified mean weight per tow (kg) with (top) GAM smoothed trend line and (bottom) 95% confidence interval on bootstrapped mean. 1978 – 2015 Massachusetts DMF Trawl survey.

Northern Sea Robin Biomass MDMF Spring Survey, Regions 1-5



Black line: GAM fit.
Grey line: timeseries median.

Northern Sea Robin Biomass MDMF Spring Survey, Regions 1-5



Dashed lines represent
95% CI on Bootstrapped Mean

Figure 2 *continued*. Paired figures of stratified mean weight per tow (kg) with (top) GAM smoothed trend line and (bottom) 95% confidence interval on bootstrapped mean. 1978 – 2015 Massachusetts DMF Trawl survey.

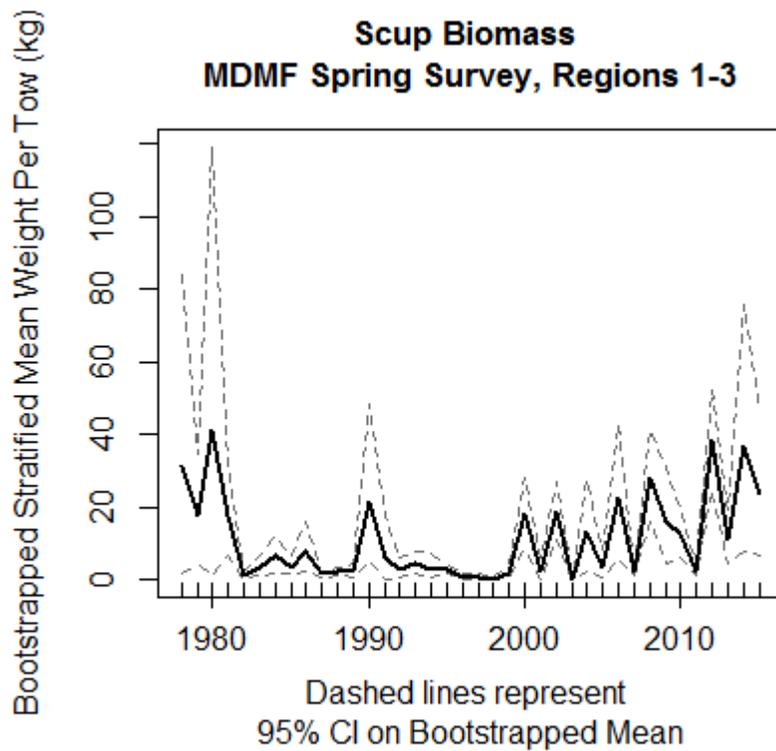
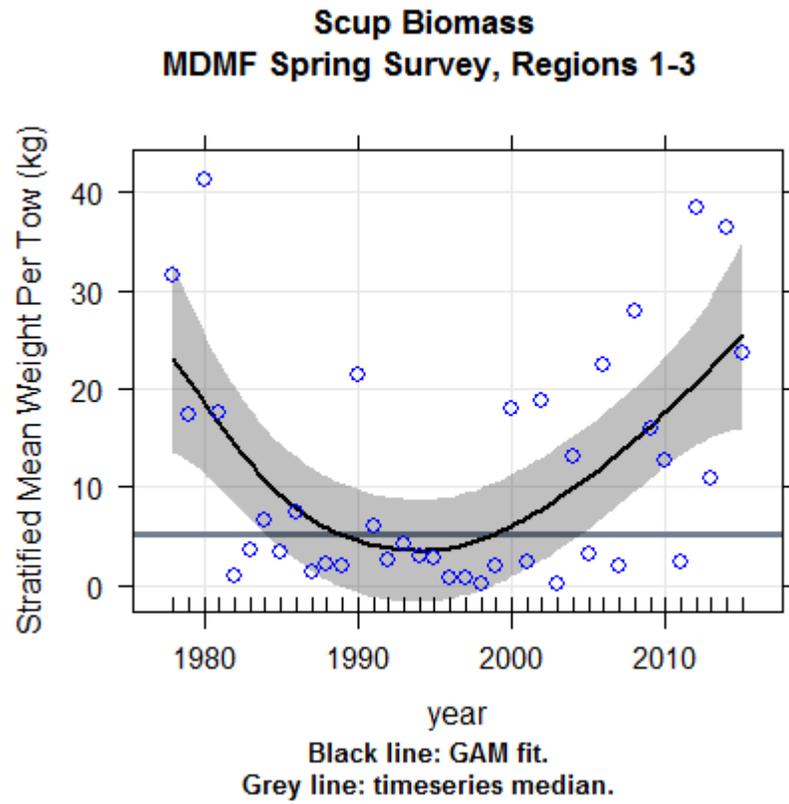


Figure 2 *continued*. Paired figures of stratified mean weight per tow (kg) with (top) GAM smoothed trend line and (bottom) 95% confidence interval on bootstrapped mean. 1978 – 2015 Massachusetts DMF Trawl survey.

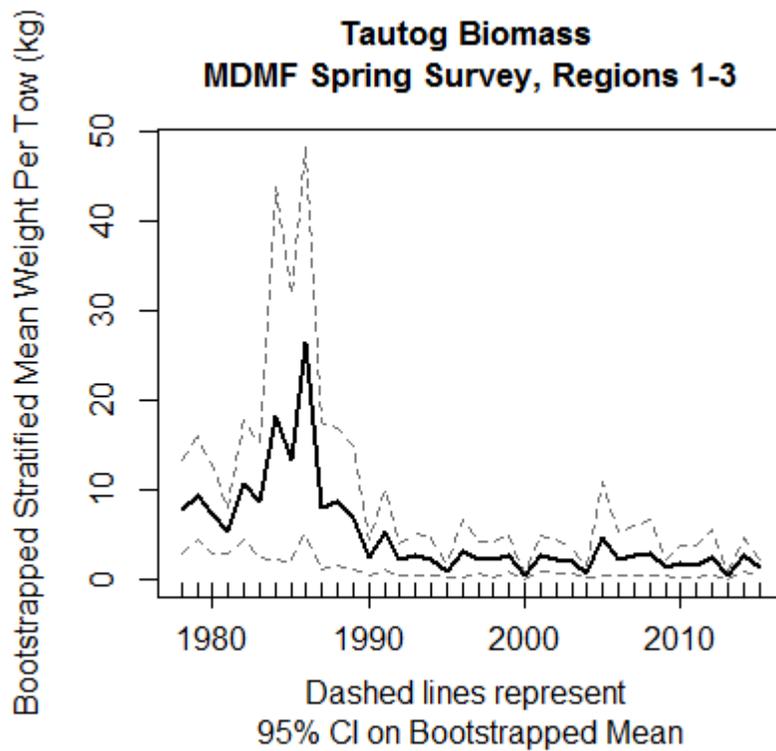
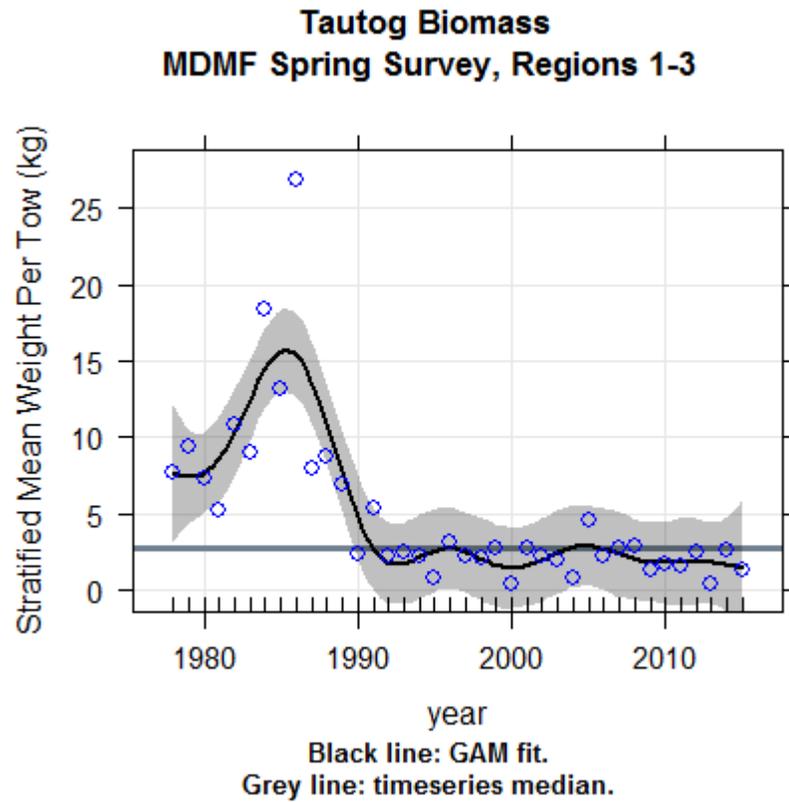
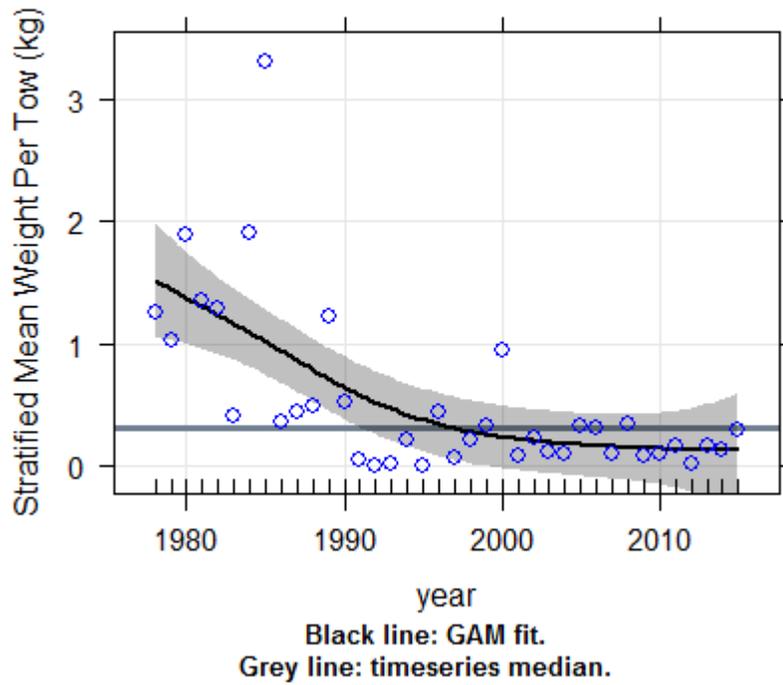


Figure 2 *continued*. Paired figures of stratified mean weight per tow (kg) with (top) GAM smoothed trend line and (bottom) 95% confidence interval on bootstrapped mean. 1978 – 2015 Massachusetts DMF Trawl survey.

Tautog Biomass MDMF Fall Survey, Regions 1-3



Tautog Biomass MDMF Fall Survey, Regions 1-3

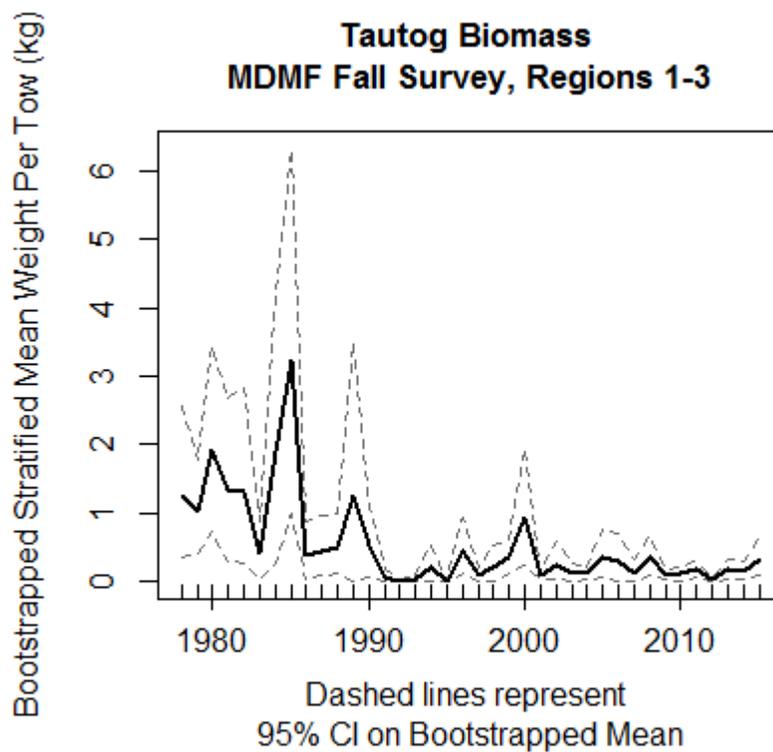
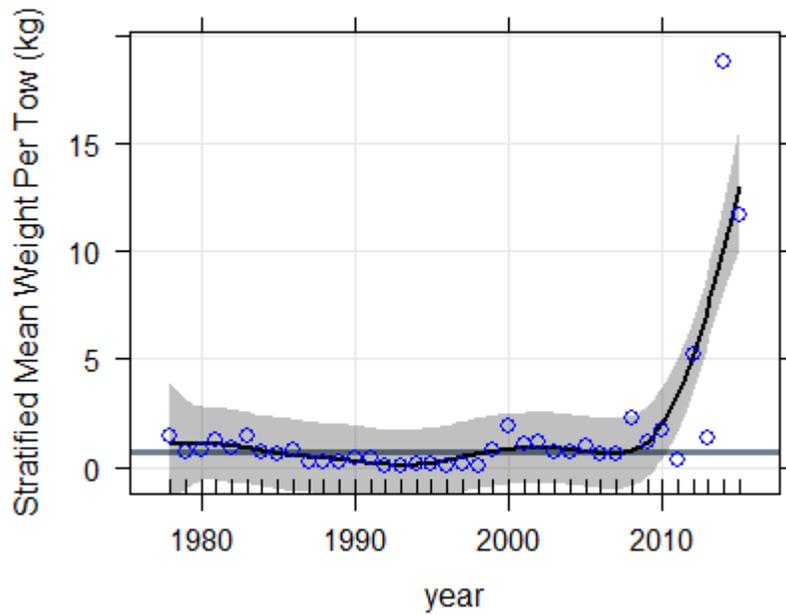


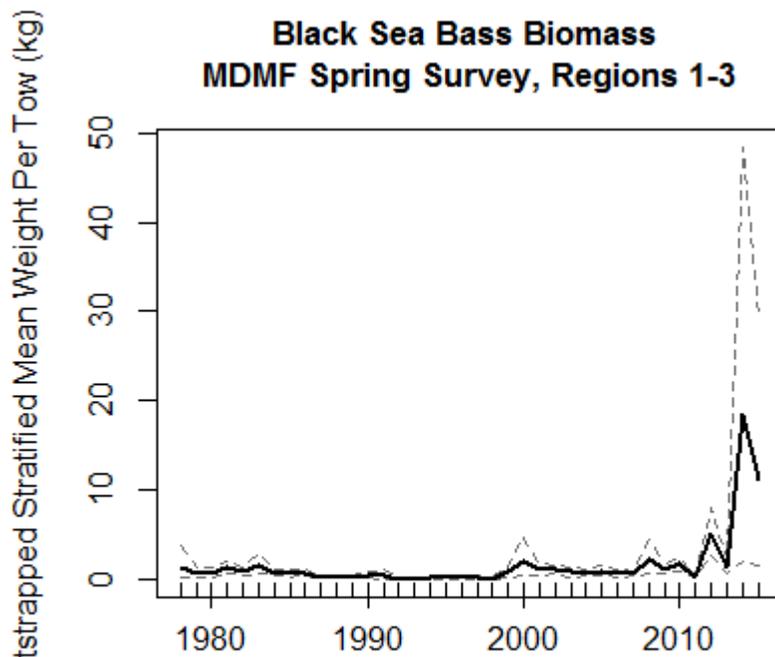
Figure 2 *continued*. Paired figures of stratified mean weight per tow (kg) with (top) GAM smoothed trend line and (bottom) 95% confidence interval on bootstrapped mean. 1978 – 2015 Massachusetts DMF Trawl survey.

Black Sea Bass Biomass MDMF Spring Survey, Regions 1-3



Black line: GAM fit.
Grey line: timeseries median.

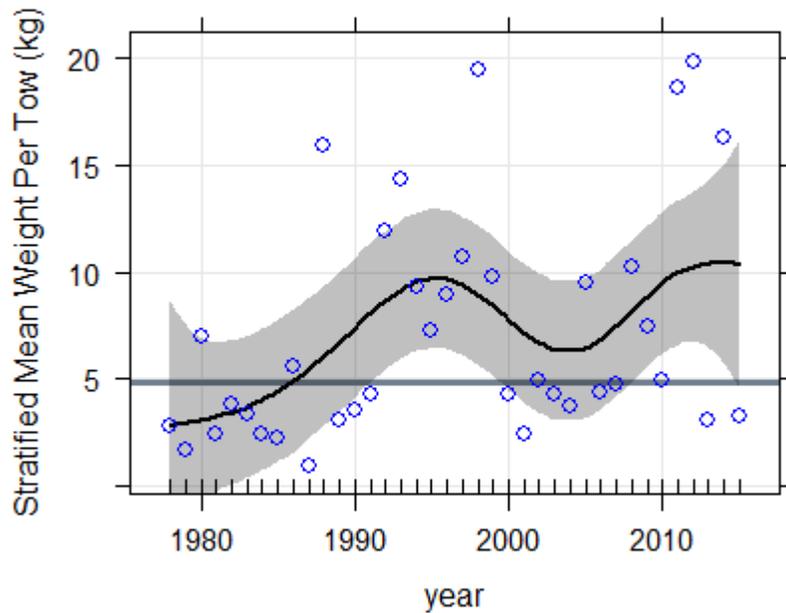
Black Sea Bass Biomass MDMF Spring Survey, Regions 1-3



Dashed lines represent
95% CI on Bootstrapped Mean

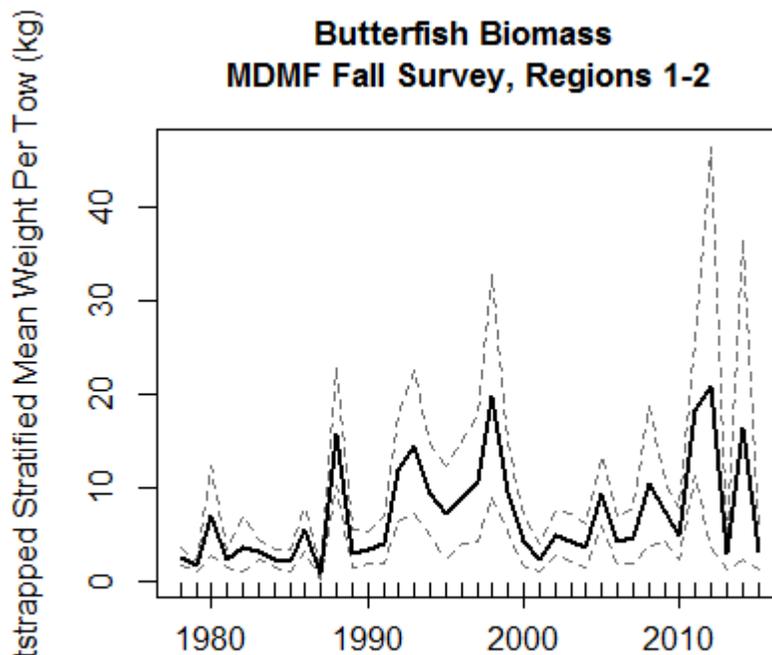
Figure 2 *continued*. Paired figures of stratified mean weight per tow (kg) with (top) GAM smoothed trend line and (bottom) 95% confidence interval on bootstrapped mean. 1978 – 2015 Massachusetts DMF Trawl survey.

Butterfish Biomass MDMF Fall Survey, Regions 1-2



Black line: GAM fit.
Grey line: timeseries median.

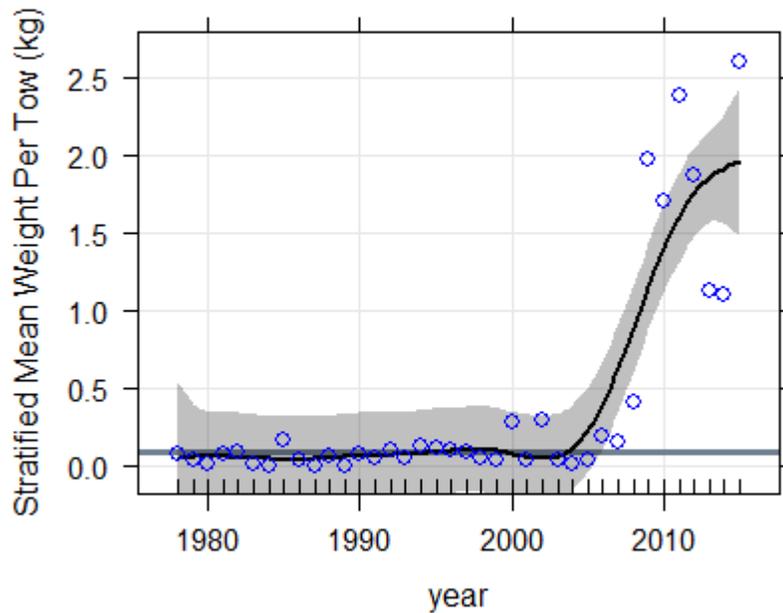
Butterfish Biomass MDMF Fall Survey, Regions 1-2



Dashed lines represent
95% CI on Bootstrapped Mean

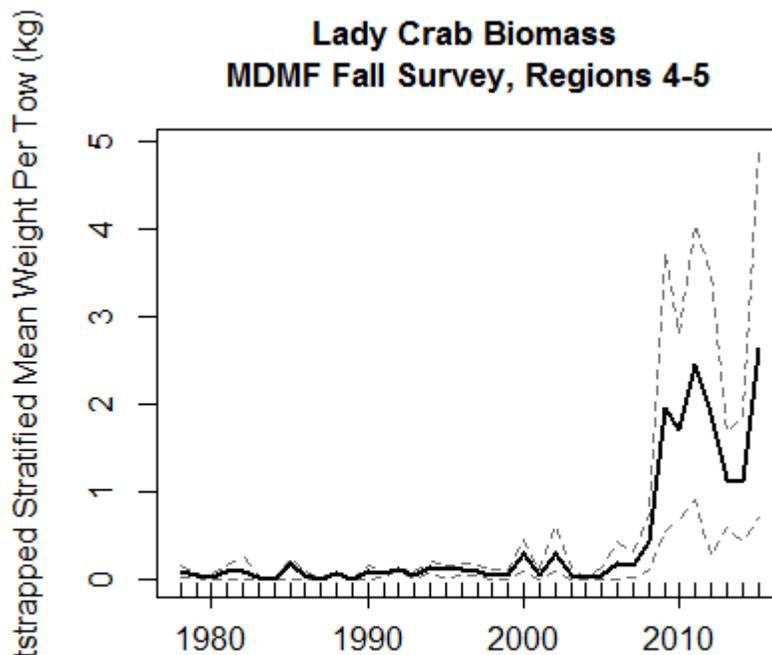
Figure 2 *continued*. Paired figures of stratified mean weight per tow (kg) with (top) GAM smoothed trend line and (bottom) 95% confidence interval on bootstrapped mean. 1978 – 2015 Massachusetts DMF Trawl survey.

Lady Crab Biomass MDMF Fall Survey, Regions 4-5



Black line: GAM fit.
Grey line: timeseries median.

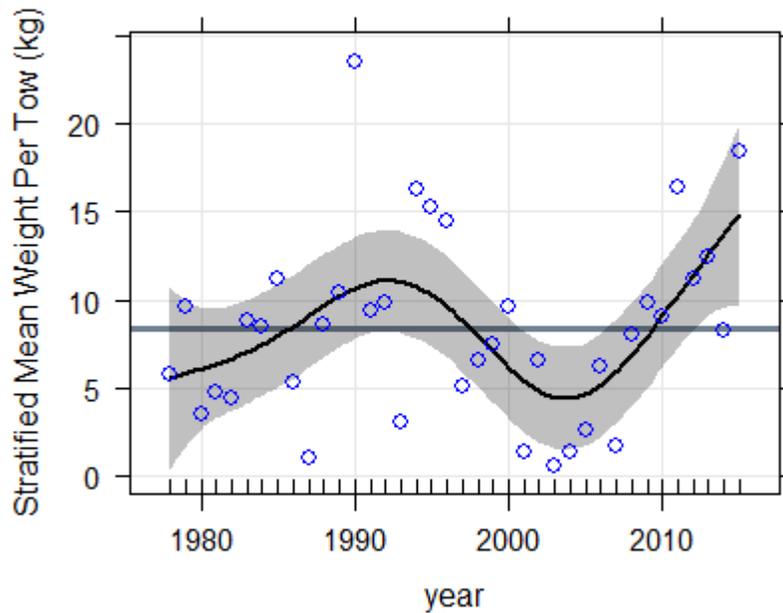
Lady Crab Biomass MDMF Fall Survey, Regions 4-5



Dashed lines represent
95% CI on Bootstrapped Mean

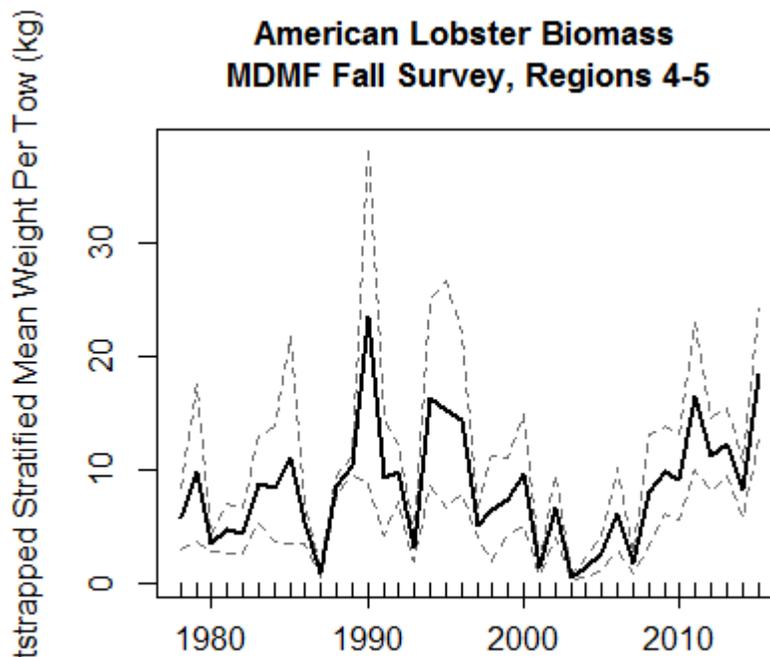
Figure 2 *continued*. Paired figures of stratified mean weight per tow (kg) with (top) GAM smoothed trend line and (bottom) 95% confidence interval on bootstrapped mean. 1978 – 2015 Massachusetts DMF Trawl survey.

American Lobster Biomass MDMF Fall Survey, Regions 4-5



Black line: GAM fit.
Grey line: timeseries median.

American Lobster Biomass MDMF Fall Survey, Regions 4-5



Dashed lines represent
95% CI on Bootstrapped Mean

Figure 3. Paired figures of stratified mean number per tow with (top) GAM smoothed trend line and (bottom) ± 2 standard errors. 1978 – 2015 Massachusetts DMF Trawl survey.

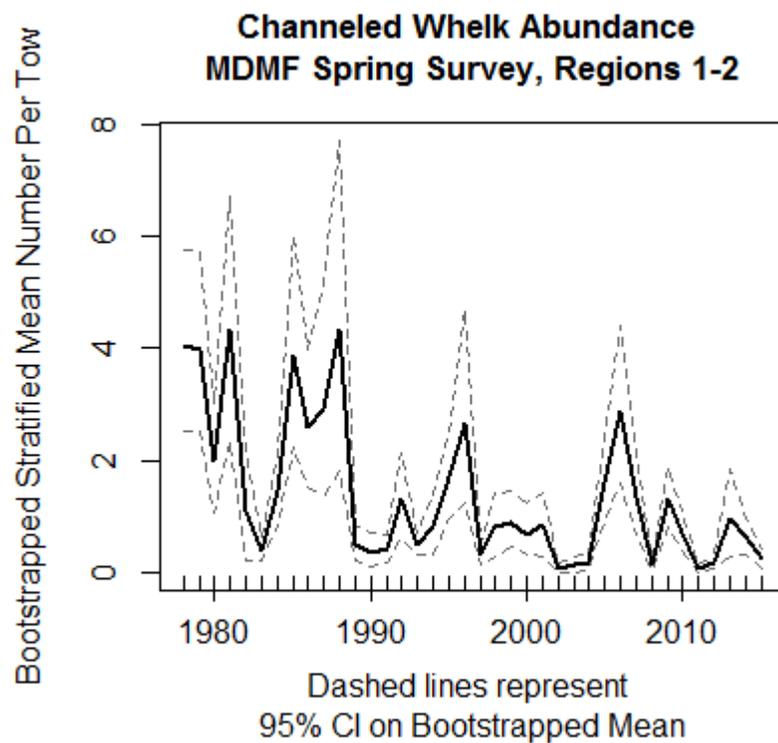
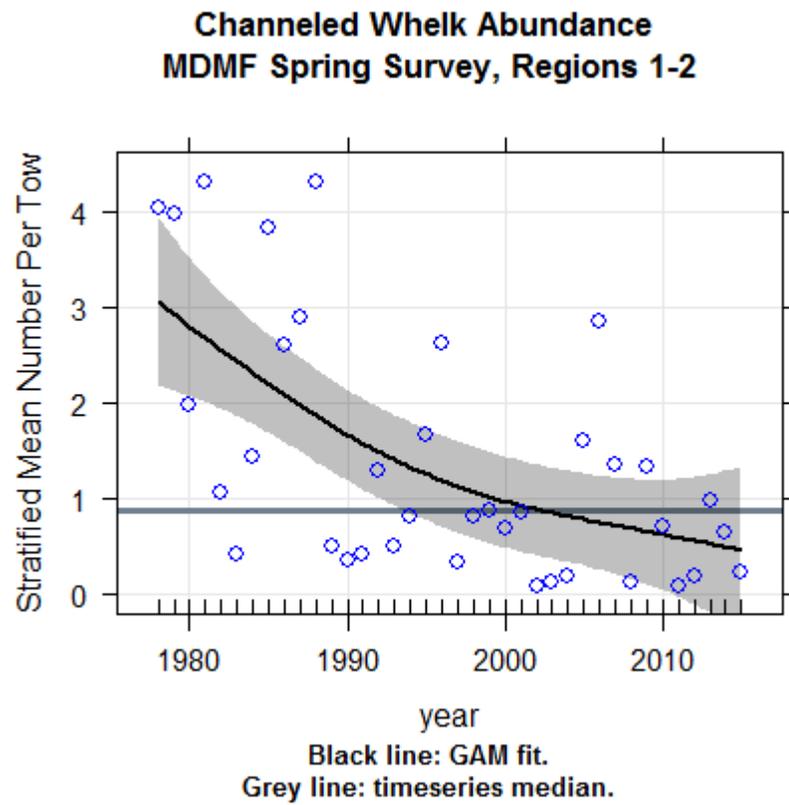
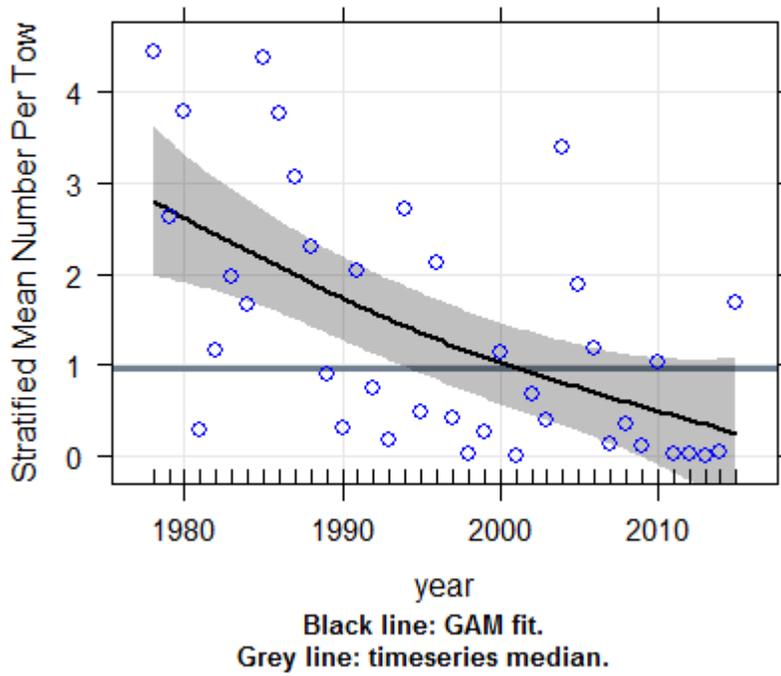


Figure 3 *continued*. Paired figures of stratified mean number per tow with (top) GAM smoothed trend line and (bottom) ± 2 standard errors. 1978 – 2015 Massachusetts DMF Trawl survey.

Channeled Whelk Abundance MDMF Fall Survey, Regions 1-2



Channeled Whelk Abundance MDMF Fall Survey, Regions 1-2

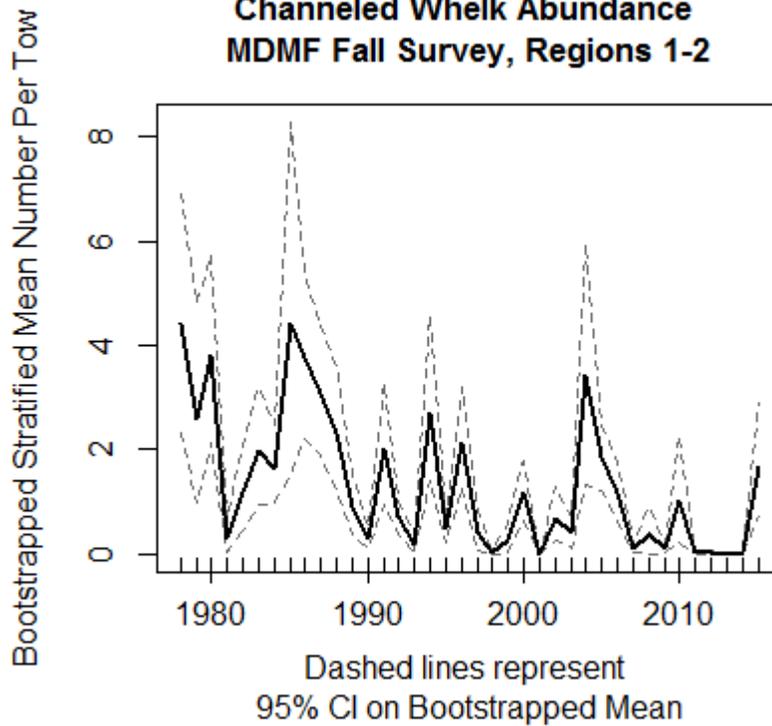


Figure 3 *continued*. Paired figures of stratified mean number per tow with (top) GAM smoothed trend line and (bottom) ± 2 standard errors. 1978 – 2015 Massachusetts DMF Trawl survey.

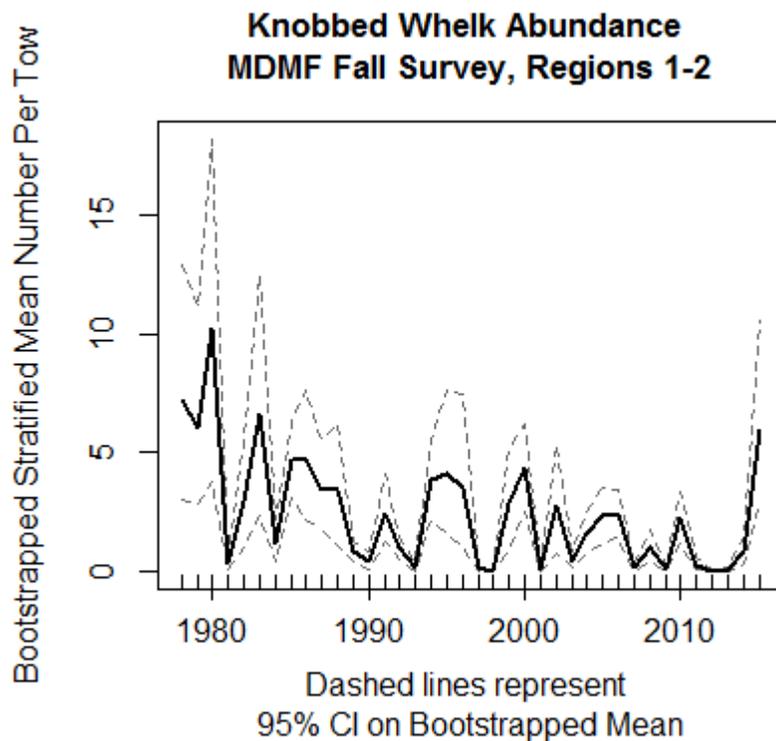
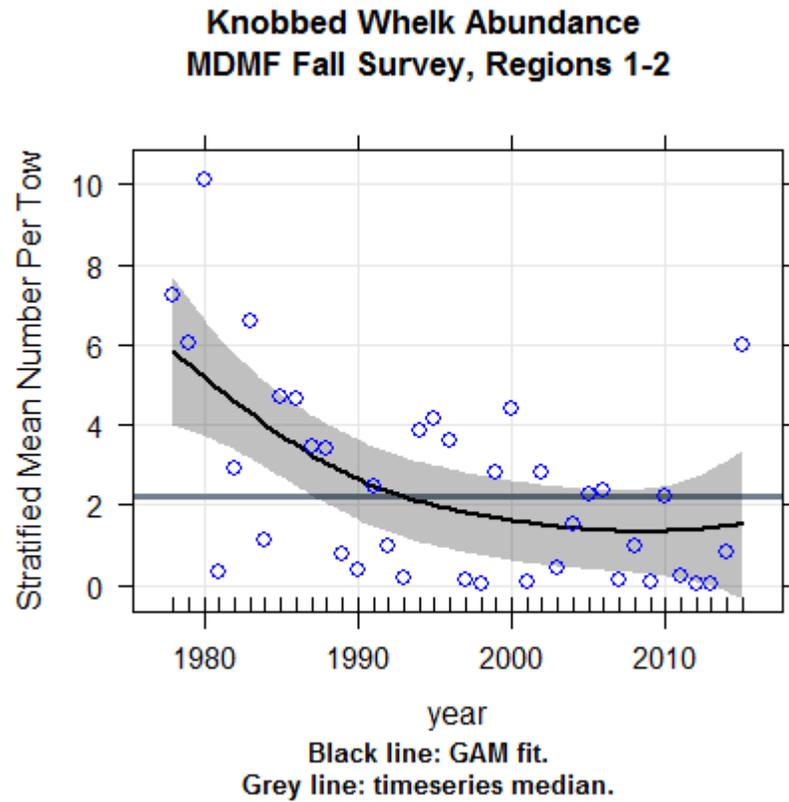
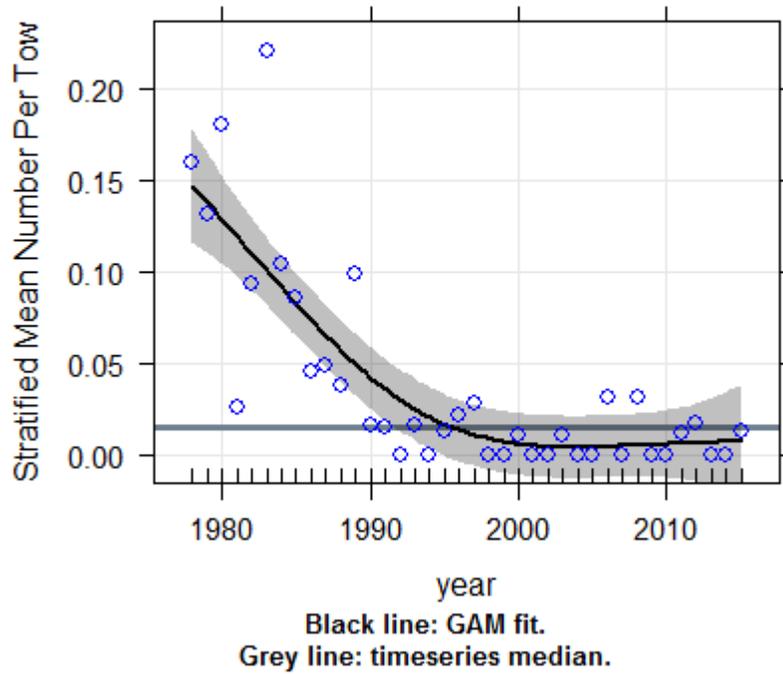


Figure 3 *continued*. Paired figures of stratified mean number per tow with (top) GAM smoothed trend line and (bottom) ± 2 standard errors. 1978 – 2015 Massachusetts DMF Trawl survey.

Atlantic Wolffish Abundance MDMF Spring Survey, Regions 3-5



Atlantic Wolffish Abundance MDMF Spring Survey, Regions 3-5

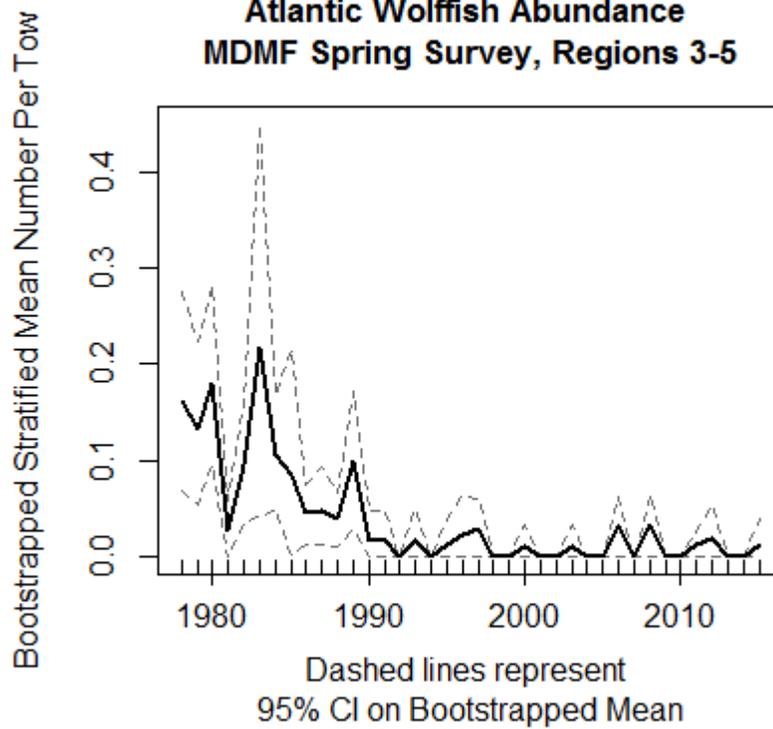


Figure 4. Paired figures of pre-recruit stratified mean number per tow with (top) GAM smoothed trend line and (bottom) 95% confidence interval on bootstrapped mean. 1978 – 2015 Massachusetts DMF Trawl survey.

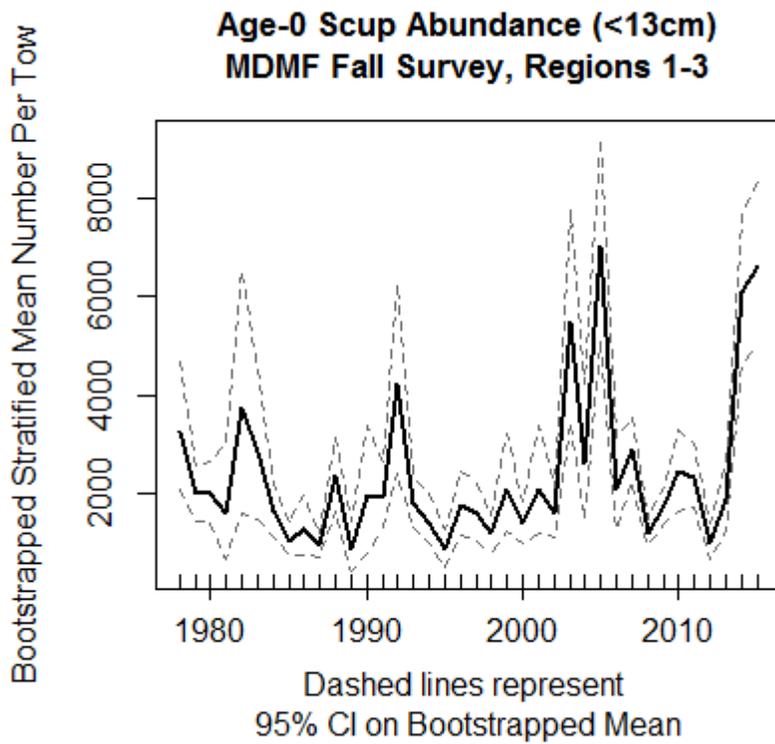
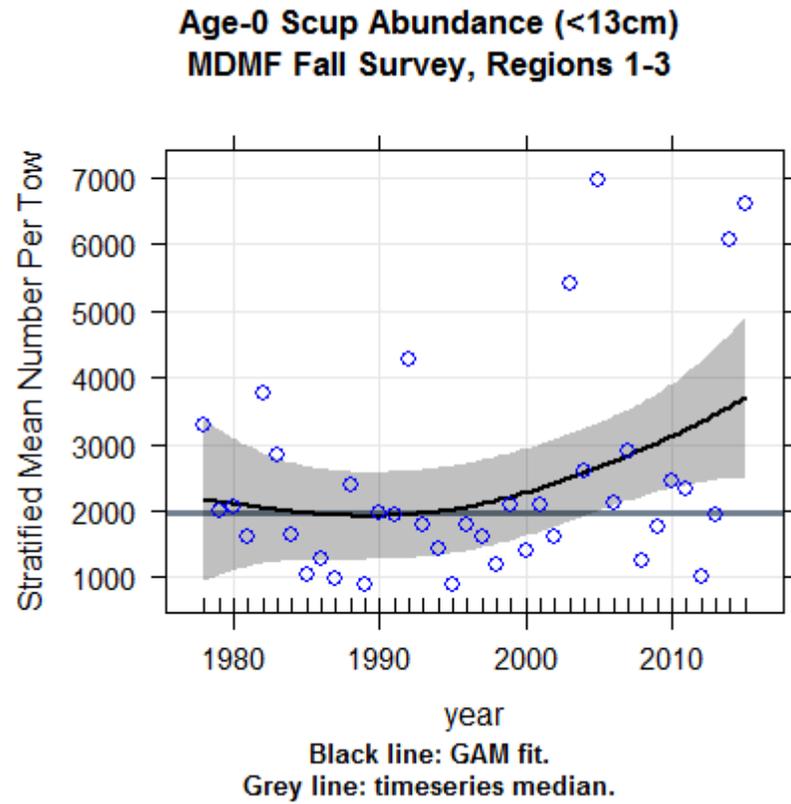
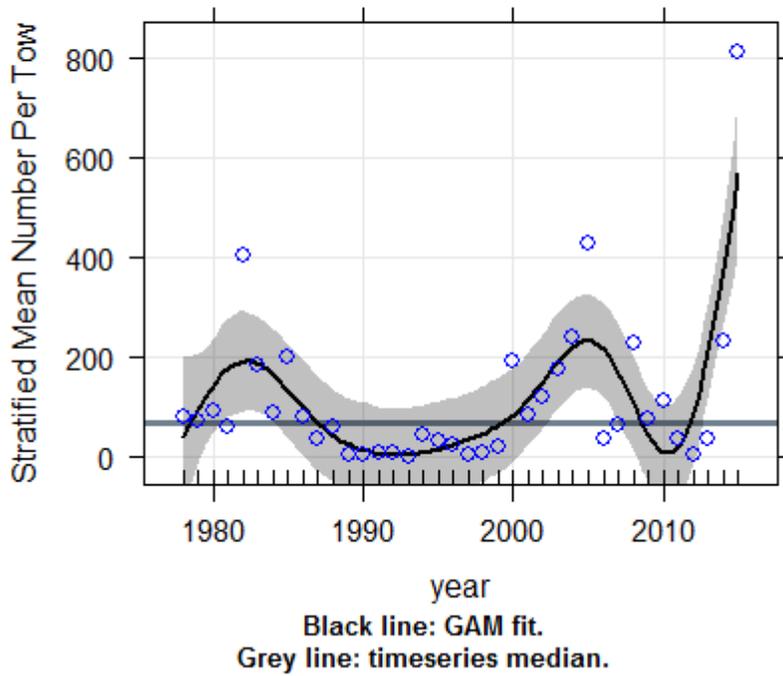


Figure 4 *continued*. Paired figures of pre-recruit stratified mean number per tow with (top) GAM smoothed trend line and (bottom) 95% confidence interval on bootstrapped mean. 1978 – 2015 Massachusetts DMF Trawl survey.

**Age-0 Black Sea Bass Abundance (<12cm)
MDMF Fall Survey, Regions 1-3**



**Age-0 Black Sea Bass Abundance (<12cm)
MDMF Fall Survey, Regions 1-3**

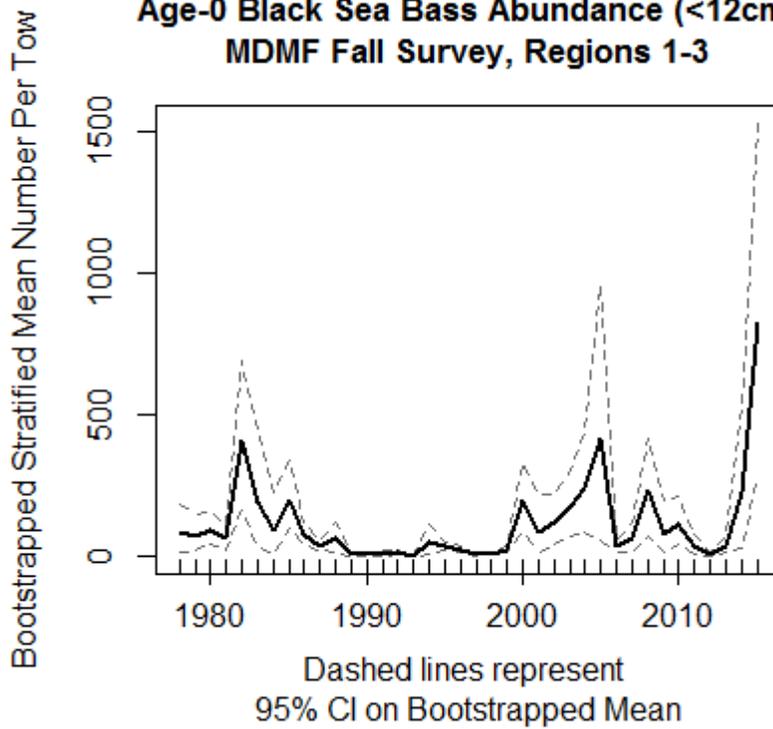


Figure 5. Abundance-at-age. Timeseries range varies dependent on age sample availability. Massachusetts DMF trawl survey.

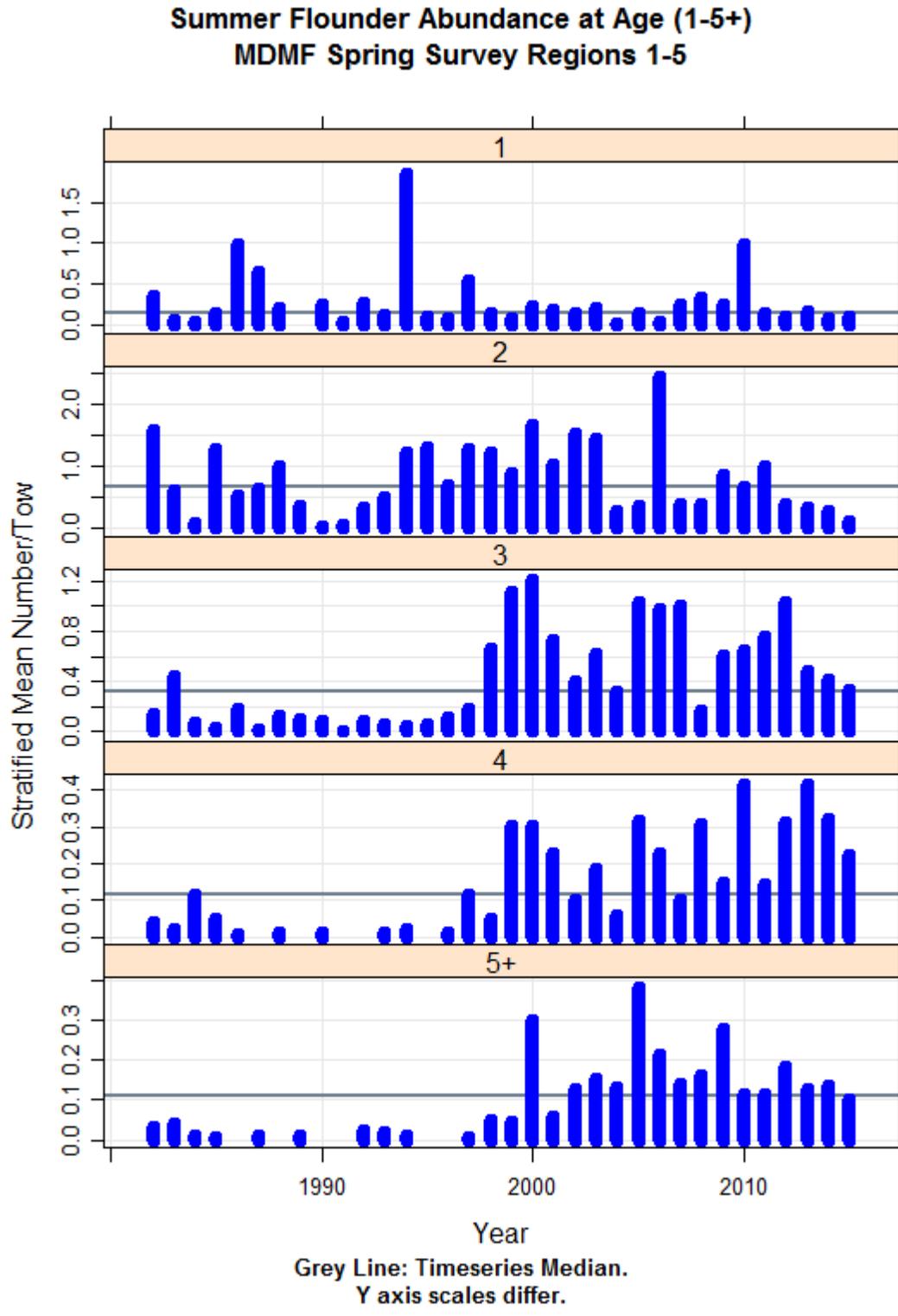
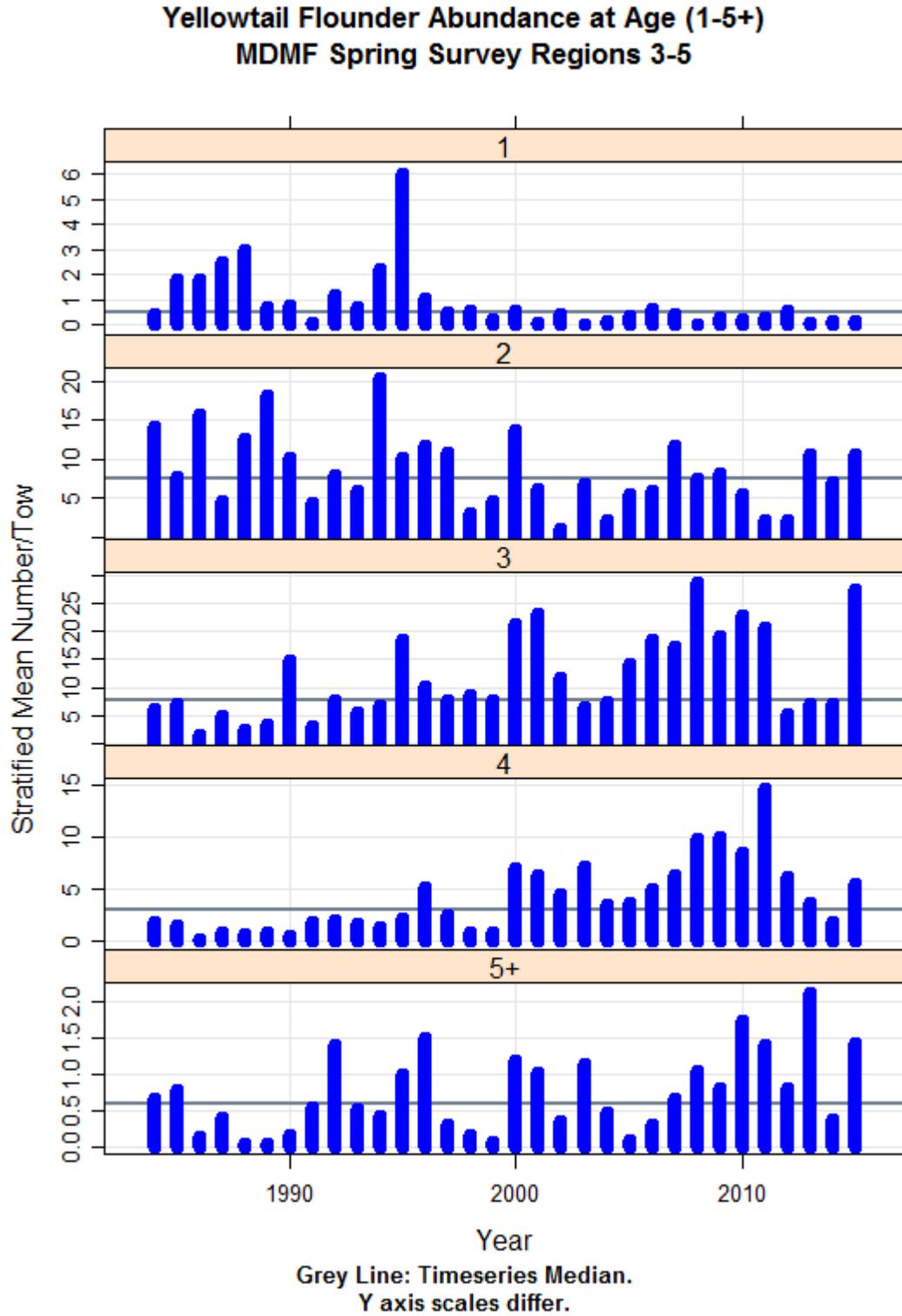


Figure 5 *continued*. Abundance-at-age. Timeseries range varies dependent on age sample availability. Massachusetts DMF trawl survey.



Appendix B.

Trends in Observed Bottom Temperatures Massachusetts Bottom Trawl Survey. 1978 – 2015

A timeseries analysis of bottom temperatures recorded during spring and fall bottom trawl surveys is updated here to include 2015 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 Tidbit™ temperature logger 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 – 2015.

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
Median	12.0	11.4	10.9	9.8	12.2	11.4	9.6	9.4	8.9	6.4	5.5	9.2	8.3	7.1	6.2	5.1	4.7	7.7	7.3	5.7	5.2	4.7	4.3
Mean	12.0	11.4	10.7	9.6	12.1	11.3	9.9	9.5	9.0	6.4	5.6	9.0	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	8.3	11.5	11.6	11.3	10.2	8.1	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 fall survey, 1978 – 2015.

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	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
Median	18.9	18.6	17.5	16.5	19.6	19.4	16.2	16.2	14.6	9.5	8.4	16.2	12.9	10.1	9.2	8.5	7.8	14.0	11.8	10.4	9.4	8.4	7.7
Mean	18.7	18.6	17.5	16.4	19.4	19.3	16.1	15.6	14.7	9.7	8.3	15.7	13.2	10.6	9.5	8.3	7.6	14.1	12.4	10.6	9.2	8.2	7.7
Maximum	21.5	20.7	19.3	18.2	21.2	21.3	18.7	17.3	19.4	14.6	12.6	19.8	19.2	15.5	14.8	11.9	9.9	17.9	17.2	16.2	12.4	11.8	9.8
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	5.5

**Stratum Mean Bottom Water Temperature Observations
MDMF Spring Survey, 1978-2015**

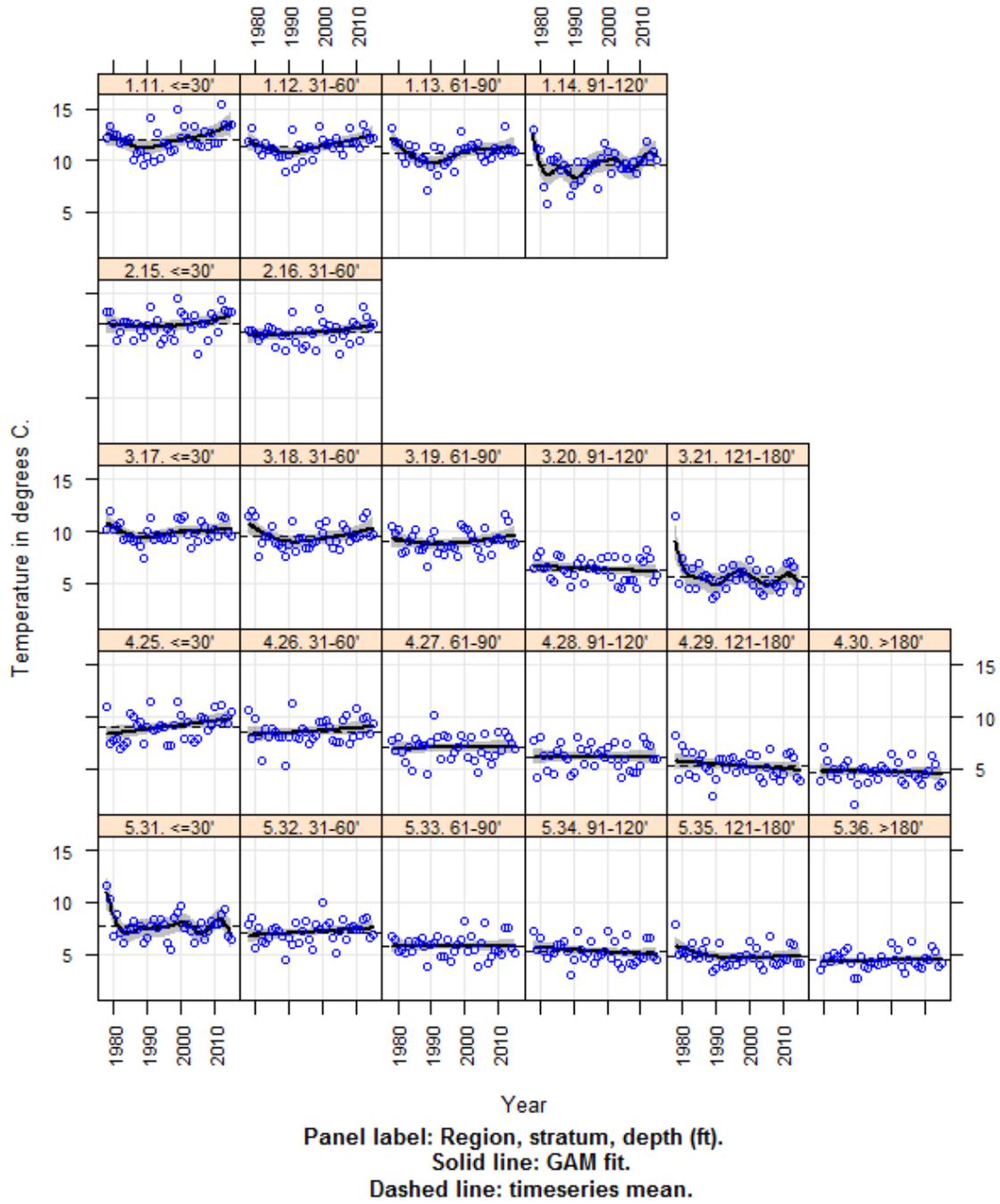


Figure 1.

Stratified Mean Bottom Temperature by Region. MDMF Spring Trawl Survey, 1978 - 2015.

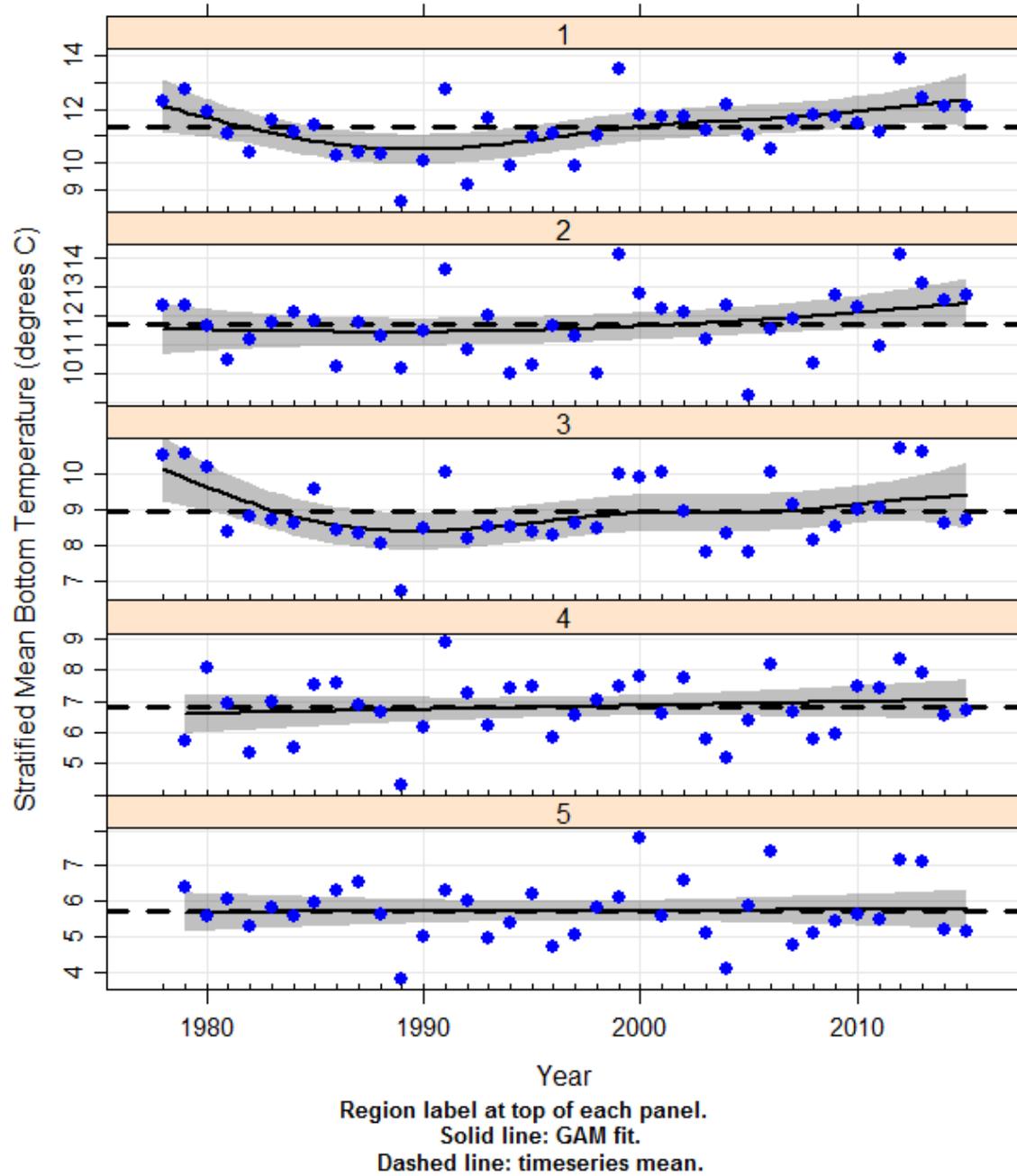


Figure 2.

**Stratum Mean Bottom Water Temperature Observations
MDMF Fall Survey, 1978-2015**

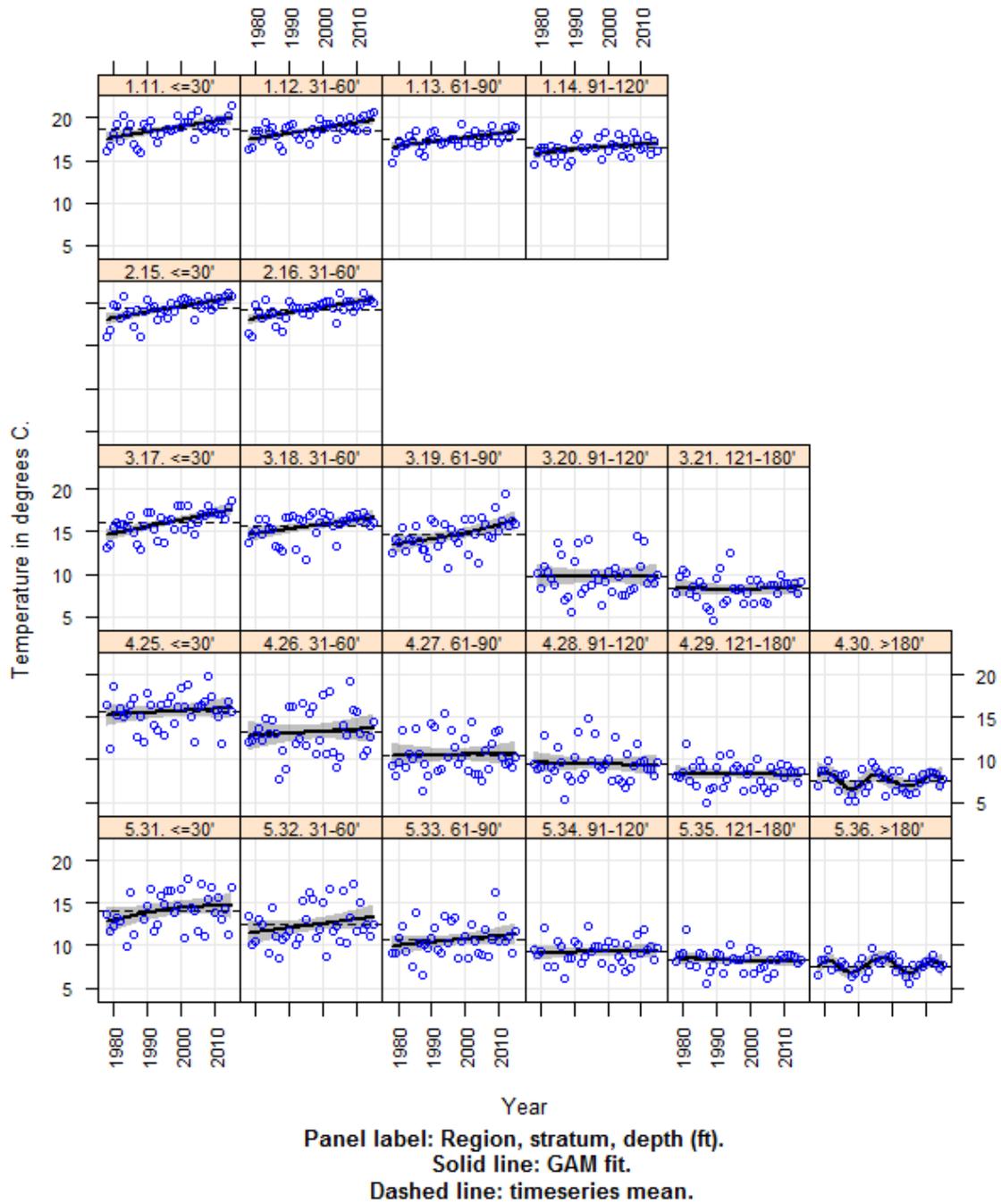


Figure 3.

Stratified Mean Bottom Temperature by Region. MDMF FALL Trawl Survey, 1978 - 2015.

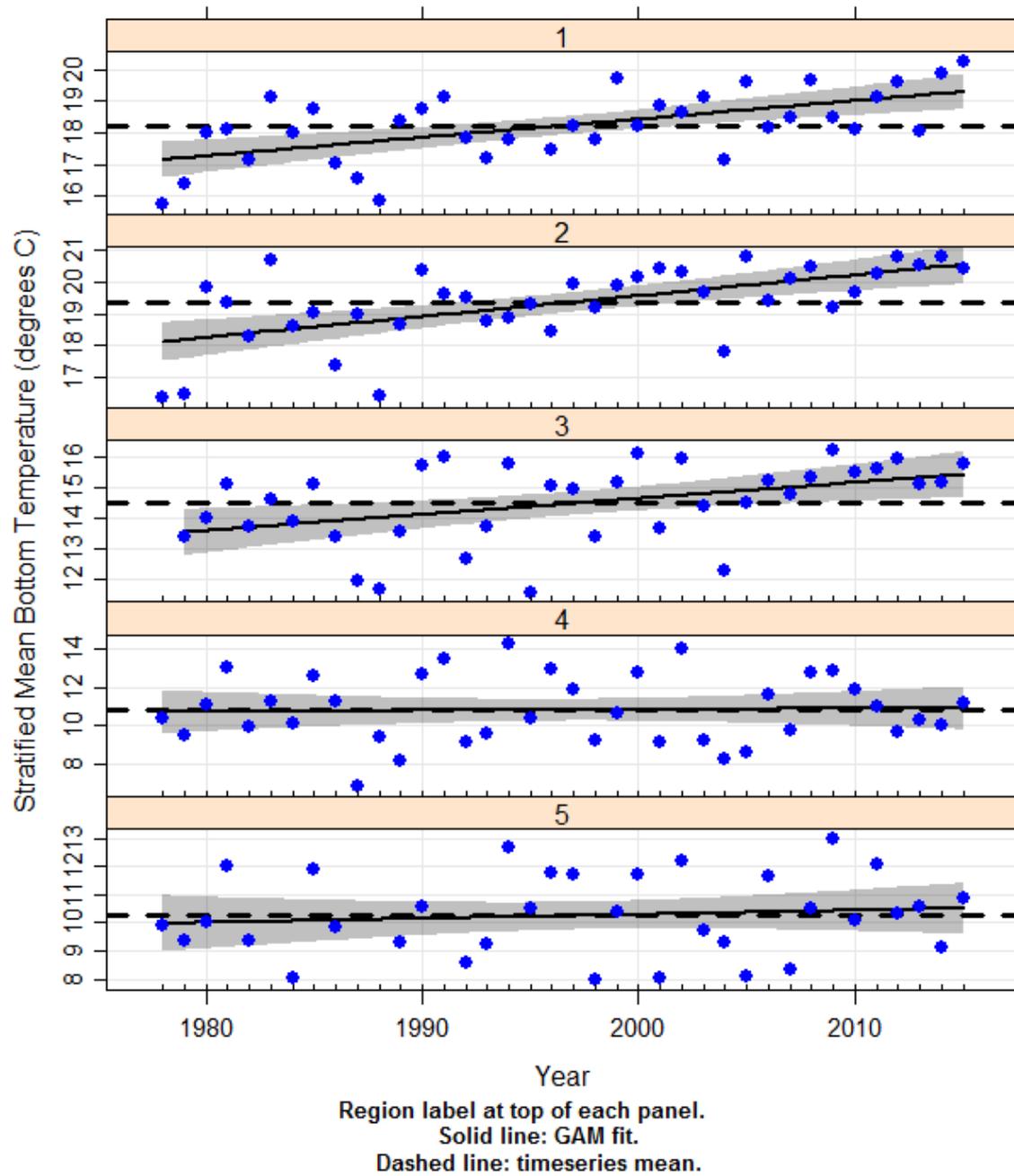


Figure 4.

Appendix C: Corrections to the trawl survey database in 2015.

Fall 2015 corrections – The final check on fall 2015 master data revealed a few introduced errors from the station reload and audit process.

MDMF database corrections on 201592 SVCAT and SVLEN data						
11/17/2015 M.Camisa						
UNION_FSCS_SVCAT						
CRUISE	STATION	SVSPP	expcatchnum reads	expcatchwt reads	expcatchnum should read	expcatchwt should read
201592	11	116	23	0.047	31	0.063
201592	11	180	23	0.047	31	0.063
201592	11	3132	24	0.291	32	0.389
201592	11	503	23	0.771	31	1.03
201592	82	503	31	1.243	34	1.379
201592	83	36	9	0.036	12	0.048
201592	101	116	4	0.03	6	0.042
UNION_FSCS_SVLEN						
CRUISE	STATION	SVSPP	length reads	expnumlen reads	length reads	expnumlen should read
201592	11	116	11	41	11	31
201592	11	180	5	41	5	31
201592	11	3132	4	41	4	31
201592	11	3132	5	1	5	1
201592	11	503	11	41	11	31
201592	82	503	3	13	3	12
201592	82	503	5	7	5	6
201592	82	503	8	7	8	6
201592	82	503	9	2	9	2
201592	82	503	10	2	10	2
201592	82	503	11	1	11	1
201592	82	503	12	1	12	1
201592	82	503	13	2	13	2
201592	82	503	14	2	14	2
201592	83	36	8	11	8	12
201592	101	116	11	4	11	3
201592	101	116	12	4	12	3

Miscellaneous corrections.

Miscellaneous MDMF sta/cat/len Database Corrections						
11/20/2015 M.Camisa						
UNION_FSCS_SVSTA						
CRUISE	STATION	AREA READS	AREA SHOULD READ			
201291	83	537	538			
UNION_FSCS_SVCAT						
CRUISE	STATION	SVSPP	EXPCATCHNUM READS	EXPCATCHNUM SHOULD READ		
201591	42	183	10	4		
UNION_FSCS_SVLEN						
CRUISE	STATION	SVSPP	LENGTH READS	EXPNUMLEN READS	LENGTH SHOULD READ	EXPNUMLEN SHOULD READ
201292	106	132	4	3	4	3
			5	10	5	9
			6	4	6	4
			7	1	7	1